ATMOSPHERIC IMPACT REPORT:

Vanadium Carbonitride (VCN) Furnace, Mpumalanga

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

Project Compiled by:

R von Gruenewaldt

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Report Details

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Client	Environmental Impact Management Services (Pty) Ltd
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Revision Record

Revision Number	**Date**	**Reason for Revision**
Rev 0	January 2026	For internal review
Rev 1	January 2026	For client review
Rev 2	February 2026	Incorporation of clients comments

List of Acronyms and Symbols

ACM	African Carbon Manufacturer
ACU	African Carbon Union
AEL	Atmospheric Emission Licence
AIR	Atmospheric Impact Report
AQA	Air Quality Act
AQMS	Air Quality Monitoring Station
AQO	Air Quality Officer
ATSDR	Agency for Toxic Substances and Disease Registry
°C	Degrees Celsius
CO	Carbon monoxide
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment (previously known as the DEA)
ECA	Electrical Calcined Anthracite
EIA	Environmental Impact Assessment
GVM	Gross Vehicle Mass
HPA	Highveld Priority Area
IRIS	Integrated Risk Information System
kg	Kilogram
m	Metres
m^2	Metres squared
m^3	Metres cubed
mm	Millimetres
m/s	Metres per second
MES	Minimum Emission Standards
MRLs	Minimum risk levels
MW	Megawatt
N_2	Nitrogen
NAAQS	National Ambient Air Quality Standards
NACA	National Association for Clean Air
NDCR	National Dust Control Regulations
NEM:AQA	National Environmental Management: Air Quality Act, 2004
NH_3	Ammonia
NO_x	Oxides of nitrogen
NO_2	Nitrogen dioxide
O_3	Ozone
OEHHA	Office of Environmental Health Hazard Assessment
PAH	Polyaromatic hydrocarbons
Pb	Lead
PM	Particulate matter
PM_{10}	Particulate Matter with an aerodynamic diameter of less than 10 μm
$PM_{2.5}$	Particulate Matter with an aerodynamic diameter of less than 2.5 μm
RAIS	Risk Assessment Information System
RELs	Reference exposure levels
RfCs	Inhalation reference concentrations
SACNASP	South African Council for Natural Scientific Professions
SAWS	South African Weather Service
SO_2	Sulfur dioxide
TCEQ	Texas Commission on Environmental Quality

tpa	Tonnes per annum
TVOC	Total volatile organic compounds
US EPA	United States Environmental Protection Agency
VCN	Vanadium carbonitride
VOCs	Volatile organic compounds
WHO	World Health Organisation
µg	Microgram

Executive Summary

Purpose

Char Technology (Pty) Ltd is proposing the Vanadium Carbonitride (VCN) Project, which entails the installation and operation of a VCN Furnace at the existing Char Technology facility. The proposed VCN furnace will not involve greenfield development or the construction of new permanent structures. Instead, the furnace will be assembled and installed within the existing licensed industrial footprint, utilising current infrastructure and structural platforms. Minor refurbishment and upgrading of existing structures may be required to accommodate the new equipment.

The existing operations at the Char Technology facility include African Carbon Union (ACU), African Carbon Manufacturer (ACM), Paste Plant and the Tar Dehydration Plant (which is situated within the ACU plant footprint).

Airshed Planning Professionals (Pty) Ltd was appointed by Environmental Impact Management Services (Pty) Ltd to compile an Atmospheric Impact Report (AIR) for the proposed VCN Furnace. Typically, an AIR would accompany the application for a variation to the Atmospheric Emissions Licence (AEL).

Air Emission License Requirement

Air emissions from the project must comply with the Minimum Emission Standards (MES) applicable to new plants. The VCN Furnace operations will fall under Subcategory 4.1: Drying and Calcining and Subcategory 4.18: Vanadium Ore Processing, as defined in Section 21 of the National Environmental Management: Air Quality Act, 2004 (NEM:AQA). The facility currently has a valid AEL but plan to amend the licence to include the VCN Furnace operations.

Potential Air Emissions

MES applicable for the type of listed activities for the VCN Furnace (as per Section 21 of the Air Quality Act), in preparation for the variation application for the AEL, was used for the simulations.

Baseline Conditions

Meteorological data from the South African Weather Service's (SAWS) weather station located in eMalahleni, ~3.5 km northeast of the VCN Furnace, was acquired for the period 2022 to 2024. The wind regime for the area largely reflects the synoptic scale circulation with dominant northerly and easterly flow fields.

Baseline air quality in the vicinity of the VCN Furnace was available from the SAWS managed Air Quality Monitoring Station (AQMS) in eMalahleni (as downloaded from the SAAQIS website in January 2026) for the period 2023 and 2024 for sulfur dioxide (SO_2), nitrogen dioxide (NO_2) and particulate matter with an aerodynamic diameter of less than 10 µm (PM_{10}) and less than 2.5 µm ($PM_{2.5}$). The availability of valid data from the AQMS over the 2023 and 2024 period was poor, with less than 73% and less than 12% respectively. Analysis of the available valid ambient measurements indicated compliance of SO_2 and NO_2 concentrations with National Ambient Air Quality (NAAQS). The measured PM_{10} and $PM_{2.5}$ exceeded NAAQS for the period 2023. No ambient data was available for the AQMS for the period 2025.

Simulated Air Quality Impacts

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

The ground level concentrations due to proposed VCN Furnace operations (assuming maximum allowable emissions according to the MES) were well within NAAQS and health effect screening levels at the closest sensitive receptors for all averaging periods.

The significance rating due to VCN Furnace operations was low for construction and low-medium for operation and decommissioning phases.

Conclusions and Recommendations

From an air quality perspective, it is recommended that the proposed VCN Furnace be authorised and that stack emissions be measured once the facility is operational in order to verify pollutants and emission concentrations from the process. The stack emissions must comply with the emission limits stipulated in the MES.

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PREFACE

Background and Context

Char Technology (Pty) Ltd operations are proposing the Vanadium Carbon-Nitride (VCN) Project, which entails the installation and operation of a VCN Furnace at the existing Char Technology facility. The proposed VCN furnace will not involve greenfield development or the construction of new permanent structures. Instead, the furnace will be assembled and installed within the existing licensed industrial footprint, utilising current infrastructure and structural platforms. Minor refurbishment and upgrading of existing structures may be required to accommodate the new equipment.

The existing operations at the Char Technology facility include African Carbon Union (ACU), African Carbon Manufacturer (ACM), Paste Plant and the Tar Dehydration Plant (which is situated within the ACU plant footprint).

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

Specialist Details

Statement of Independence

Airshed is an independent consulting firm with no interest in the project other than to fulfil the contract between the client and the consultant for delivery of specialised services as stipulated in the terms of reference.

Competency Profile: RG von Gruenewaldt (MSc (Meteorology), BSc, Pr. Sci Nat.)

Reneé von Gruenewaldt is a Registered Professional Natural Scientist (Registration Number 400304/07) with the South African Council for Natural Scientific Professions (SACNASP) and a member of the National Association for Clean Air (NACA).

Following the completion of her bachelor's degree in atmospheric sciences in 2000 and honours degree (with distinction) with specialisation in Environmental Analysis and Management in 2001 at the University of Pretoria, her experience in air pollution started when she joined Environmental Management Services (now Airshed) in 2002. Reneé von Gruenewaldt later completed her master's degree (with distinction) in Meteorology at the University of Pretoria in 2009.

Reneé von Gruenewaldt became partner of Airshed in September 2006. Airshed is a technical and scientific consultancy providing scientific, engineering and strategic air pollution impact assessment and management services and policy support to assist clients in addressing a wide variety of air pollution related risks and air quality management challenges.

She has extensive experience on the various components of air quality management including emissions quantification for a range of source types, simulations using a range of dispersion models, impacts assessment and health risk screening assessments. Reneé has been the principal air quality specialist and manager on several Air Quality Impact Assessment projects between 2006 to present and her project experience range over various countries in Africa, providing her with an inclusive knowledge base of international legislation and requirements pertaining to air quality.

A comprehensive curriculum vitae of Reneé von Gruenewaldt is provided in Appendix B. The declaration of independence for Reneé von Gruenewaldt is provided in Annexure B.

Purpose and Scope

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

1. Review of ambient air quality monitoring information.
2. Review of guidelines and standards against which air emissions, ambient air quality and inhalation health impacts are assessed and/or screened.
3. Study of physical environmental parameters that influence the dispersion of pollutants in the atmosphere, including meteorology.
4. Identification of *routine* air quality emissions from the proposed project assuming minimum emission standards (MES).
5. Atmospheric dispersion modelling to determine ground level pollutant concentrations.
6. A health risk and environmental screening study based on modelled ground level pollutant concentrations in comparison with selected air quality criteria, such as National Ambient Air Quality Standards (NAAQS) and international health screening criteria.

Approach and Methodology

The methodology followed in the AIR is discussed below.

Potential Air Emissions from the VCN Furnace

The air pollution associated with the VCN Furnace mainly includes off gases emitted from stack.

Regulatory Requirements and Assessment Criteria

In the evaluation of ambient air quality impacts reference is made to NAAQS. These standards apply only to certain common air pollutants, collectively known as criteria pollutants. Criteria pollutants include sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), inhalable particulate matter (PM) (including thoracic PM with an aerodynamic diameter of equal to or less than 10 µm or PM_{10} and inhalable PM with an aerodynamic diameter equal to or less than 2.5 µm or $PM_{2.5}$), benzene, ozone (O_3) and lead.

SO_2, NO_2, PM and ammonia (NH_3) represent the main pollutants of concern in the assessment of the project. For the current assessment, the impacts were assessed against published NAAQS, internationally recognised health effect screening criteria and National Dust Control Regulations (NDCR).

Description of the Baseline Environment

The baseline study encompassed the analysis of air quality sensitive receptors, atmospheric dispersion potential and ambient air quality within the study area.

Air quality sensitive receptors were identified from available satellite imagery.

The dispersion potential was assessed by means of measured meteorological data from the South African Weather Service (SAWS) station at eMalahleni (for the period 2022 to 2024).

The available ambient air quality data for the study area included SO_2, NO_2, PM_{10} and $PM_{2.5}$ measured at the Air Quality Monitoring Stations (AQMS) within the study area (i.e. eMalahleni AQMS managed by SAWS) for the period 2023 and 2024.

Emissions Inventory

The establishment of a comprehensive emissions inventory formed the basis for the assessment of the air quality impacts from the VCN Furnace. Use was made of MES and United States Environmental Protection Agency (US EPA) emission factors.

Atmospheric Dispersion Modelling

In the simulation of ambient air pollutant concentrations and dustfall rates for the project, use was made of the US EPA AEMOD modelling system.

Management of Uncertainties

The main assumptions, exclusions and limitations are summarised below:

- Meteorological data: Use was made of data from the closest SAWS station for the study area.
- Emissions:
    - The quantification of sources of emission was restricted to the VCN Furnace and current licensed activities at the site. Other background sources were not quantified.
    - Routine emissions from the project were modelled. Atmospheric releases occurring as a result of start-up or accidents were not accounted for.
    - Vehicle exhaust emissions were not quantified as the impacts from these sources are expected to be localized (less than 100 m from road) and will not exceed NAAQS offsite.
    - It was assumed that the VCN Furnace will operate at or below the Subcategory 4.1 and 4.18 MES.
    - All pollutants as specified in the MES were assumed to be emitted from the VCN Furnace.
- Impact assessment:

- The construction and closure phases were assessed qualitatively (Section 5.1.9) due to the temporary nature of these operations, whilst the operational phase was assessed quantitatively.
- As no on-site ambient baseline measurements were available for the assessment; current impacts were assessed assuming the ambient data measured at the closest ambient monitoring station to the site.

1 Enterprise Details

1.1 Enterprise Details

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

Table 1-1: Enterprise details

Enterprise Name	Char Technology (Pty) Ltd
Trading as	Char Technology (Pty) Ltd
Type of Enterprise	Company
Company Registration Number	94/08678/07
Registered Address	50 Van Eck Road, Ferrobank Emalahleni Local Municipality, Mpumalanga, 1035
Telephone Number (General)	+27 (013) 696 8001
Industry Type/Nature of Trade	Manufacture of Char and Electrode Paste, and Dehydration of Tar
Land Use Zoning as per Town Planning Scheme	Industrial
Land Use Rights if Outside Town Planning Scheme	N/A

Table 1-2: Contact details of responsible person

Responsible Person	Siphiwe Gogo
Telephone Number	+27 (013) 696 8005
Cell Number	+27 (0) 71 797 7039
Fax Number	N/A
Email Address	Siphiwe.Gogo@glencore.co.za
After Hours Contact Details	+27 (0) 71 797 7039

1.2 Location and Extent of the Plant

Table 1-3: Location and extent of the plant

Physical Address of the Plant	50 Van Eck Road, Ferrobank Emalahleni Local Municipality, Mpumalanga, 1035
Description of Site (Where no Street Address)	ACU Erf No. 42, 43, 44, 1/44 Ferrobank ACM Erf No. 31 and 32 Ferrobank Paste Plant Erf No. 45 and 95 Ferrobank VCN Furnace Erf No: 43 Ferrobank
Coordinates of Approximate Centre of Operations	Paste Plant Latitude/ Longitude: -25.853803/ 29.162782 ACU Latitude/ Longitude: -25.852102/ 29.164710 Tar Dehydration Plant Latitude/ Longitude: -25.853086/ 29.164815 ACM Latitude/ Longitude: -25.854372/ 29.165958 VCN Furnace Latitude/ Longitude: -25.852475/ 29.164603
Extent	177 600 m²
Elevation Above Sea Level	1 530 m
Province	Mpumalanga
Metropolitan/District Municipality	Nkangala District Municipality
Local Municipality	Emalahleni Local Municipality
Designated Priority Area	Highveld Priority Area

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

Char Technology is situated within the jurisdiction of the Emalahleni Local Municipality, which falls under the administration of the Nkangala District Municipality. Positioned in the Ferrobank industrial area, the site's closest residential area is KwaGuqa. Nearby industrial entities operating within a 5 km radius from the facilities include Samancor, Bushveld Vanchem, Engen garage, Elkem and Afrigrit. Additionally, sites encompassed within the same administrative and environmental licensing framework consist of the Paste Plant, African Carbon Union (ACU) and African Carbon Manufacturers (ACM). The VCN Furnace is located within the ACU boundary on Erf No. 43.

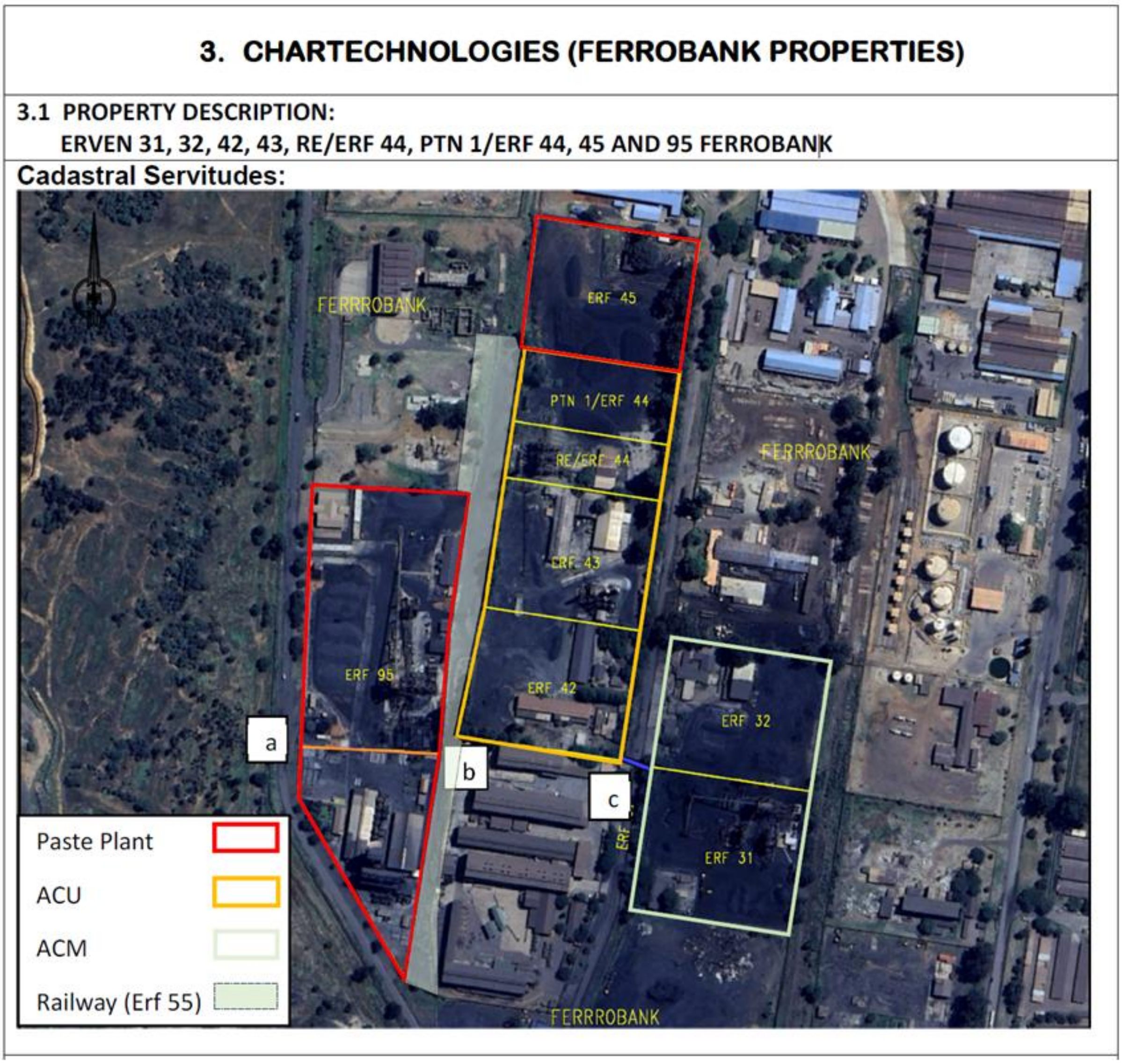


Figure 1-1: Location of the existing Char Technology (Pty) Ltd operations

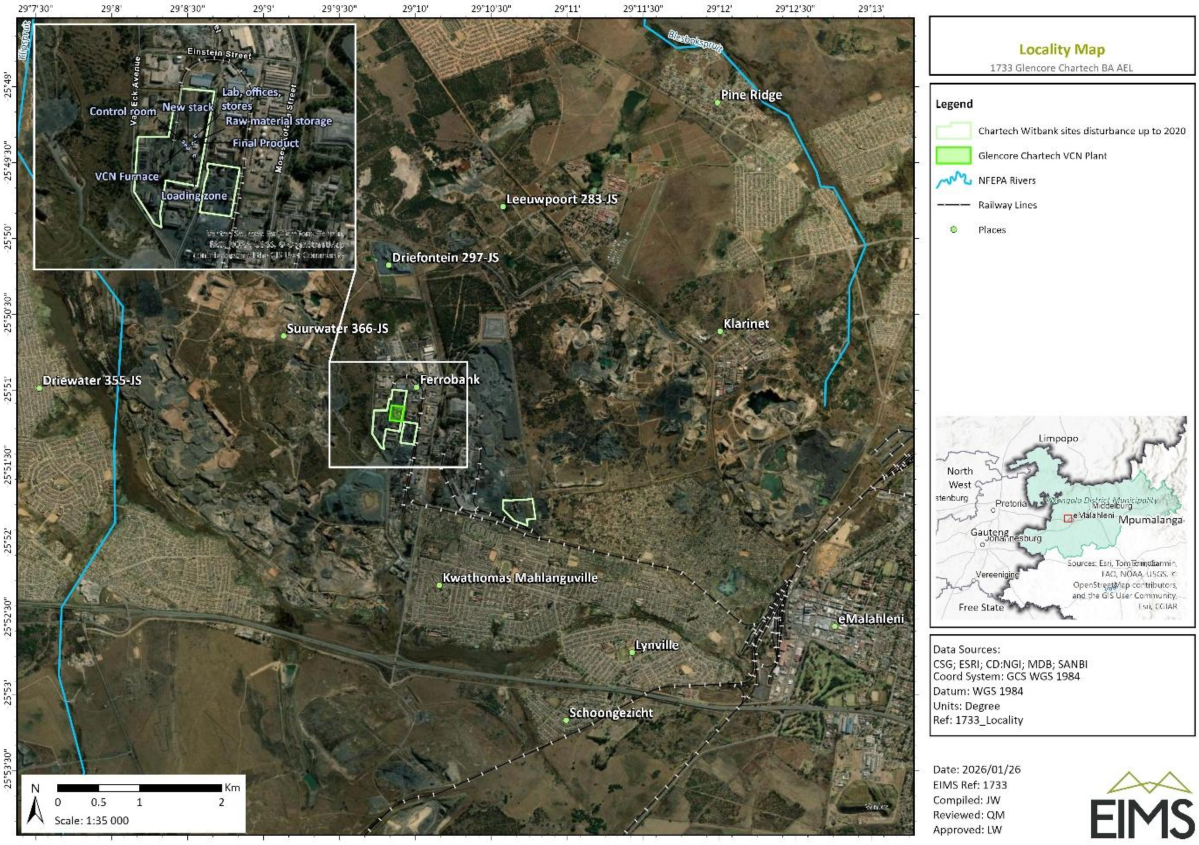


Figure 1-2: Location of proposed VCN Furnace

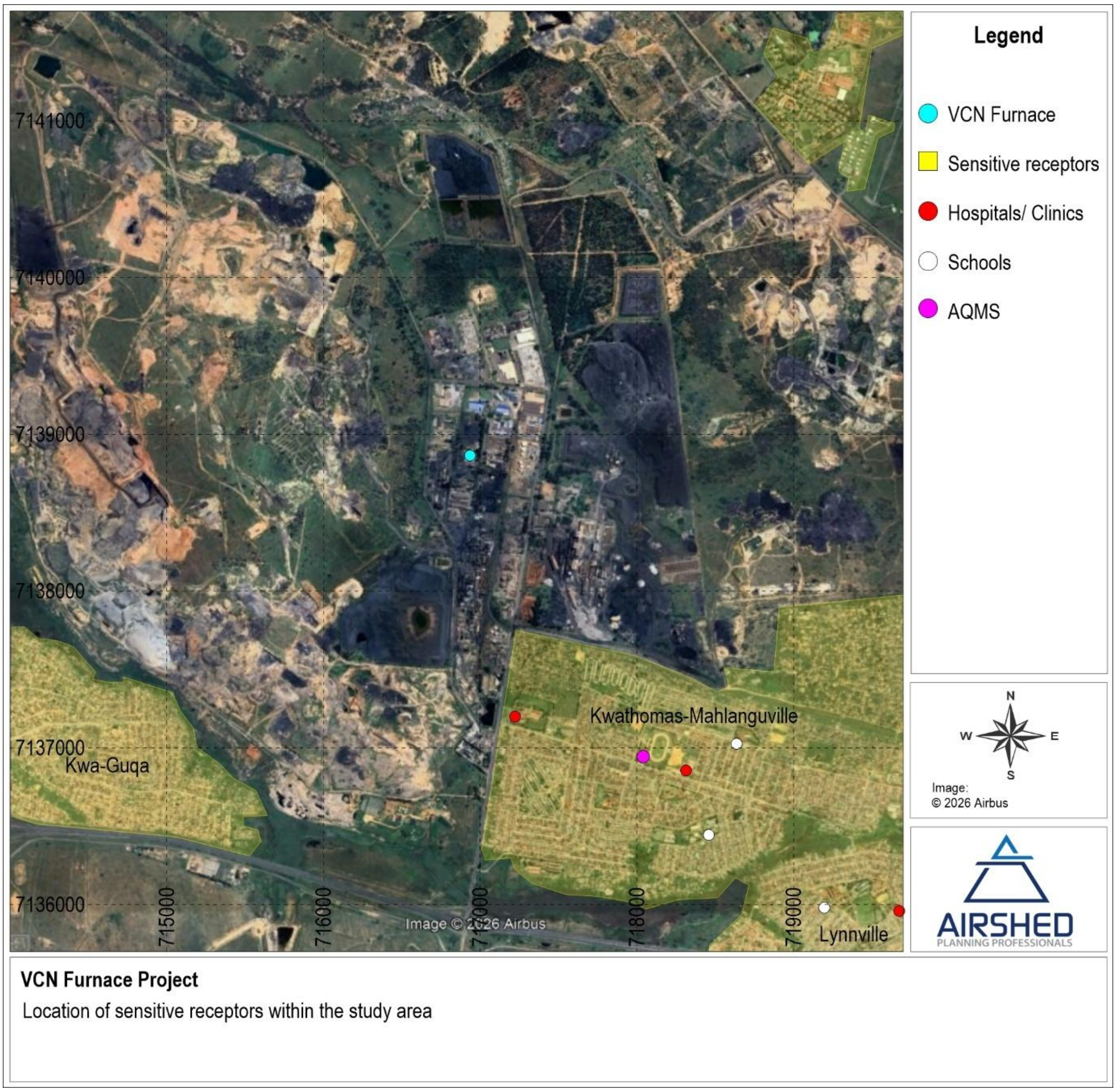


Figure 1-3: Location of proposed VCN Furnace to sensitive receptors

1.4 Atmospheric Emission Licence and other Authorisations

Char Technology (Pty) Ltd has an existing Atmospheric Emissions License (AEL) (NDM/AEL/MP312/13/06). Char Technology (Pty) Ltd is planning to apply for a variation to its current AEL.

2 Nature of the Process

2.1 Process Description for Existing Licensed Operations

At the time of this assessment, the existing licensed operations were under care and maintenance.

2.1.1 African Carbon Union (ACU) and African Carbon Manufacture (ACM)

2.1.1.1 Raw Material Receiving (Coal Supply)

Blended coal is used for the generation of char at the ACU and ACM Plant. A blend of low-grade coal used originates from available domestic and international suppliers. Trucks from the coal mines deliver the coal to site. The coal delivery trucks are weighed at the weigh bridge when entering and leaving site, where the weighbridge Manufacturing Execution System (a computerized logistics software) system automatically measures the Tare and Gross Vehicle Mass (GVM) of the trucks to determine the delivered coal tonnage (net weight). The Manufacturing Execution System information is used in the production process reporting and delivery planning. Manufacturing Execution System tracks the materials being loaded or unloaded, ensuring accurate inventory management.

Stockpiled coal is measured daily to determine production input and output and to ensure optimal coal stockpiling rotation is achieved. Quality assurance of raw material is achieved by scooping a bag of coal from each received stockpile then sent to the laboratory to determine the percentage elemental composition of the coal. A sampling implement of 250mm L x 150mm W x 150mm H is used for sampling coal. On new coal suppliers, samples are collected directly from the mine prior to truck delivery. Raw coal is stockpiled at the stockyard inside the plant area. Coal is blended to specification after which the coal will be put in the bin by a Front-End Loader through the conveyor belt to the retort where it is going to be devolatized and discharged as final product (char). The onsite coal stockyard has a storage capacity of 24 000 tons of coal to meet the consumption of twelve retorts for 16 days.

2.1.1.2 Char and Tar Production

Blended coal is extracted from a loading bin via a vibrating feeder onto a coal conveyor. The coal is screened, where the undersized coal (duff) is extracted. The screened, sized coal is then transported to the top of the retort and stored in a holding bin. The coal duff is extracted from the screen then placed in a (+-3 m high) stockpile, separate from the raw material. It is then sold off to the mining industry.

The raw material (blended coal) in the coal bin is transferred to the coal conveyor 1 via a vibrator feeder, to the screen, where duff is discharged through a coal screen. The product moves then to coal conveyor 2, 3, 4, and this happens simultaneously. The conveyor feeds directly into the retort with coal where it is de-volatized with heated gas that is drawn through the bed of coal. The de-volatized coal (char) is then extracted from the retort with a vibrating feeder and quenched with process water, then transferred onto the product conveyor. During the de-volatizing process, tar is extracted from the off gasses with a set of drop boxes and cyclones. The off gasses also pass through the interceptor where additional abatement takes place. The liquid, crude tar is then stored in holding tanks. The product that is now called char is screened to remove undersized product. The sized product is taken from the product bay with a Front-End Loader and placed in stockpiles in the product stockyard. The undersized, secondary product (char breeze) is also taken with a Front-end loader to a (+-3 m high) stockpile, separate from the final product. The char breeze is then sold off to the smelting industry. The tar that has been extracted in the process is transported to the tar dehydration plant.

2.1.2 Electrode Paste Plant (Soderberg Electrode Paste Production)

2.1.2.1 Raw Material Receiving and Handling (Anthracite and Pitch Supply)

Blended anthracite and pitch are used for the generation of paste at the Paste Plant. A blend of raw anthracite and pitch are sourced from available domestic and international suppliers. Pitch is delivered by tankers and trucks from the mines deliver anthracite. The onsite anthracite and pitch have a storage capacity of 15 000 tons to meet the consumption of five furnaces for 33 days.

Raw, washed anthracite is stockpiled at the stockyard inside the plant area. Anthracite delivery trucks and pitch delivery tankers are weighed at the weigh bridge when entering and leaving site, where the weighbridge Manufacturing Execution System automatically measures the Tare and GVM of the trucks to determine the delivered anthracite or pitch tonnages. The Manufacturing Execution System information is used in the production process reporting and delivery planning. Stockpiled anthracite is measured daily to determine production input and output and to ensure optimal anthracite stockpiling rotation is achieved. Quality assurance of raw material is achieved by scooping a bag of anthracite from each received stockpile then sent to the laboratory to determine the percentage elemental composition of the anthracite.

2.1.2.2 Storage and Process Feed

Raw anthracite is fed into the loading bin by a Front End Loader. The loading bin then transfers the raw anthracite into conveyor 2 which then transfers this raw material to the bucket elevator 1. The bucket elevator 1 transfers the raw material to the screen where fines are discharged; and the screened raw anthracite is transferred to conveyors 3 and 4 which in turn feed the individual Calcining Furnace bins. The screened raw material goes through the calcining process inside the furnace then it is discharged through the turn tables onto conveyor 5 which transfers the Electrical Calcined Anthracite (ECA) into conveyor 6. From Conveyor 6, the ECA is transferred to bucket elevator 2 which will then feed into the screen feed bin. The ECA is then screened on Screens 2.1 and 2.2, where the fines are transported to the ball mill feed bins. The screened ECA is stored in the storage bins where it is then transferred via Conveyor 8 to the scales which then transfers to the anthracite pre-heaters; and eventually transported to the mixer.

2.1.2.3 Calcining

Electrical Calcined Anthracite (ECA) is produced in 5 x 1.5 MVA vertical shaft furnaces. In the calcining furnace, the raw anthracite is subjected to electrical induction heating which drives off the volatiles, resulting in ECA. At each furnace, the ECA is discharged through the turn tables to a conveyor. The off gas from the calcining process passes through dampers then onto the chimney stacks. The ECA is crushed and filtered, before it is fed into the fractioning plant. The dust extraction plant is fitted at the calciner furnace discharge point to remove all ambient dust from the plant process.

2.1.2.4 Mixing and Moulding

Pitch comes in from the storage tanks to pitch pre-heaters to the pitch scale to the mixer. Heat treated pitch with a softening point of 55-59°C or 68-73°C is used as binder. The ECA is screened into various fractions where after it is processed in the blending and the mixing. The pre-heated ECA is processed in the blending and mixing section by using high intensity mixers, simultaneously with the pitch. The processed pitch and ECA are then discharged through the paste hopper where moulding takes place. At the moulding area, the 600 mm and 500 mm paste cylinders and paste briquettes (80 x 80 x 80 mm cubes) are moulded into the final products. Cooling of the paste cylinder is achieved through air-cooling inside the paste building and that of the briquettes through water cooling also inside the paste building.

2.1.2.5 Packaging and Dispatch

Paste cylinders are transferred to the product yard then packaged for loading. The paste briquettes are transferred to the product bunker, where they are finally loaded for dispatch. Cylinders are shrink-wrapped and strapped onto pallets whereas briquettes are supplied in bulk bags.

The Paste Plant has an installed capacity of +- 32 000 tpa. Soderberg Electrode Paste is specially formulated to minimize thermal shock and to reduce overall consumption rate. Success achieved is evident locally and abroad in the ferrochromium, silicon metal, ferrosilicon, iron, ferro/silicon manganese, nickel and copper industries.

2.1.3 Tar Dehydration Plant

Crude tar from various char plants is received then pumped into the crude tar storage tanks. Crude tar is then pumped from these various storage tanks through the forced-feed evaporator where solids and water are separated. The forced-feed evaporator receives heat from the 4tph (2.85 MW) package boiler, which is fuelled by coal (peas). Separated water is then stored in recovered water tanks, then later transported back to the char plants for reuse in the process (as process water). Dry tar is stored in final product tanks where it is then collected for dispatch to the customers.

2.2 Process Description for the Proposed Vanadium Carbonitride (VCN) Furnace (Proposed Project)

The VCN furnace will process briquetted furnace feed supplied to Char Technology from a licensed facility. These briquettes are produced using a mixture of milled vanadium pentoxide (V_2O_5) flakes, vanadium trioxide (V_2O_3), carbon powder, and iron powder, which are pressed into a solid feedstock prior to delivery to the site.

2.2.1 Facility and Project Overview

The project entails installing and operating a new, enclosed continuous pusher (graphite-crucible) furnace to produce VCN at an existing metallurgical site. Briquetted feed materials (vanadium oxides with carbon and a trace of iron) are processed under high-purity nitrogen to form VCN.

The installation comprises a subsidiary (pre-heat) furnace, a primary high-temperature furnace, off-gas handling with CO flaring and fabric filtration (baghouse), recirculating product cooling, and on-site nitrogen generation and purification.

2.2.2 Normal Process Flow (Unit Operations)

This subsection summarises the sequence of unit operations from charging through thermal processing, cooling and packing, including the 24/7 operating regime.

2.2.2.1 Feed Preparation and Charging

This step covers receipt, internal handling and sealed charging of briquettes to minimise dust and ensure process integrity. **Briquettes are produced off-site from a blend of milled V_2O_5 flakes, V_2O_3, carbon powder and iron powder, pressed to ~45 mm.** At the VCN plant, sealed bags are received, stored indoors on concrete, and loaded into graphite crucibles. No raw material handling conveyors or stockpiles are used; movements are by forklift on paved/concrete surfaces.

2.2.2.2 Pre-Heating (Subsidiary Furnace) – Electric Furnace

This step removes residual moisture to stabilise downstream high-temperature reactions. Crucibles enter a pre-heat / drying zone at approximately 300°C to remove residual moisture.

2.2.2.3 Reduction, Carburisation and Nitridation (Primary Furnace) – Electric Furnace

This step effects carbothermal reduction of vanadium oxides and simultaneous carburisation/nitridation in nitrogen to form VCN.

Crucibles are advanced by hydraulic pushers through a zoned, continuous furnace with a controlled temperature profile (~600 to 1 500°C) and excess N_2 to prevent oxidation. The dominant reaction pathway is carbothermal reduction of vanadium oxides with simultaneous nitridation in N_2, e.g.: $V_2O_3(s) + 3\ C(s) + N_2(g) \rightarrow 2\ V(C,N)(s) + 3\ CO/CO_2(g)$.

2.2.2.4 Controlled Cooling and Discharge

This step safely cools product to handling temperature and discharges it with minimal drop height and fugitive dust.

Product passes through natural cooling followed by rapid water-assisted cooling to <= 80°C before discharge. A sealed, automated rotator empties the crucible into a skip directly below the discharge (< 0.5 m drop) to minimise dusting; a double seal is fitted between the water cooling section and the auto rotator.

2.2.2.5 Packing and Dispatch

This step packages cooled product into sealed bags for transport, with all vehicle movements confined to paved areas.

Cooled VCN is packed in sealed bags (< 20 kg) and palletised in bulk bags for shipment by truck (~30 t per truck; ~2 trucks/week). Internal transfers occur on concrete paved surfaces.

2.2.2.6 Process Timing and Regime

Push cycle ~15–20 minutes (crucibles move at ~1.6 m/h). Operation is continuous, 24 h/day, ~348 days/year (allowance for planned maintenance).

2.3 Listed Activities

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

Table 2-1: Current facility wide listed activities

Section 21 Subcategory	Name of the Listed Activity	Description of the Listed Activity
3.3	Tar processing	Processes in which tar, creosote or any other product of distillation of tar is distilled or is heated in any manufacturing process.
3.4	Char, charcoal and carbon black production	Production of char, charcoal and the production and use of carbon black.
3.5	Electrode paste production	Production of electrode paste.
5.1	Storage and handling of ore and coal	Storage and handling of ore and coal not situated in the premises of a mine or works as defined in the Mines Health and Safety Act 29 of 1996.

Table 2-2: Listed activities for the proposed VCN Furnace

Section 21 Subcategory	Name of the Listed Activity	Description of the Listed Activity
4.1	Drying and calcining	Drying and calcining of mineral solids including ore.
4.18	Vanadium ore processing	The processing of vanadium-bearing ore or slag for the production of vanadium oxides or vanadium carbide by the

		application of heat.

2.4 Unit Processes

The unit processes associated with the listed activities (as per Section 21 of NEM:AQA) for the currently licensed activities and proposed for the VCN Furnace are listed in Table 2-3.

Table 2-3: The unit processes for the currently listed activities and proposed VCN Furnace

Unit Process	Function of Unit Process	Batch or Continuous Process
ACU and ACM (Char and Tar Production)		
Raw material handling (coal stockpiles)	Receiving and storage of coal.	Batch
Coal bunkers (Char Plant)	Storage of coal.	Batch
Laboratory	Analysis of coal received and char produced to ensure that it is within the required specification.	Batch
Coal blending	Aggregating coal from different stockpiles into the raw material feed.	Batch
Raw material feeding	Feeding coal.	Continuous
Coal screening	Separating correct size coal from undersized coal (fines).	Continuous
Coal fines stockpiling and handling	Temporary storage prior to dispatch.	Batch
Coal conveyance	Raw material feed into the process equipment (retorts)	Continuous
Coal hoppers	Ensuring sufficient process reserves of raw material and directs the transfer of material into the process equipment.	Continuous
Combustion	Char generation by retorts.	Continuous
Coal fines stockpiling and handling	Receiving and storage of coal fines.	Batch
Process water dams	Ensuring sufficient process reserves of product quenching water required by the process.	Continuous
SWD – Storm water dams	Capture storm water runoff from the plants.	Continuous
Discharge vibrators	Screens for product sizing separators	Continuous
Fans – exhaust, interceptor and stack	The fan maintains draught balance in the system by regulating the velocity of the process off gas.	Continuous
Char conveyors	Product transfer from process equipment to screening.	Continuous
By-pass conveyor	Redundant conveyor used in cases of emergencies as well as during planned maintenance that affects the primary conveyor.	Continuous
Char screening	Separating correct size Char from undersized Char (breeze).	Continuous

Unit Process	Function of Unit Process	Batch or Continuous Process
Char fines stockpiling and handing	Receiving and storage of Char fines.	Continuous
Tar generation (discharge from dropbox and cyclones)	Heavy residue from the process off gas scrubbing equipment.	Continuous
Tar storage and handling	Receiving and storage of Crude Tar.	Continuous
Product (char) handling and stockpiling	Receiving and storage of Char.	Batch
Cyclones	Cyclones to clean process off-gas, secondary abatement equipment which separates high-momentum particles (tar) from the process off-gas. A cyclone is a device used for separating particles from an air, gas, or liquid stream. It works based on the principle of centrifugal force to remove particulates from a flow without the use of filters. The contaminated air or fluid enters the cyclone tangentially, creating a spiral or vortex motion inside the chamber. As the flow spins rapidly, centrifugal force pushes heavier particles outward toward the walls of the cyclone.	Continuous
Interceptor	Final process off-gas additional abatement equipment to further increase the efficiency of the cyclones.	Continuous
Dropbox	Initial process off-gas abatement equipment to capture maximum high-momentum particles (tar).	Continuous
Paste Plant (Electrode Paste Production)		
Raw material handling (anthracite stockpiles)	Receiving, handling and storage (stockpiling) of washed anthracite.	Batch
Semi-Closed Storage Area for Anthracite Stockpiles	Storage of washed anthracite prior being transferred to the bucket elevator.	Continuous
Pitch Storage Tanks	Receiving, handling and storage of pitch.	Continuous
Pitch Pre-Heaters	Pre-heating of pitch prior mixing with calcine anthracite.	Continuous
Conveyance	Transfer points for anthracite.	Continuous
Bucket Elevators	Transfer points for anthracite.	Continuous
Screen Feed Bin	Storage of anthracite	Continuous
Furnaces	Calcining of washed anthracite to produce calcine anthracite.	Continuous
Dust extraction system	Dust laden air, from the process operation, passes into the dust hopper situated at the base of the filter unit. At this point a degree of pre-separation takes place, whereby the heavier dust settles downwards into the hopper, and the lighter dust is carried upwards onto the filter bags. This dust is trapped on the outer surface of the bags and clean air exits through the fabric into the duct and fan system which discharges the clean air into the atmosphere.	Continuous

Unit Process	Function of Unit Process	Batch or Continuous Process
	Cleaning accumulated dust from the filter bags is achieved by automatically controlling and directing a pulse of pneumatic air into the interior of each filter tube via actuation from a computerised pulsating unit. The cleaning process is continuous, and it is not necessary to shut the fan unit down to clean filter bags.	
Screens	Screening of calcined anthracite.	Continuous
Storage Bin	Storage of calcined anthracite.	Continuous
Ball Mill	Crushing of calcined anthracite to fine dust.	Continuous
Anthracite Pre-Heaters	Heating of calcined anthracite.	Continuous
Mixer	Mixing of heated calcine anthracite with heated pitch to form Soderberg Electrode Paste.	Continuous
Moulding and Cooling	Tapping of hot paste from mixer into moulds, then cooling it down before pulling paste cylinders from moulds. When making briquettes the paste is tapped from the hopper into the briquette mould where it is levelled, the briquettes are then cooled down before tipping them outside in the designated areas.	Batch
Storage, Packaging and Dispatch of Product Area	Storage, packaging and dispatch of Soderberg Electrode Paste to clients.	Continuous
Production of Briquette Fines		
Mixing of Fines	Fines are collected from the milling and screening of calcine anthracite and mixed with tar slurry and quenching fines to produce briquetting fines.	Batch
Storage and Dispatch Area	Storage and dispatch of briquetting fines to clients.	Batch
Production of Skimmer Block		
Baking	Baking of skimmer paste to produce skimmer block.	Batch
Storage, Packaging and Dispatch Area	Storage, packaging and dispatch of skimmer block to clients.	Batch
Tar Dehydration Plant		
Raw Material Handling (Coal Peas Stockpiles)	Handling and storage of coal peas (boiler peas).	Batch
Loading Bin	Feeding in coal peas to be used as energy source for the boiler.	Batch
Crude Tar Storage Tanks	Storage of crude tar which is offloaded by bulk tankers.	Batch
Forced-Feed Evaporator	Separates solids and water from the crude tar.	Continuous
Boiler	Emission unit used to boil water out of the crude tar.	Continuous

Unit Process	Function of Unit Process	Batch or Continuous Process
Integral fly-ash venturi	The venturi scrubber uses the differential between high velocity gases and free-flowing water in the off-gas to create droplets which entrap contaminants, hold them in suspension and deliver them as a highly concentrated slurry. This slurry then drops down back onto the furnace bed where it is discharged with the bottom ash.	Continuous
Condensate/Water Tanks	Storage of separated water which is then later transported back to the char plants for reuse in the process (as process water).	Continuous
Product (Tar) Storage Tanks	Storage of dry tar prior dispatch to clients.	Continuous
VCN Furnace		
Feed preparation and charging	Briquettes are fed into the furnace at the feed station for pre-heating.	Batch
Pre-heating (Subsidiary Furnace) – electric furnace.	This removes residual moisture to stabilise downstream high-temperature reactions. Crucibles enter a pre-heat / drying zone at approximately 300°C to remove residual moisture.	Batch
Reduction, carburisation and nitridation (Primary Furnace) – electric furnace	Crucibles are advanced by hydraulic pushers through a zoned, continuous furnace with a controlled temperature profile (~600 to 1 500°C) and excess N_2 to prevent oxidation.	Batch
Controlled cooling and discharge	Product passes through natural cooling followed by rapid water-assisted cooling to <= 80°C before discharge. A sealed, automated rotator empties the crucible into a skip directly below the discharge (< 0.5 m drop) to minimise dusting; a double seal is fitted between the water cooling and auto rotator.	Batch
Packing and dispatch	Cooled VCN is packed in sealed bags (< 20 kg) and palletised in bulk bags for shipment by truck (~30 t per truck; ~2 trucks/week). Internal transfers occur on concrete paved surfaces.	Batch

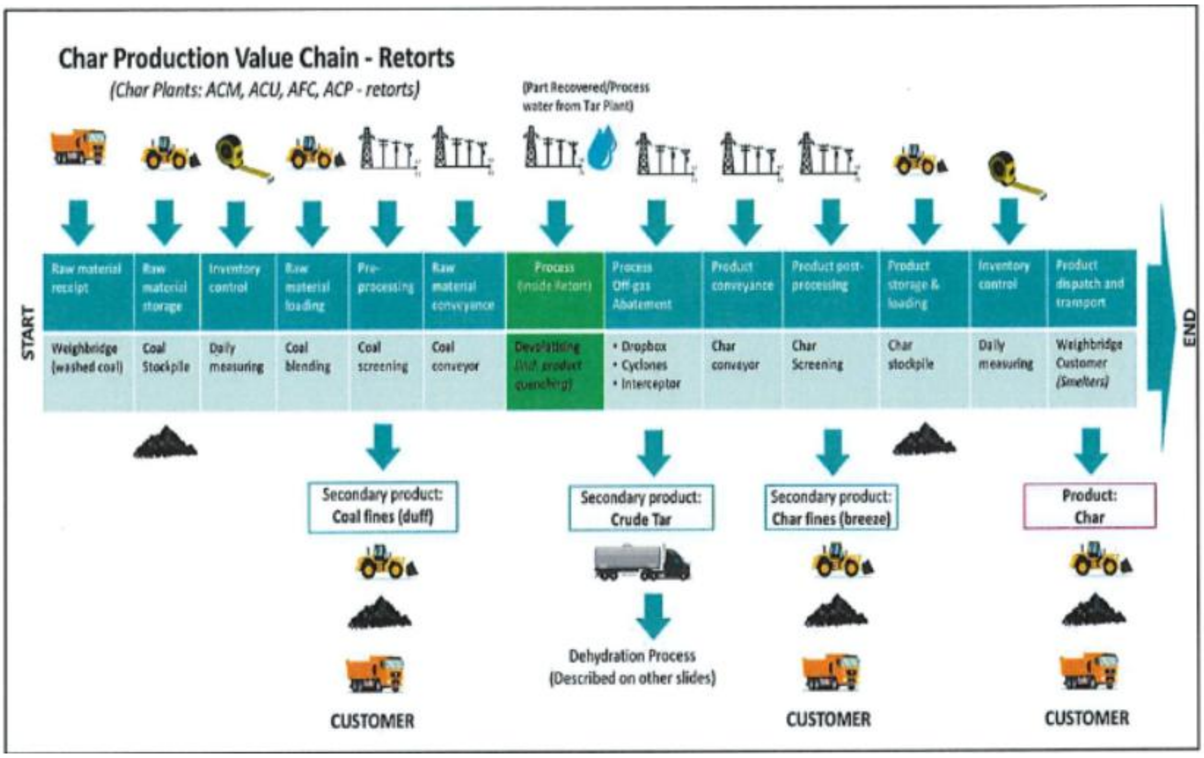


Figure 2-1: Char Technology (Pty) Ltd process flow: Char production value chain - retorts

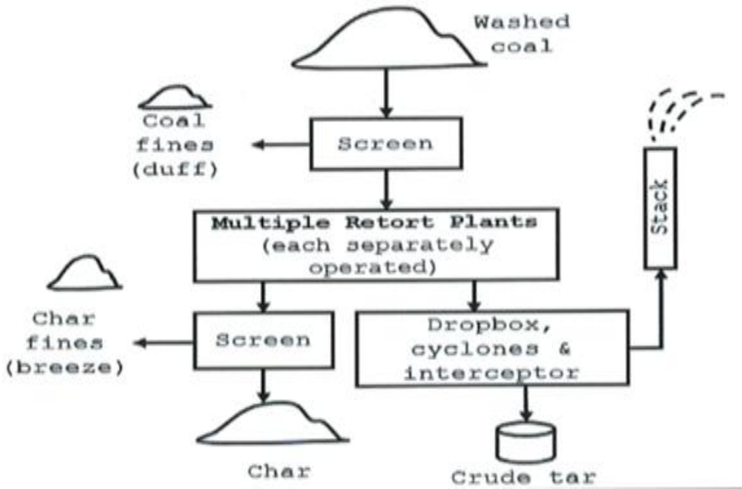


Figure 2-2: Process flow diagram for Char and Tar production

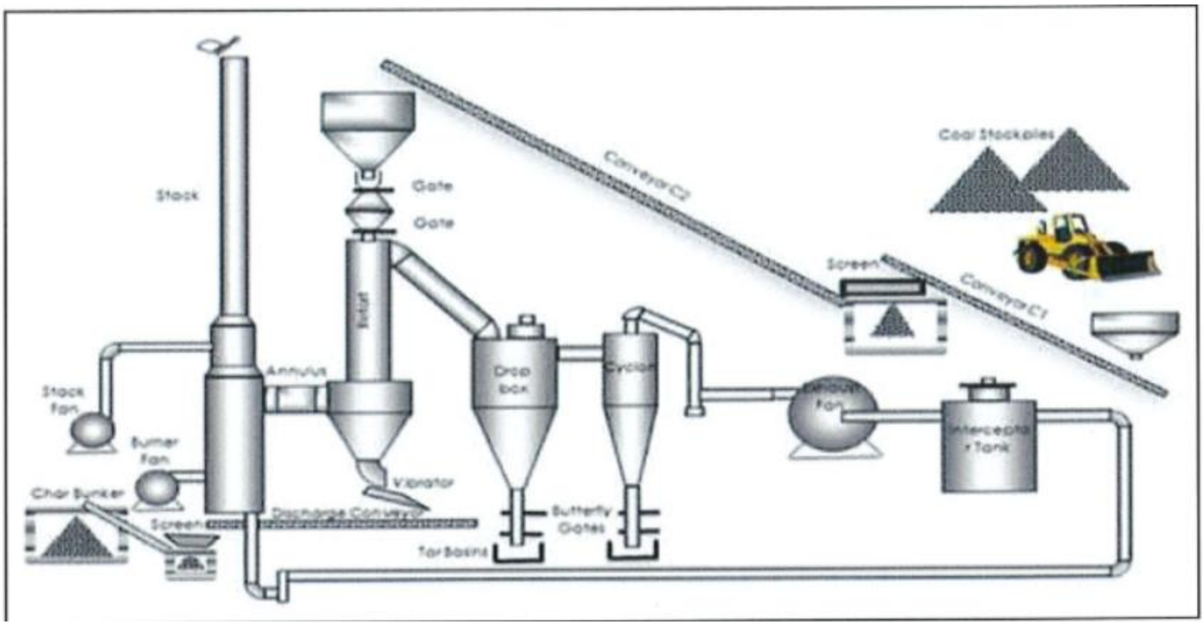


Figure 2-3: Char Technology (Pty) Ltd (AFC) process flow: retorts

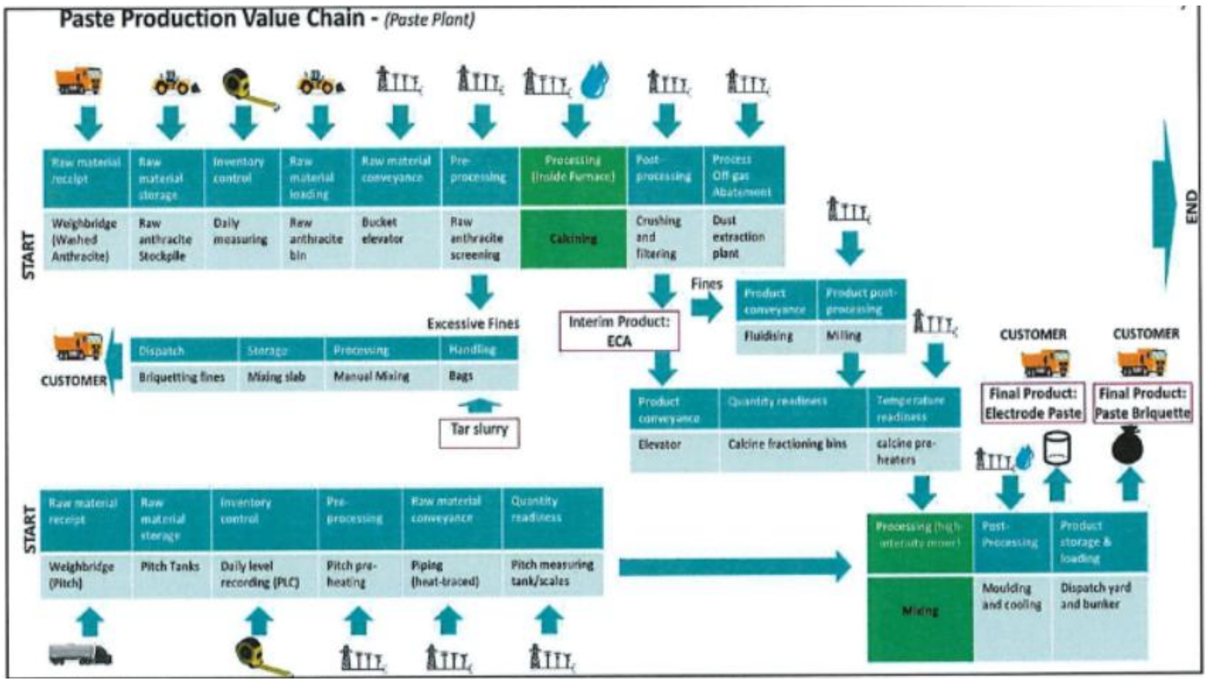


Figure 2-4: Char Technology (Pty) Ltd process flow: Paste production value chain

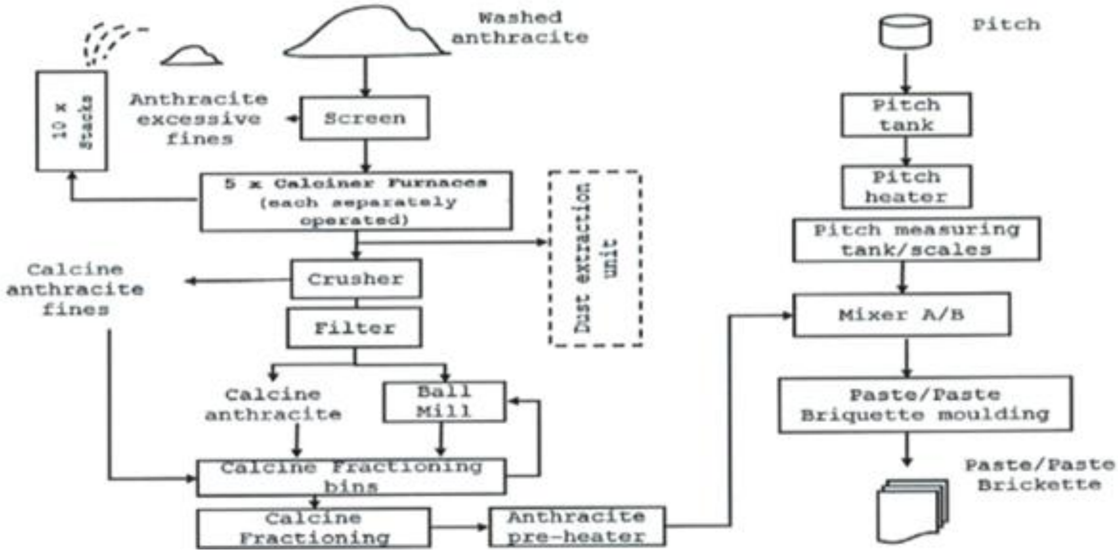


Figure 2-5: Process flow for electrode paste production

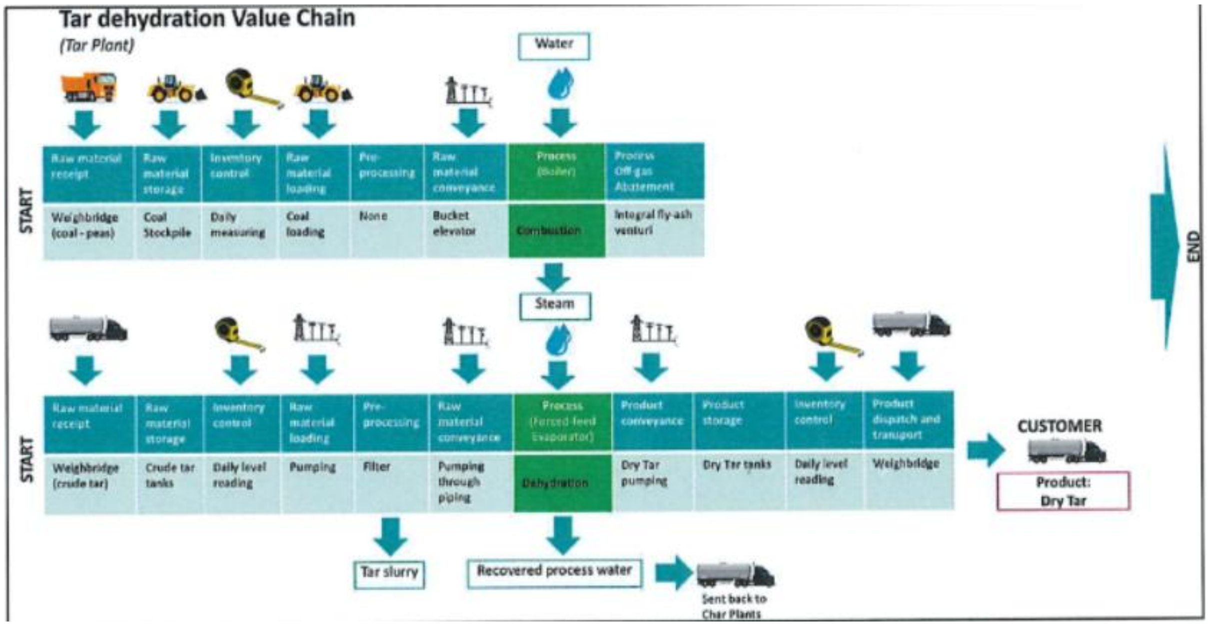


Figure 2-6: Char Technology (Pty) Ltd process flow: Tar dehydration value chain

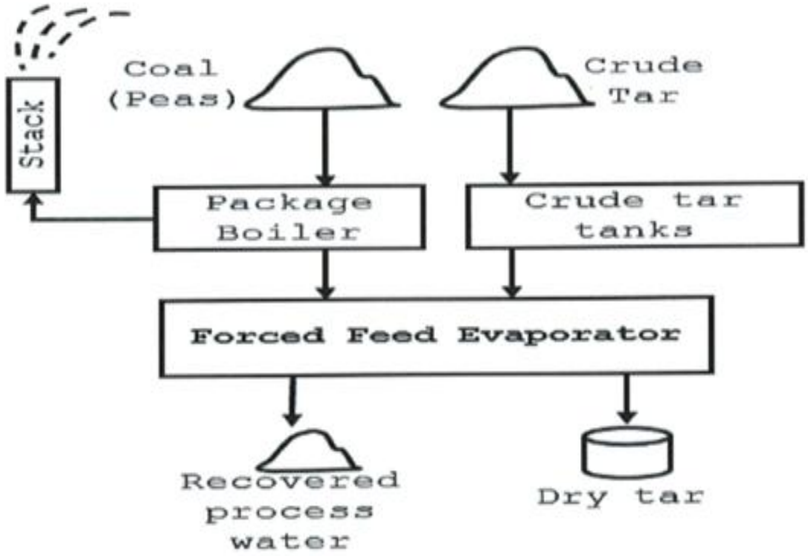


Figure 2-7: Process flow for Tar dehydration

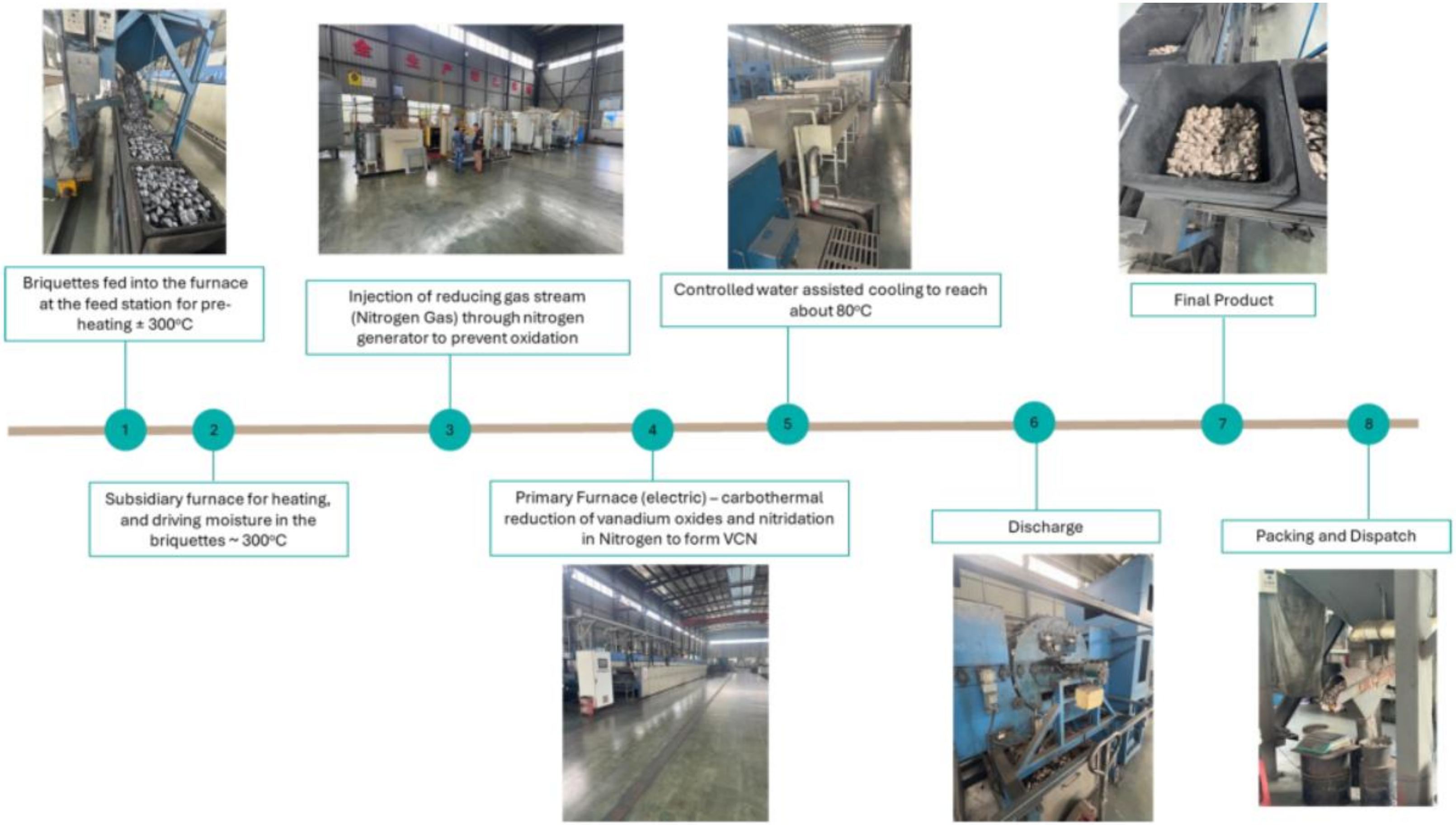


Figure 2-8: Process flow for the VCN Furnace

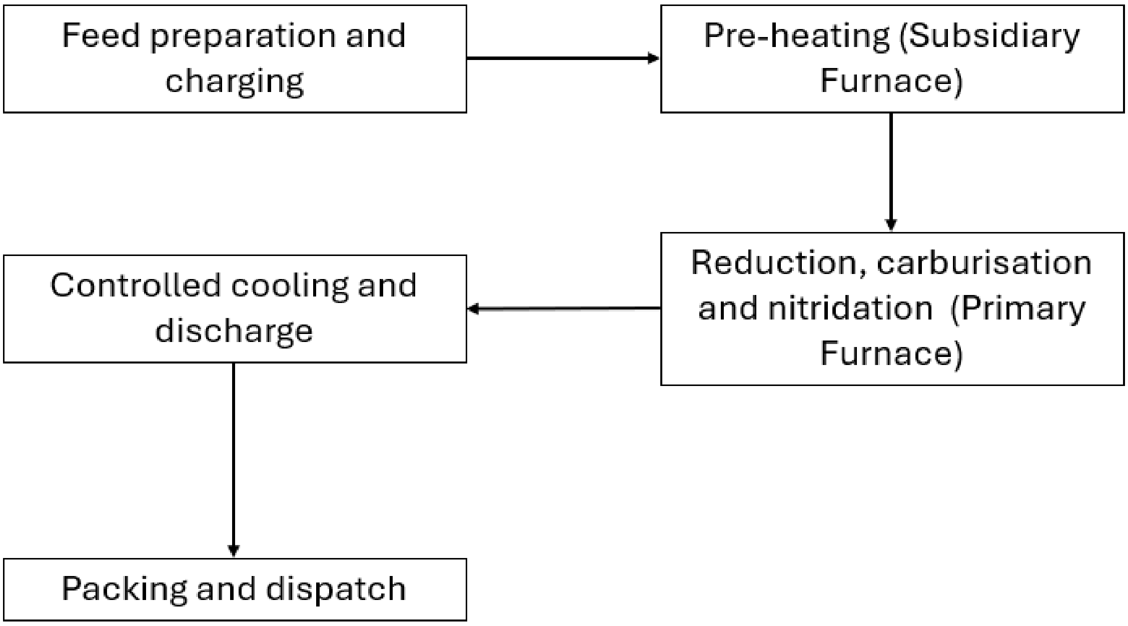


Figure 2-9: Simplified process flow for the VCN Furnace

3 TECHNICAL INFORMATION

Raw material consumption rates are tabulated in Table 3-1. Production rates are tabulated in Table 3-2, with by-products listed in Table 3-3. Appliances to prevent air pollution are given in Table 3-4.

3.1 Raw Material Consumption Rates

Table 3-1: Raw materials used

Raw Material Type	Design Consumption Rate (Quantity)	Actual Consumption Rate (Quantity)	Units (quantity/period)
ACU and ACM (Char and Tar Production)			
Coal	352 000	340 000	Tonnes/annum
Paste Plant (Electrode Paste Production)			
Anthracite	31 500	25 100	Tonnes/annum
Pitch	8 000	6 750	Tonnes/annum
Tar Dehydration Plant			
Crude Tar	35 664	18 800	Tonnes/annum
VCN Furnace			
Vanadium (as V_2O_5/ V_2O_3 feed)	1 587	TBC[(a)]	Tonnes/annum
Carbon powder	1 253	TBC[(a)]	Tonnes/annum
Iron powder	10	TBC[(a)]	Tonnes/annum

(a) To be confirmed once operational

3.2 Production Rates

Table 3-2: Production rates

Product Name	Design Production Capacity (Quantity)	Actual Production Capacity 2025 (Quantity)	Units (quantity/period)
ACU and ACM (Char and Tar Production)			
Char	183 600	178 000	Tonnes/annum
Paste Plant (Electrode Paste Production)			
Paste (electrode paste and paste briquettes)	32 000	25 500	Tonnes/annum
Tar Dehydration Plant			
Dry tar	24 970	21 850	Tonnes/annum
VCN Furnace			

Product Name	Design Production Capacity (Quantity)	Actual Production Capacity 2025 (Quantity)	Units (quantity/period)
VCN briquettes	2 088	TBC[(a)]	Tonnes/annum

(a) To be confirmed once operational

Table 3-3: By-Product rates

By-Product Name	Design Production Capacity (Quantity)	Actual Production Capacity (Quantity)	Units (quantity/period)
ACU and ACM (Char and Tar Production)			
Crude Tar	10 032	9 500	Tonnes/annum
Coal fines	35 200	34 100	Tonnes/annum
Char fines	22 500	21 800	Tonnes/annum
Paste Plant (Electrode Paste Production)			
Briquetting fines	1 200	720	Tonnes/annum
Tar Dehydration Plant			
Tar slurry	30	25	Tonnes/annum

3.3 Appliances and Abatement Equipment Control Technology

Table 3-4: Abatement equipment control technology used

Source Code	Appliance Name	Appliance Type / Description	Control Appliance Function / Purpose
Paste Plant (Electrode Paste Production)			
EU0001	Paste Furnace 1	Calcining Furnace	Dust collector
EU0002	Paste Furnace 2	Calcining Furnace	Dust collector
EU0003	Paste Furnace 3	Calcining Furnace	Dust collector
EU0004	Paste Furnace 4	Calcining Furnace	Dust collector
EU0005	Paste Furnace 5	Calcining Furnace	Dust collector
African Carbon Union (ACU)			

Source Code	Appliance Name	Appliance Type / Description	Control Appliance Function / Purpose
EU0006	ACU Retort 1	Retort	In house design to control emissions from the cyclone, interceptor and dropbox
EU0007	ACU Retort 2	Retort	In house design to control emissions from the cyclone, interceptor and dropbox
EU0008	ACU Retort 3	Retort	In house design to control emissions from the cyclone, interceptor and dropbox
EU0009	ACU Retort 4	Retort	In house design to control emissions from the cyclone, interceptor and dropbox
EU0010	ACU Retort 5	Retort	In house design to control emissions from the cyclone, interceptor and dropbox
EU0011	ACU Retort 6	Retort	In house design to control emissions from the cyclone, interceptor and dropbox
African Carbon Manufacture (ACM)			
EU0012	ACM Retort 1	Retort	In house design to control emissions from the cyclone, interceptor and dropbox
EU0013	ACM Retort 2	Retort	In house design to control emissions from the cyclone, interceptor and dropbox
EU0014	ACM Retort 3	Retort	In house design to control emissions from the cyclone, interceptor and dropbox
EU0015	ACM Retort 4	Retort	In house design to control emissions from the cyclone, interceptor and dropbox
EU0016	ACM Retort 5	Retort	In house design to control emissions from the cyclone, interceptor and dropbox
EU0017	ACM Retort 6	Retort	In house design to control emissions from the cyclone, interceptor and dropbox
Tar Dehydration Plant			
EU0018	Boiler	Boiler	Integral fly ash ventury
VCN Furnace			
EU0019	VCN Furnace Stack	VCN Furnace Stack	Baghouse

4 ATMOSPHERIC EMISSIONS

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

4.1 Point Source Parameters

Table 4-1: Point sources of atmospheric pollutant emissions from the existing licensed operations and the proposed VCN Furnace

Point Source code	Source name	Stack Name	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Height Above Nearby Building (m)	Diameter at Stack Tip / Vent Exit (m)	Actual Gas Exit Temperature (°C)	Actual Gas Volumetric Flow (m³/hr)	Actual Gas Exit Velocity (m/s)
Paste Plant (Electrode Paste Production)										
EU0001	Paste Furnace 1	Paste Furnace 1 Stack 1 (SV Paste F1 S1)	-25.8549150	29.1629200	19.052	13	0.74	178-390	1908-32364	8.83548
		Paste Furnace 1 Stack 2 (SV Paste F1 S2)	-25.8563795	29.1644147	19.052	13	0.74	178-390	1908-32364	8.83548
EU0002	Paste Furnace 2	Paste Furnace 2 Stack 1 (SV Paste F2 S1)	-25.8553517	29.1630333	19.052	13	0.74	178-390	1908-32364	8.83548
		Paste Furnace 2 Stack 2 (SV Paste F2 S2)	-25.8552950	29.1627467	19.052	13	0.74	178-390	1908-32364	8.83548

Point Source code	Source name	Stack Name	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Height Above Nearby Building (m)	Diameter at Stack Tip / Vent Exit (m)	Actual Gas Exit Temperature (°C)	Actual Gas Volumetric Flow (m³/hr)	Actual Gas Exit Velocity (m/s)
EU0003	Paste Furnace 3	Paste Furnace 3 Stack 1 (SV Paste F3 S1)	-25.8548081	29.1628554	19.052	13	0.74	178-390	1908-32364	8.83548
		Paste Furnace 3 Stack 2 (SV Paste F3 S2)	-25.8553417	29.1627300	19.052	13	0.74	178-390	1908-32364	8.83548
EU0004	Paste Furnace 4	Paste Furnace 4 Stack 1 (SV Paste F4 S1)	-25.8550405	29.1626936	19.052	13	0.74	178-390	1908-32364	8.83548
		Paste Furnace 4 Stack 2 (SV Paste F4 S2)	-25.8553417	29.1625083	19.052	13	0.74	178-390	1908-32364	8.83548
EU0005	Paste Furnace 5	Paste Furnace 5 Stack 1 (SV Paste F5 S1)	-25.8553499	29.1625033	19.052	13	0.74	178-390	1908-32364	8.83548
		Paste Furnace 5 Stack 2 (SV Paste F5 S2)	-25.8550086	29.1625940	19.052	13	0.74	178-390	1908-32364	8.83548
African Carbon Union (ACU)										
EU0006	ACU Retort 1	ACU Retort 1 Stack (SV ACU R1 S1)	-25.8520254	29.16422978	33	27	1	300-600	35972-87672	19.8625

Point Source code	Source name	Stack Name	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Height Above Nearby Building (m)	Diameter at Stack Tip / Vent Exit (m)	Actual Gas Exit Temperature (°C)	Actual Gas Volumetric Flow (m³/hr)	Actual Gas Exit Velocity (m/s)
EU0007	ACU Retort 2	ACU Retort 2 Stack (SV ACU R2 S2)	-25.85199131	29.16407655	33	27	1	300-600	35972-87672	19.8625
EU0008	ACU Retort 3	ACU Retort 3 Stack (SV ACU R3 S3)	-25.85195139	29.16425344	33	27	1	300-600	35972-87672	19.8625
EU0009	ACU Retort 4	ACU Retort 4 Stack (SV ACU R4 S4)	-25.85192206	29.16409294	33	27	1	300-600	35972-87672	19.8625
EU0010	ACU Retort 5	ACU Retort 5 Stack (SV ACU R5 S5)	-25.85188138	29.16426706	33	27	1	300-600	35972-87672	19.8625
EU0011	ACU Retort 6	ACU Retort 6 Stack (SV ACU R6 S6)	-25.8518618	29.16411157	33	27	1	300-600	35972-87672	19.8625
African Carbon Manufacture (ACM)										
EU0012	ACM Retort 1	ACM Retort 1 Stack (SV ACM R1 S1)	-25.85486516	29.16612018	43	37	1	300-600	36972-87672	19.8625
EU0013	ACM Retort 2	ACM Retort 2 Stack (SV ACM R2 S2)	-25.85490066	29.16634681	43	37	1	300-600	36972-87672	19.8625

Point Source code	Source name	Stack Name	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Height Above Nearby Building (m)	Diameter at Stack Tip / Vent Exit (m)	Actual Gas Exit Temperature (°C)	Actual Gas Volumetric Flow (m³/hr)	Actual Gas Exit Velocity (m/s)
EU0014	ACM Retort 3	ACM Retort 3 Stack (SV ACM R3 S3)	-25.85506006	29.16599005	43	37	1	300-600	36972-87672	19.8625
EU0015	ACM Retort 4	ACM Retort 4 Stack (SV ACM R4 S4)	-25.85515668	29.16594113	43	37	1	300-600	36972-87672	19.8625
EU0016	ACM Retort 5	ACM Retort 5 Stack (SV ACM R5 S5)	-25.855073	29.855112	43	37	1	300-600	36972-87672	19.8625
EU0017	ACM Retort 6	ACM Retort 6 Stack (SV ACM R6 S6)	-25.16631	29.166317	43	37	1	300-600	36972-87672	19.8625
Tar Dehydration Plant										
EU0018	Boiler	Tar dehydration stack	-25.853039	29.16468	25	25	0.66	1115-160	2160-15480	8.3-12.6
VCN Furnace										
EU0019	VCN Stack	VCN Furnace Stack	-25.8525	29.16444	35		2.5	80	19688	1.21

4.2 Point Source Maximum Emission Rates during Normal Operating Conditions

Table 4-2: Atmospheric pollutant emission rates for the existing licensed operations and the proposed VCN Furnace

Point Source code	Pollutant Name	Maximum Release Rate				Emissions Hours[b]	Type of Emissions (Continuous / Routine but Intermittent / Emergency Only)
		(mg/Nm³)[a]	(mg/Am³)	(kg/hr)	(tpa)		
Paste Plant (Electrode Paste Production)							
EU0001	Particulate matter (PM)	50	33	0.45	3.97	8760	Routine but Intermittent
EU0002	Particulate matter (PM)	50	33	0.45	3.97	8760	Routine but Intermittent
EU0003	Particulate matter (PM)	50	33	0.45	3.97	8760	Routine but Intermittent
EU0004	Particulate matter (PM)	50	33	0.45	3.97	8760	Routine but Intermittent
EU0005	Particulate matter (PM)	50	33	0.45	3.97	8760	Routine but Intermittent
African Carbon Union (ACU)							
EU0006	Particulate matter (PM)	50	17	0.9	8	8760	Routine but Intermittent
	Polycyclic aromatic hydrocarbon (PAH)	0.1	0.034	0.002	0.017	8760	Routine but Intermittent
EU0007	Particulate matter (PM)	50	17	0.9	8	8760	Routine but Intermittent
	Polycyclic aromatic hydrocarbon (PAH)	0.1	0.034	0.002	0.017	8760	Routine but Intermittent
EU0008	Particulate matter (PM)	50	17	0.9	8	8760	Routine but Intermittent
	Polycyclic aromatic hydrocarbon (PAH)	0.1	0.034	0.002	0.017	8760	Routine but Intermittent
EU0009	Particulate matter (PM)	50	17	0.9	8	8760	Routine but Intermittent

Point Source code	Pollutant Name	Maximum Release Rate				Emissions Hours[b]	Type of Emissions (Continuous / Routine but Intermittent / Emergency Only)
		(mg/Nm³)[a]	(mg/Am³)	(kg/hr)	(tpa)		
	Polycyclic aromatic hydrocarbon (PAH)	0.1	0.034	0.002	0.017	8760	Routine but Intermittent
EU0010	Particulate matter (PM)	50	17	0.9	8	8760	Routine but Intermittent
	Polycyclic aromatic hydrocarbon (PAH)	0.1	0.034	0.002	0.017	8760	Routine but Intermittent
EU0011	Particulate matter (PM)	50	17	0.9	8	8760	Routine but Intermittent
	Polycyclic aromatic hydrocarbon (PAH)	0.1	0.034	0.002	0.017	8760	Routine but Intermittent
African Carbon Manufacture (ACM)							
EU0012	Particulate matter (PM)	50	17	0.9	8	8760	Routine but Intermittent
	Polycyclic aromatic hydrocarbon (PAH)	0.1	0.034	0.002	0.017	8760	Routine but Intermittent
EU0013	Particulate Matter (PM)	50	17	0.9	8	8760	Routine but Intermittent
	Polycyclic aromatic hydrocarbon (PAH)	0.1	0.034	0.002	0.017	8760	Routine but Intermittent
EU0014	Particulate matter (PM)	50	17	0.9	8	8760	Routine but Intermittent
	Polycyclic aromatic hydrocarbon (PAH)	0.1	0.034	0.002	0.017	8760	Routine but Intermittent
EU0015	Particulate matter (PM)	50	17	0.9	8	8760	Routine but Intermittent
	Polycyclic aromatic hydrocarbon (PAH)	0.1	0.034	0.002	0.017	8760	Routine but Intermittent

Point Source code	Pollutant Name	Maximum Release Rate				Emissions Hours[b]	Type of Emissions (Continuous / Routine but Intermittent / Emergency Only)
		(mg/Nm³)[a]	(mg/Am³)	(kg/hr)	(tpa)		
EU0016	Particulate matter (PM)	50	17	0.9	8	8760	Routine but Intermittent
	Polycyclic aromatic hydrocarbon (PAH)	0.1	0.034	0.002	0.017	8760	Routine but Intermittent
EU0017	Particulate matter (PM)	50	17	0.9	8	8760	Routine but Intermittent
	Polycyclic aromatic hydrocarbon (PAH)	0.1	0.034	0.002	0.017	8760	Routine but Intermittent
Tar Dehydration Plant							
EU0018	Total volatile organic compounds (TVOCs)	130	84	0.97	8.5	8760	Routine but Intermittent
VCN Furnace							
EU0019	Particulate matter (PM)	50	39	0.76	7	8760	Routine but Intermittent
	Sulfur dioxide (SO_2)	1000	773	15	133	8760	Routine but Intermittent
	Oxides of nitrogen (NOx expressed as NO_2)	500	387	8	67	8760	Routine but Intermittent
	Ammonia (NH_3)	30	23	0.46	4	8760	Routine but Intermittent

Notes:

(a) Maximum release concentration as per the New Plant MES (Section 21 of NEM:AQA)

(b) Total operational hours per annum (assumed)

4.3 Point Source Maximum Emission Rates Under Start-Up, Maintenance and Shut-Down Conditions

Table 4-3: Atmospheric pollutant emission rates for the existing licensed operations and the proposed VCN Furnace under start-up, maintenance and shut-down conditions

Point Source Code	Pollutant Name	Maximum Release Rate (mg/Nm³)	Averaging Period (Instantaneous, Hourly, Daily, Monthly, Annual)	Maximum Gas Volumetric Flow (m³/hr)	Maximum Gas Exit Velocity (m/s)	Emissions Hours	Permitted Duration of Emissions
EU0001, EU0002, EU0003, EU0004, EU0005	PM	50	Daily	1908-32364	8.83548	24	Continuous
EU0006, EU0007, EU0008, EU0009, EU0010, EU0011, EU0012, EU0013, EU0014, EU0015, EU0016, EU0017	PM	50	Daily	36972-87672	19.8625	24	Continuous
	PAH	0.1					
EU0018	TVOCs	130	Daily	16272	14	24	Continuous
EU0019	PM	50	Daily	19688	1.21	24	Continuous
	SO_2	1000	Daily	19688	1.21	24	Continuous
	NO_x as NO_2	500	Daily	19688	1.21	24	Continuous
	NH_3	30	Daily	19688	1.21	24	Continuous

4.4 Fugitive Emissions (Area and or Line Sources)

Table 4-4: Area sources of atmospheric pollutant emissions for the existing licensed operations and the proposed VCN Furnace

Source code	Source name	Source Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emissions
Paste Plant (Electrode Paste Production)									
EU0020	Raw Material Handling (Anthracite Stockpiles)	Emission Unit Type: Receiving, handling and storage of washed anthracite. Description: Fugitive dust emissions resulting from receiving, handling and storage of washed anthracite.	-25.85236	29.1642222	3	200	5	Intermittent (stockpiling depends on raw material handling)	Batch
EU0021	Semi-Closed Storage Area for Anthracite	Emission Unit Type: Storage of washed anthracite prior being transferred to the bucket elevator. Description: Fugitive dust emissions resulting from the storage of washed anthracite prior being transferred to the bucket elevator.	-25.854915	29.162914	2	48	20	24	Batch
EU0022	Anthracite Bin x2	Emission Unit Type: Supply of anthracite to conveyor through the feeders. Description: Fugitive dust emissions resulting from the transfer of anthracite.	-25.85456	29.1623611	2	6	6	24	Continuous

Source code	Source name	Source Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emissions
EU0023	Conveyor 2	Emission Unit Type: Transfer of anthracite to bucket elevator 1. Description: Fugitive dust emissions resulting from the transfer of anthracite.	-25.85344	29.1631667	0 to 1.8	12	0.4	24	Continuous
EU0024	Bucket Elevator 1	Emission Unit Type: Transfer of anthracite to screen. Description: Fugitive dust emissions resulting from the transfer of anthracite.	-25.8555	29.163	0 to 30	30	0.4	24	Continuous
EU0025	Double Screen x1	Emission Unit Type: Screening fines from the anthracite. Description: Fugitive dust emissions resulting from the screening of fines from the anthracite.	-25.85539	29.1629167	30	2	1	24	Continuous
EU0026	EU0025 Conveyor 3 and 4	Emission Unit Type: Transfer of anthracite from the screen to the furnaces. Description: Fugitive dust emissions resulting from the transfer of anthracite.	-25.85533	29.162917	25	40	0.4	24	Continuous
EU0027	Turn Table x5	Emission Unit Type: Discharging of calcined anthracite from the furnace. Description: Fugitive emissions resulting from the discharging of calcined anthracite	-25.85536	29.162528	5	2	2	24	Continuous

Source code	Source name	Source Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emissions
		from the furnace.							
EU0028	Conveyor 5 and 6	Emission Unit Type: Transfer of anthracite to bucket elevator 2. Description: Fugitive dust emissions resulting from the transfer of anthracite to bucket elevator 2.	-25.85531	29.1625	0.1 to 1.5	40	0.4	24	Continuous
EU0029	Bucket Elevator 2	Emission Unit Type: Transfer of anthracite to the bin. Description: Fugitive dust emissions resulting from the transfer of anthracite to the bin.	-25.8555	29.162972	0 to 40	1	0.4	24	Continuous
EU0030	Screen Feed Bin x1	Emission Unit Type: Storage of anthracite. Description: Fugitive dust emissions resulting from storage of anthracite.	-25.85544	29.162333	35	1.6	0.35	24	Continuous
EU0031	Screens 2.1 and 2.2	Emission Unit Type: Screening calcined anthracite. Description: Fugitive dust emissions resulting from the screening of calcined anthracite.	-25.85553	29.161694	30	2.4	1	24	Continuous
EU0032	Storage Bin x1	Emission Unit Type: Storage of calcined anthracite.	-25.85522	29.165917	2 to 20	6	4	24	Continuous

Source code	Source name	Source Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emissions
		Description: Fugitive dust emissions resulting from storage of calcined anthracite.							
EU0033	Ball Mill x1	Emission Unit Type: Crushing calcined anthracite to fine dust. Description: Fugitive dust emissions resulting from the crushing of calcined anthracite to fine dust.	-25.85514	29.162639	0.9 to 2.5	5	2.5	24	Batch
EU0034	Ball Mill Fines	Emission Unit Type: Storage of ball mill fines. Description: Fugitive dust emissions resulting from the storage of ball mill fines.	-25.85536	29.1625	15	2	2	24	Continuous
EU0035	Conveyor 8	Emission Unit Type: Transfer of calcined anthracite to the pre-heaters. Description: Fugitive dust emissions resulting from the transfer of calcined anthracite to pre-heaters.	-25.85511	29.16325	12	8	0.4	24	Batch
EU0036	Anthracite Pre-Heaters x2	Emission Unit Type: Heating of anthracite. Description: Fugitive emissions resulting from the heating of anthracite.	-25.85483	29.163444	10	1.5	1.5	24	Batch
EU0037	Pitch Scale x2	Emission Unit Type: Scale pitch Description: Fugitive emissions of aromatic compounds,	-25.85497	29.162806	10	1	1	24	Batch

Source code	Source name	Source Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emissions
		hydrocarbons and heterocyclic compounds							
EU0038	Pitch Pre-Heaters x2	Emission Unit Type: Pre-heating of pitch prior mixing with calcined anthracite. Description: Fugitive emissions of pitch volatiles resulting from the pre-heating of pitch.	-25.85497	29.162806	0.2	3	1.5	24	Batch
EU0039	Mixer x2	Emission Unit Type: Mixes the heated calcined anthracite with heated pitch. Description: Fugitive emissions resulting from the mixing of heated calcined anthracite with heated pitch.	-25.855	29.162389	5	1	1	24	Batch
EU0040	Haul Roads	Emission Unit Type: Transportation of raw materials and product on haul roads within the operational footprint of the facility. Description: Fugitive dust emissions resulting from the transportation of raw materials and product on haul roads within the operational footprint of the facility.	NA	NA	NA	1000	7	24	Batch
African Carbon Union (ACU)									
EU0041	Raw Material (Coal Handling	Emission Unit Type: Receiving, storage and handling of coal.	-25.85308	29.163778	3	200	3	Intermittent (stockpiling	Batch

Source code	Source name	Source Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emissions
	Stockpiles)	Description: Fugitive dust emissions resulting from the receiving, storage and handling of coal.						depends on	
EU0042	Coal Blending x 1	Emission Unit Type: Aggregating coal from different stockpiles into the raw material feed. Description: Fugitive dust emissions resulting from aggregating coal from the different stockpiles.	-25.852939	29.164	3	5	5	24	Batch
EU0043	Coal Feeder Bin x1	Emission Unit Type: A Front-End Loader loads coal into the bin from the stockpiles (feeding) and it is temporarily stored prior being transferred to the coal screen. Description: Fugitive dust emissions resulting from coal being loaded into the bin and its temporary storage prior to transfer to the coal screen.	-25.852939	29.164	3	5	5	24	Continuous
EU0044	Coal Conveyor x 1	Emission Unit Type: Transfer of raw material (coal) from the feeder bin to the coal screen. Description: Fugitive dust emissions resulting from the transfer of coal from the feeder bin to the coal screen.	-25.85264	29.163972	3	24	0.6	24	Continuous

Source code	Source name	Source Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emissions
EU0045	Coal Screen x 1	Emission Unit Type: Screening of +15mm coal, separating correct size coal from undersized coal (fines). Description: Fugitive dust emissions resulting from screening of coal.	-25.85264	29.164	3	3.2	1.3	24	Continuous
EU0046	Coal Fines Stockpiling and Handling	Emission Unit Type: Temporary storage of coal fines prior to dispatch. Description: Fugitive dust emissions resulting from temporary storage of coal fines.	-25.84977	29.164561	3	30	17	24	Batch
EU0047	Coal Conveyor 2	Emission Unit Type: Transfer of raw material (+15mm) from screen to coal hopper for retorts (feeding of coal into the process equipment, i.e. retorts). Description: Fugitive dust emissions resulting from the transfer of raw material (+15mm coal) from screen to coal hopper for retorts.	-25.85261	29.164083	27	100	0.6	24	Continuous
EU0048	Coal Hopper for Retorts x 1	Emission Unit Type: Directs the transfer of material into the process equipment (retorts). Supply of coal to retort 1–6 via small coal	-25.852	29.164167	20	5	3	24	Continuous

Source code	Source name	Source Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emissions
		feeders and coal conveyor. Description: Fugitive dust emissions resulting from the transfer of material into the process equipment (retorts) and coal conveyors.							
EU0049	Coal Conveyor 3	Emission Unit Type: Transfer of coal from the coal hopper to the bin where it is going to be supplied via small conveyor feeders 5 and 6. Description: Fugitive dust emissions resulting from the transfer of coal hopper to the bin where it is going to be supplied via small conveyor feeders 5 and 6.	-25.85189	29.164167	20	5	3	24	Continuous
EU0050	Discharge Vibrators x 6	Emission Unit Type: Char is being discharged and quenched. Description: Fugitive emissions resulting from char being discharged and quenched.	-25.852	29.164222	2	2	0.6	24	Continuous
EU0051	Product Conveyor (Char Conveyor) x 1	Emission Unit Type: Char received from vibrators transferred to product conveyor. Product transferred from process equipment to screening. Description: fugitive emissions resulting from	-25.85192	29.1642222	3	60	0.6	24	Continuous

Source code	Source name	Source Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emissions
		the transfer of char.							
EU0052	By-Pass Conveyor x 1	Emission Unit Type: Split raw material other conveyors. Description: Fugitive dust emission resulting from the splitting of raw material	-25.858204	29.164685	2	120	0.6	24	Continuous
EU0053	Char Screen x 1	Emission Unit Type: Screening of +12mm char from the product conveyor to the char bin, i.e. separating correct size char from undersized char (breeze). Description: Fugitive dust emissions resulting from screening of +12mm char.	-25.86425	29.16425	3	1.8	1.1	24	Continuous
EU0054	Char Fines Stockpiles	Emission Unit Type: Handling and storage of char fines. Description: Fugitive dust emissions resulting from the handling and storage of char fines.	-25.84977	29.164567	3	30	18	24	Batch
EU0055	Char Stockpile	Emission Unit Type: Handling and storage of char. Description: Fugitive dust emissions resulting from handling and storage of char	-25.85161	29.164167	1	30	24	24	Batch

Source code	Source name	Source Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emissions
EU0056	Tar Generation x 6	Emission Unit Type: Discharge and collection of tar from the dropbox and cyclones Description: Fugitive emissions of hydrocarbons resulting from the discharge and collection of tar from the dropbox and cyclone.	-25.851996	29.164235	1.5	20	15	24	Continuous
EU0057	Unpaved Roads	Emission Unit Type: Transportation of raw materials and product on unpaved roads within the operational footprint of the facility. Description: Fugitive dust emissions resulting from the transportation of raw materials and product on unpaved roads within the operational footprint of the facility.	N/A	N/A	1.5	60	7	24	Continuous
African Carbon Manufacture (ACM)									
EU0058	Raw Handling (Stockpiles)	Emission Unit Type: Receiving, storage and handling of coal. Description: Fugitive dust emissions resulting from the receiving, storage and handling of coal.	-25.85278	29.165528	5	50	3	Intermittent (stockpiling depends on raw material handling)	Batch
EU0059	Coal Blending x 1	Emission Unit Type: Aggregating coal from different stockpiles into the raw material	-25.855043	29.165525	3	5	5	24	Batch

Source code	Source name	Source Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emissions
		feed. Description: Fugitive dust emissions resulting from aggregating coal from the different stockpiles.							
EU0060	Coal Feeder Bin x 1	Emission Unit Type: A Front-End Loader loads coal into the bin from the stockpiles (feeding) and it is temporarily stored prior being transferred to the coal screen. Description: Fugitive emissions resulting from coal being loaded into the bin and its temporary storage prior transfer to the coal screen.	-25.8550433	29.165525	3	5	5	24	Batch
EU0061	Coal Conveyor 1	Emission Unit Type: Transfer of raw material (coal) from the feeder bin to the coal screen. Description: Fugitive dust emissions resulting from the transfer of coal from the feeder bin to the coal screen.	-25.85489	29.1654722	12	60	0.6	24	Batch
EU0062	Coal Screen x 1	Emission Unit Type: Screening of +15mm coal, separating correct size coal from undersized coal (fines). Description: Fugitive dust emissions resulting from screening of coal.	-25.85489	29.1655	12	1.8	1.1	24	Batch

Source code	Source name	Source Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emissions
EU0063	Coal Fines Stockpiling and Handling	Emission Unit Type: Temporary storage of coal fines prior to dispatch. Description: Fugitive dust emissions resulting from temporary storage of coal fines.	-25.854675	29.165382	3	30	17	24	Batch
EU0064	Coal Conveyor 2	Emission Unit Type: Transfer of raw material (+15mm) from screen to coal hopper for retorts (feeding of coal into the process equipment, i.e. retorts) Description: Fugitive dust emissions resulting from the transfer of raw material (~15mm coal) from screen to coal hopper for retorts.	-25.85489	29.1655	10	80	0.6	24	Batch
EU0065	Coal Hopper for Retorts x 1	Emission Unit Type: Directs the transfer of material into the process equipment (retorts). Supply of coal to retort 1–6 via small coal feeders and coal conveyor. Description: Fugitive dust emissions resulting from the transfer of material into the process equipment (retorts) and coal conveyors.	-25.8548	29.166194	20	5	3	24	Batch

Source code	Source name	Source Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emissions
EU0066	Coal Conveyor 3 and 4	Emission Unit Type: Transfer of coal from the coal hopper to the bin where it is going to be supplied via small conveyor feeders 4-6. Description: Fugitive dust emissions resulting from the transfer of coal hopper to the bin where it is going to be supplied via small conveyor feeders 4-6.	-25.8519	29.164167	6	40	0.6	24	Batch
EU0067	Discharge Vibrators x 6	Emission Unit Type: Char is being discharged and quenched. Description: Fugitive emissions resulting from char being discharged and quenched.	-25.852	29.164222	2	2	0.6	24	Batch
EU0068	Product Conveyor (Char Conveyor) x 1	Emission Unit Type: Char received from vibrators transferred to product conveyor. Product transferred from process equipment to screening. Description: Fugitive emissions resulting from the transfer of char.	-25.85192	29.164222	3	80	0.6	24	Batch
EU0069	By-Pass Conveyor x 1	Emission Unit Type: Split raw material other conveyors. Description: Fugitive dust emission	-25.8551316	29.1661816	2-3	120	0.6	24	Batch

Source code	Source name	Source Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emissions
		resulting from the splitting of raw material							
EU0070	Char Screen x 2	Emission Unit Type: Screening of +12mm char from the product conveyor to the char bin, i.e. separating correct size char from undersized char (breeze). Description: Fugitive dust emissions resulting from screening of +12mm char.	-25.85178	29.16425	3	1.8	1.1	24	Batch
EU0071	Char Fines Stockpiles x1	Emission Unit Type: Handling and storage of char fines. Description: Fugitive dust emissions resulting from the handling and storage of char fines.	-25.855777	29.166248	3	30	18	24	Batch
EU0072	Char Stockpile x 1	Emission Unit Type: Handling and storage of char. Description: Fugitive dust emissions resulting from handling and storage of char	-25.855617	29.165598	3	150	25	24	Batch
EU0073	Tar Generation x 6	Emission Unit Type: Discharge and collection of tar from the dropbox and cyclones. Description: Fugitive emissions of hydrocarbons resulting from the discharge and collection of tar from the dropbox and cyclone.	-25.855093	29.166158	1.5	20	15	24	Batch

Source code	Source name	Source Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emissions
EU0074	Unpaved Roads	Emission Unit Type: Transportation of raw materials and product on unpaved roads within the operational footprint of the facility. Description: Fugitive dust emissions resulting from the transportation of raw materials and product on unpaved roads within the operational footprint of the facility.	NA	NA	NA	NA	NA	24	Batch
Tar Dehydration Plant									
EU0075	Raw Material Handling (Coal Peas Stockpiles)	Emission Unit Type: Handling and storage of coal peas (boiler peas). Description: Fugitive dust emissions resulting from the receiving, storage and handling of coal peas (boiler peas).	-25.85381	29.164282	3	22.4	8.1	Intermittent (stockpiling depends on raw material handling)	Batch
EU0076	Loading Bin	Emission Unit Type: Feeding in coal peas to be used as energy source for the boiler. Description: Fugitive dust emissions resulting from the temporary storage of coal peas (boiler peas) prior feed into the boiler.	-25.852975	29.164633	3	5	5	24	Batch
EU0077	Integral Venturi Fly-Ash	Emission Unit Type: The venturi scrubber uses the differential between high velocity gases and free-flowing water in the off-gas to create droplets which entrap	-25.853158	29.164621	5.5	0.4	0.66	24	Batch

Source code	Source name	Source Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emissions
		contaminants, hold them in suspension and deliver them as a highly concentrated slurry. This slurry then drops down back onto the furnace bed where it is discharged with the bottom ash Description: Fugitive dust emissions resulting from the removal of slurry from the furnace bed.							
EU0078	Haul Roads	Emission Unit Type: Transportation of raw materials and product on haul roads within the operational footprint of the facility. Description: Fugitive dust emissions resulting from the transportation of raw materials and product on haul roads within the operational footprint of the facility.	NA	NA	1.5	60	7	24	Batch
VCN Furnace									
EU0079	Paved Roads	Emission Unit Type: Transportation of raw materials and product on paved roads within the operational footprint of the facility. Description: Fugitive dust emissions resulting from the transportation of raw materials and product on paved roads within	NA	NA	NA	NA	NA	24	Batch

Source code	Source name	Source Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emissions
		the operational footprint of the facility.							

Table 4-5: Fugitive emission factors used to qualify the routine emissions from the operational phase of the existing licensed operations and the proposed VCN Furnace

Activity	Emission Equation	Source	Information assumed/provided	Confidence Rating
Vehicle entrainment on unpaved surfaces	$E = k(s/12)^a(W/3)^b$ Where, E = size-specific emission factor (lb/VKT) s = surface material silt content (%) W = mean vehicle weight (tons) The particle size multiplier (k) is given as 0.15 for $PM_{2.5}$, 1.5 for PM_{10}, and as 4.9 for TSP.	US EPA AP42 Section 13.2.2	Silt content for roads of 6% was used for the assessment. The capacity of the trucks used was provided as 30 t, 34 t and 18 t. The throughput of the raw material, product and by-product was provided for project operations. *75% control efficiencies were assumed*	The quality ratings given for the equation (B) pertain to the mid-range of the measured source conditions for the equation.

Activity	Emission Equation	Source	Information assumed/provided	Confidence Rating
	A is given as 0.9 for $PM_{2.5}$ and PM_{10} and 0.7 for TSP. A is given as 0.45 for $PM_{2.5}$, PM_{10} and TSP.		*for the mitigated scenarios.*	
Vehicle entrainment on paved surfaces	$$E = k(sL)^{0.91}(W)^{1.02}$$ Where, E = size-specific emission factor (g/VKT) sL = surface silt loading (g/m²) W = mean vehicle weight (tons) The particle size multiplier (k) is given as 0.15 for $PM_{2.5}$, 0.62 for PM_{10}, and as 3.23 for TSP.	US EPA AP42 Section 13.2.1	Silt content for paved access road of 9.7 g/m² was used for the assessment. The capacity of the trucks used was provided as 30 t, 34 t and 18 t. The throughput of the raw material, product and by-product was provided for project operations.	The quality ratings given for the equation is A (but D for $PM_{2.5}$).
Materials handling	NPI emission factor for miscellaneous transfer points (including conveying): TSP – 0.00032 kg/tonne PM_{10} – 0.00015 kg/tonne $PM_{2.5}$ – assumed to be 0.00001 kg/tonne	NPI Section: Mining	The throughput of the material was provided.	Materials handling based primarily on tonnages handled. No factors are available for $PM_{2.5}$ – so large uncertainty for this size fraction.

Activity	Emission Equation	Source	Information assumed/provided	Confidence Rating
				Quality rating for the equation: U.
Screening	$E_{TSP} = 0.08\ kg/t\ material\ processed$ $E_{PM10} = 0.06\ kg/t\ material\ processed$ $E_{PM2.5} = 0.0111\ kg/t\ material\ processed$ Fraction of $PM_{2.5}$ taken from US EPA crushed stone emission factor ratio for tertiary crushing.	NPI Section: Mining	Throughput of material screened was provided for the assessment.	No factors are available for $PM_{2.5}$ – so large uncertainty for this size fraction. Quality rating for the equation: • C – screening
Wind Erosion	TSP – 0.4 kg/ha/h PM_{10} – 0.2 kg/ha/h $PM_{2.5}$ – assumed to be 0.15 kg/ha/h	NPI Section: Mining	Layout of all storage piles were identified from satellite imagery.	No factors are available for $PM_{2.5}$ – so large uncertainty for this size fraction. Quality rating for the equation: U.

Notes:

(a) The AP-42 emission factor rating is an overall assessment of how good a factor is, based on both the quality of the test(s) or information that is the source of the factor and on how well the factor represents the emission source. Higher ratings are for factors based on many unbiased observations, or on widely accepted test procedures. For example, ten or more source tests on different randomly selected plants would likely be assigned an "A" rating if all tests are conducted using a single valid reference measurement method. Likewise, a single observation based on questionable methods of testing would be assigned an "E", and a factor extrapolated from higher-rated factors for similar processes would be assigned a "D" or an "E". (US EPA, 2016)

AP-42 emission factor quality ratings are thus assigned:

- A — Excellent. Factor is developed from A- and B-rated source test data taken from many randomly chosen facilities in the industry population. The source category population is sufficiently specific to minimize variability.
- B — Above average. Factor is developed from A- or B-rated test data from a "reasonable number" of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. As with an A rating, the source category population is sufficiently specific to minimize variability.
- C — Average. Factor is developed from A-, B-, and/or C-rated test data from a reasonable number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. As with the A rating, the source category population is sufficiently specific to minimize variability.
- D — Below average. Factor is developed from A-, B- and/or C-rated test data from a small number of facilities, and there may be reason to suspect that these facilities do not represent a random sample of the industry. There also may be evidence of variability within the source population.
- E — Poor. Factor is developed from C- and D-rated test data, and there may be reason to suspect that the facilities tested do not represent a random sample of the industry. There also may be evidence of variability within the source category population.
- U – Uncertain.

Table 4-6: Fugitive particulate emissions quantified for the operational phase for the existing licensed operations and the proposed VCN Furnace

Description	Unmitigated Operations Emissions (tpa)			Mitigated Operations (assuming 75% CE on unpaved roads) Emissions (tpa)		
	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
ACU, ACM, Paste Plant, Tar Dehydration Plant						
Materials handling	0.49	0.23	0.02	0.49	0.23	0.02
Screening	88.38	66.28	12.26	88.38	66.28	12.26
Vehicle entrainment	495.26	100.88	21.46	436.77	85.29	19.90
Windblown dust from stockpiles	16.83	8.42	6.31	16.83	8.42	6.31
Total	**600.96**	**175.81**	**40.05**	**542.47**	**160.22**	**38.49**
VCN Furnace						
Vehicle entrainment	1.01	0.19	0.05	1.01	0.19	0.05
Total	**1.01**	**0.19**	**0.05**	**1.01**	**0.19**	**0.05**

4.5 Fugitive Emissions (Tanks)

The tank characteristics is summarised in Table 4-7. The stock throughputs and calculated volatile organic compounds (VOCs) is summarised in Table 4-8. The VOC emissions were calculated using the US-EPA Tanks 5 emission model. The benzene content was assumed to be 1% from crude tar, 0.1% from diesel, and 50% from pitch.

Table 4-7: Tank characteristics

Tank ID	Tank Type	Shell Length (ft)	Shell Height (ft)	Shell Diameter (ft)	Maximum Liquid Height (ft)	Average Liquid Height (ft)	Minimum Liquid Height (ft)	Is Tank Insulated?	Shell Colour/ Shade	Shell Condition	Roof Colour/ Shade	Roof Condition
ACM												
TKACM1	Horizontal Fixed Roof Tank	65.617		11	6.43		3.773	No	Black	Average		
TKACM2	Horizontal Fixed Roof Tank	65.617		11	6.43		3.773	No	Black	Average		
TKACM3	Vertical Fixed Roof Tank		65.617	7.546	55.774	44.291		No	Black	Average	Black	Average
TKACM4	Vertical Fixed Roof Tank		65.617	7.546	55.774	44.291		No	Black	Average	Black	Average
TKACM5	Horizontal Fixed Roof Tank	13.123		5.906	5.02		2.953	No	Black	Average		
TKACM6	Horizontal Fixed Roof Tank	15.748		6.562	5.577		3.281	No	Black	Average		
ACU												
TKACU1	Horizontal Fixed Roof Tank	26.247		5	2.526		1.476	No	Black	Average		
TKACU2	Horizontal Fixed Roof Tank	26.247		5	2.526		1.476	No	Black	Average		
TKACU3	Horizontal Fixed Roof Tank	13.123		6.135	5.217		3.084	No	Black	Average		
TKACU4	Horizontal Fixed Roof Tank	13.123		6.135	5.217		3.084	No	Black	Average		
TKACU5	Horizontal Fixed Roof Tank	13.123		6.135	5.217		3.084	No	Black	Average		
TKACU6	Horizontal Fixed Roof Tank	13.123		6.135	5.217		3.084	No	Black	Average		
Paste Plant												
TKP1	Vertical Fixed Roof Tank		31.496	15.092	26.772	21.26		Yes	Black	Average	Black	Average
TKP10	Vertical Fixed Roof Tank		10.499	5.512	4.692	3.724		No	Gray - Light	Average	Gray - Light	Average
TKP11	Vertical Fixed Roof Tank		7.218	5	3.215	2.559		No	Gray - Light	Average	Gray - Light	Average
TKP2	Vertical Fixed Roof Tank		31.496	15.092	26.772	21.26		Yes	Black	Average	Black	Average
TKP3	Vertical Fixed Roof Tank		31.496	15.092	26.772	21.26		Yes	Black	Average	Black	Average
TKP4	Vertical Fixed Roof Tank		31.496	15.092	26.772	21.26		Yes	Black	Average	Black	Average
TKP5	Vertical Fixed Roof Tank		31.496	15.092	26.772	21.26		Yes	Black	Average	Black	Average

Tank ID	Tank Type	Shell Length (ft)	Shell Height (ft)	Shell Diameter (ft)	Maximum Liquid Height (ft)	Average Liquid Height (ft)	Minimum Liquid Height (ft)	Is Tank Insulated?	Shell Colour/ Shade	Shell Condition	Roof Colour/ Shade	Roof Condition
TKP6	Vertical Fixed Roof Tank		31.496	15.092	26.772	21.26		Yes	Black	Average	Black	Average
TKP7	Vertical Fixed Roof Tank		31.496	15.092	26.772	21.26		Yes	Black	Average	Black	Average
TKP8	Vertical Fixed Roof Tank		31.496	15.092	26.772	21.26		Yes	Black	Average	Black	Average
TKP9	Vertical Fixed Roof Tank		18.045	7.546	6.43	5.1		No	Gray - Light	Average	Gray - Light	Average
Tar Dehydration Plant												
TKT1	Vertical Fixed Roof Tank		80	7.546	71.949	57.136		No	Black	Average	Black	Average
TKT2	Vertical Fixed Roof Tank		42.323	7.546	35.99	28.576		No	Black	Average	Black	Average
TKT3	Vertical Fixed Roof Tank		42.323	7.546	35.99	28.576		No	Black	Average	Black	Average
TKT4	Vertical Fixed Roof Tank		42.323	7.546	35.99	28.576		No	Black	Average	Black	Average
TKT5	Vertical Fixed Roof Tank		51.509	7.546	43.799	34.777		No	Black	Average	Black	Average
TKT6	Vertical Fixed Roof Tank		51.509	7.546	43.799	34.777		No	Black	Average	Black	Average

Table 4-8: Tank throughputs and VOC emissions

Tank ID	Chemical Name	Annual Stock Throughput (m^3/yr)	Annual Standing Losses (lb/yr)	Annual Working Losses (lb/yr)	Annual Total Losses (lb/yr)	Annual Total VOC emissions (tpa)
ACM						
TKACM1	Crude Tar	3	3 235.90	12 476.53	15 712.43	7.13
TKACM2	Crude Tar	4	3 235.90	12 476.53	15 712.43	7.13
TKACM3	Crude Tar	2173	3 235.90	12 476.53	15 712.43	7.13
TKACM4	Crude Tar	2173	3 235.90	12 476.53	15 712.43	7.13
TKACM5	Diesel	2173	1.61	4.16	5.77	0.003
TKACM6	Diesel	2173	2.39	4.71	7.09	0.003
ACU						
TKACU1	Crude Tar	133	2 987.21	522.23	3 509.44	1.59
TKACU2	Crude Tar	133	2 987.21	522.23	3 509.44	1.59
TKACU3	Diesel	3	1.74	0.02	1.77	0.001
TKACU4	Diesel	3	1.74	0.02	1.77	0.001
TKACU5	Diesel	3	1.74	0.02	1.77	0.001
TKACU6	Diesel	3	1.74	0.02	1.77	0.001
Paste Plant						
TKP1	Pitch	781	236.91	4 297.10	4 534.01	2.06
TKP10	Diesel	2	1.06	0.01	1.08	0.0005
TKP11	Diesel	1	0.60	0.01	0.61	0.0003
TKP2	Pitch	781	236.91	4 297.10	4 534.01	2.06
TKP3	Pitch	781	236.91	4 297.10	4 534.01	2.06
TKP4	Pitch	781	236.91	4 297.10	4 534.01	2.06
TKP5	Pitch	781	236.91	4 297.10	4 534.01	2.06
TKP6	Pitch	781	236.91	4 297.10	4 534.01	2.06
TKP7	Pitch	781	236.91	4 297.10	4 534.01	2.06
TKP8	Pitch	781	236.91	4 297.10	4 534.01	2.06
TKP9	Diesel	7	3.82	0.05	3.87	0.002
Tar Dehydration Plant						
TKT1	Crude Tar	15921	2 175.13	20 711.70	22 886.82	10.38
TKT2	Crude Tar	7961	2 020.25	10 380.90	12 401.16	5.63
TKT3	Crude Tar	7961	2 020.25	10 380.90	12 401.16	5.63
TKT4	Tar	87000	3 232.41	97 817.57	101 049.98	45.84
TKT5	Tar	5800	3 338.74	16 205.48	19 544.22	8.87
TKT6	Tar	5800	3 338.74	16 205.48	19 544.22	8.87

5 IMPACT OF ENTERPRISE ON THE RECEIVING ENVIRONMENT

5.1 Analysis of Emissions' Impact on Human Health

The current assessment investigates the impacts from the following scenarios:

- Existing licenced operations (Section 5.1.5)
- Proposed VCN Furnace (Section 5.1.6)
- Existing licenced operations and proposed VCN Furnace combined (Section 5.1.7).

5.1.1 Approach and Methodology

5.1.1.1 Atmospheric Dispersion Model Selection

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

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

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

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

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

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

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

The stochastic uncertainty includes all errors or uncertainties in data such as source variability, observed concentrations, and meteorological data. Even if the field instrument accuracy is excellent, there can still be large uncertainties due to unrepresentative placement of the instrument (or taking of a sample for analysis). Model evaluation studies suggest that the data input error term is often a major contributor to total uncertainty. Even in the best tracer studies, the source emissions are known only with an accuracy of ±5%, which translates directly into a minimum error of that magnitude in the model predictions. It is also well known that wind direction errors are the major cause of poor agreement, especially for relatively short-term predictions (minutes to hourly) and long downwind distances. All of the above factors contribute to the inaccuracies not even associated with the mathematical models themselves.

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

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

5.1.1.2 Meteorological Data Requirements

AERMOD requires two specific input files generated by the AERMET pre-processor. AERMET is designed to be run as a three-stage processor and operates on three types of data (upper air data, on-site measurements, and the national meteorological database). Meteorological data (including wind speed, wind direction and temperature) recorded at the SAWS weather station located at eMalahleni was used to generate AERMOD-ready meteorological files. The period of the meteorological data was 2022 to 2024.

5.1.1.3 Source Data Requirements

The AERMOD model is able to model point, area, volume and line sources. The atmospheric emissions of the pollutants of concern, as a result of the operations from the project, were modelled as point sources (stacks and tanks), area sources (roads and wind erosion sources) and volume sources (materials handling and screening).

5.1.1.4 Modelling Domain

The dispersion of pollutants was modelled for an area covering 6 km (north-south) by 5.7 km (east-west) centred over the facility. The modelling domain was selected on the basis of the sources of emissions and potential impact areas. This area was divided into a grid with a resolution of 50 m (north-south) by 50 m (east-west). AERMOD simulates ground-level concentrations for each of the receptor grid points. For the current study, AERMET version 23132 and AERMOD version 24142 were used.

5.1.2 *Legal Requirements*

5.1.2.1 *Atmospheric Impact Report*

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

- The AQO reasonably suspects that a person has contravened or failed to comply with the AQA or any conditions of an AEL and that detrimental effects on the environment occurred or there was a contribution to the degradation in ambient air quality.
- A review of a provisional AEL or an AEL is undertaken in terms of section 45 of the AQA.

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

5.1.2.2 *National Ambient Air Quality Standards*

NAAQS are available for $PM_{2.5}$ gazetted on 29 June 2012 (no. 35463), PM_{10}, sulfur dioxide SO_2, NO_2, O_3, CO, lead (Pb) and benzene gazetted on 24 December 2009. The NAAQS are provided in Table 5-1.

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

Substance	Molecular formula / notation	Averaging period	Concentration limit (µg/m³)	Frequency of exceedance	Compliance date
Sulfur dioxide	SO_2	10 minutes	500	526	Immediate
		1 hour	350	88	Immediate
		24 hours	125	4	Immediate
		1 year	50	-	Immediate
Nitrogen dioxide	NO_2	1 hour	200	88	Immediate
		1 year	40	-	Immediate
Particulate matter	PM_{10}	24 hour	75	4	Immediate
		1 year	40	-	Immediate
Fine particulate matter	$PM_{2.5}$	24 hour	40		Immediate
			25		1 Jan 2030
		1 year	20		Immediate
			15		1 Jan 2030
Ozone	O_3	8 hours (running)	120	11	Immediate

Substance	Molecular formula / notation	Averaging period	Concentration limit (µg/m³)	Frequency of exceedance	Compliance date
Benzene	C_6H_6	1 year	5	-	Immediate
Lead	Pb	1 year	0.5	-	Immediate
Carbon monoxide	CO	1 hour	30 000	88	Immediate
		8 hour (calculated on 1 hour averages)	10 000	11	Immediate

5.1.2.3 Screening Criteria for Non-Criteria Pollutants

The potential for health impacts associated with non-criteria pollutants are assessed according to guidelines published by the following institutions:

- World Health Organization (WHO) guideline values for non-carcinogens and unit risk factor guidelines for carcinogens,
- Chronic and sub-chronic inhalation reference concentrations (RfC) and cancer unit risk factors published by the US-EPA in its Integrated Risk Information System (IRIS),
- Reference exposure levels (RELs) published by the Californian Office of Environmental Health Hazard Assessment (OEHHA), and
- Minimal risk levels (MRLs) issued by the US Federal Agency for Toxic Substances and Disease Registry (ATSDR).
- The Texas Commission on Environmental Quality (TCEQ)

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

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

Pollutant	Averaging Period	Selected Criteria	Source
Ammonia (NH_3)	Acute (µg/m³)	1 184	ATSDR
	Chronic (µg/m³)	500	IRIS
Polyaromatic hydrocarbons (PAH)	Acute (µg/m³)	0.5	TCEQ interim guideline
	Chronic (µg/m³)	0.05	TCEQ interim guideline

5.1.2.4 International Health Criteria and Unit Risk Factors for Volatile Organic Compounds (VOCs)

Volatile Organic Compounds are a class of several hundred carbon-based chemical compounds that evaporate easily into the air. The sources of VOCs include fuel additives, fuel evaporation, and incomplete combustion. Some VOCs have little or no known direct human health effects, while others are extremely toxic and/or carcinogenic. Very little is known about how various VOCs combine in the atmosphere or in the human body, or what the cumulative impacts of exposure might be.

As the term VOC refers to a group of pollutants, generally guidelines are not available for comparison to determine the health impacts due to exposure to these pollutants. To estimate the probable health impacts a breakdown of the types of pollutants, which dominate in a specific area is required, whereby their respective toxicities can be determined.

Although standards for exposure to VOCs in non-industrial settings do not exist, a number of exposure limits have been recommended. The European Collaborative Action (ECA) Report No. 11 titled Guidelines for Ventilation Requirements in Buildings (European Concerted Action, 1992) lists the following Total VOC (TVOC) concentration ranges as measured with a flame ionisation detector calibrated to toluene. These recommendations are based on Mølhave's toxicological work on mucous membrane irritation (Mølhave, 1990).

Comfort range:	<200 µg/m³
Multifactoral exposure range:	200 to 3 000 µg/m³
Discomfort range:	3 000 to 25 000 µg/m³
Toxic range:	>25 000 µg/m³

The same European report also lists a second method based on Seifert's work (Seifert, 1990). This method established TVOC guidelines based on the ten most prevalent compounds in each of seven chemical classes. The concentrations in each of these classes should be below the maximums listed below.

Alkanes:	100 µg/m³.
Aromatic hydrocarbons:	50 µg/m³.
Terpenes:	30 µg/m³.
Halocarbons:	30 µg/m³.
Esters:	20 µg/m³.
Aldehydes and ketones (excluding formaldehyde):	20 µg/m³.
Other:	50 µg/m³.

The VOC concentration is calculated by adding the totals from each class. Seifert gives a target TVOC concentration of 300 µg/m³, which is the sum of the above-listed target concentrations. The author also states that no individual compound concentration should exceed 50% of the guideline for its class or 10 percent of the TVOC guideline concentration. However, Seifert states that *"…the proposed target value is not based on toxicological considerations but – to the author's best judgment."*

The 1-year (annual average) inhalation criteria selected for this study is 200 µg/m³. It should be noted that this screening criteria is only a guideline and not a legal requirement.

5.1.2.5 Listed Activities and Minimum Emission Standards for the Proposed VCN Furnace

The proposed VCN Furnace is a Listed Activity under Section 21 of the Air Quality Act (AQA) and requires an AEL to operate. The proposed VCN Furnace will be required to comply with the new plant Minimum Emission Standards (MES). The applicable listed activity is Subcategory 4.1 (Drying and Calcining) and Subsection 4-18 (Vanadium Ore Processing) summarised in Table 5-3 and Table 5-4 respectively.

Table 5-3: Listed Activity Subcategory 4.1

Subcategory 4.1 – Drying and Calcining			
Description:	Drying and calcining of mineral solids including ore.		
Application:	Facilities with capacity of more than 100 tons/month product.		
Substance or Mixture of Substances		**Plant Status**	**mg/Nm³ under normal conditions of 273 Kelvin and 101.3 kPa**
Common Name	**Chemical Symbol**		
Particulate matter	PM	New	50
Sulfur dioxide	SO_2		1 000
Oxides of nitrogen	NO_X, expressed as NO_2		400

Table 5-4: Listed Activity Subcategory 4.18

Subcategory 4.18 – Vanadium Ore Processing			
Description:	The processing of vanadium-bearing ore or slag for the production of vanadium oxides or vanadium carbide by the application of heat.		
Application:	All installations		
Substance or Mixture of Substances		**Plant Status**	**mg/Nm³ under normal conditions of 273 Kelvin and 101.3 kPa**
Common Name	**Chemical Symbol**		
Particulate matter	PM	New	50
Sulfur dioxide	SO_2		1 200

Ammonia	NH_3		30

5.1.2.6 Regulations Regarding Air Dispersion Modelling

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

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

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

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

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

- Apportionment of individual sources for installations with multiple sources. In this way, the individual contribution of each source to the maximum ambient predicted concentration can be determined. This may be extended to the study of cumulative impact assessments where modelling can be used to model numerous installations and to investigate the impact of individual installations and sources on the maximum ambient pollutant concentrations.

- Analysis of ground level concentration changes as a result of different release conditions (e.g. by changing stack heights, diameters and operating conditions such as exit gas velocity and temperatures).
- Assessment of variable emissions as a result of process variations, start-up, shut-down or abnormal operations.
- Specification and planning of ambient air monitoring programs which, in addition to the location of sensitive receptors, are often based on the prediction of air quality hotspots.

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

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

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

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

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

Chapter 5 provides general guidance on geophysical data, model domain and coordinates system required in dispersion modelling, whereas Chapter 6 elaborates more on these parameters as well as the inclusion of background air concentration data. The chapter also provides guidance on the treatment of NO_2 formation from NO_x emissions, chemical transformation of sulfur dioxide into sulfates and deposition processes.

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

5.1.2.7 Highveld Priority Area

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

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

- **Goal 1:** By 2015, organisational capacity in government is optimised to efficiently and effectively maintain, monitor and enforce compliance with ambient air quality standards.
- **Goal 2:** By 2020, industrial emissions are equitably reduced to achieve compliance with ambient air quality standards and dust fall-out limit values.
- **Goal 3:** By 2020, air quality in all low-income settlements is in full compliance with ambient air quality standards.
- **Goal 4:** By 2020, all vehicles comply with the requirements of the National Vehicle Emission Strategy.
- **Goal 5:** By 2020, a measurable increase in awareness and knowledge of air quality exists.
- **Goal 6:** By 2020, biomass burning and agricultural emissions will be 30% less than current.
- **Goal 7:** By 2020, emissions from waste management are 40% less than current.

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

Table 5-5: Emission reduction activities for industrial sources

Objectives	Key Activities/ Opportunities	Responsibility
Reduce emissions from industries	Compliance with the minimum emission standards and other atmospheric emission licence conditions.	Identified stakeholders in regulation 3(2)(a) and 3(2)(b).

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

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

5.1.3 Atmospheric Dispersion Potential

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

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

Since no weather measurements are available from the site, meteorological information was obtained from the nearest South African Weather Services weather station. The station is located ~3.5 km to the northeast of the VCN Furnace. The following summary is based on the period 2022 to 2024.

5.1.3.1 Local Wind Field

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

The wind roses comprise 16 spokes, which represent the directions from which winds blew during a specific period. The colours used in the wind roses below, reflect the different categories of wind speeds; the yellow area, for example, representing winds in between 4 and 5 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The frequency with which calms occurred, i.e. periods during which the wind speed was below 1 m/s are also indicated.

The period wind field and diurnal variability in the wind field are shown in Figure 5-1. During the 2022 to 2024 period, the wind field was dominated by winds from the north and east, with less frequent winds from the southwestern sector. During the day, the prevailing wind direction is from the north and from the east during night-time.

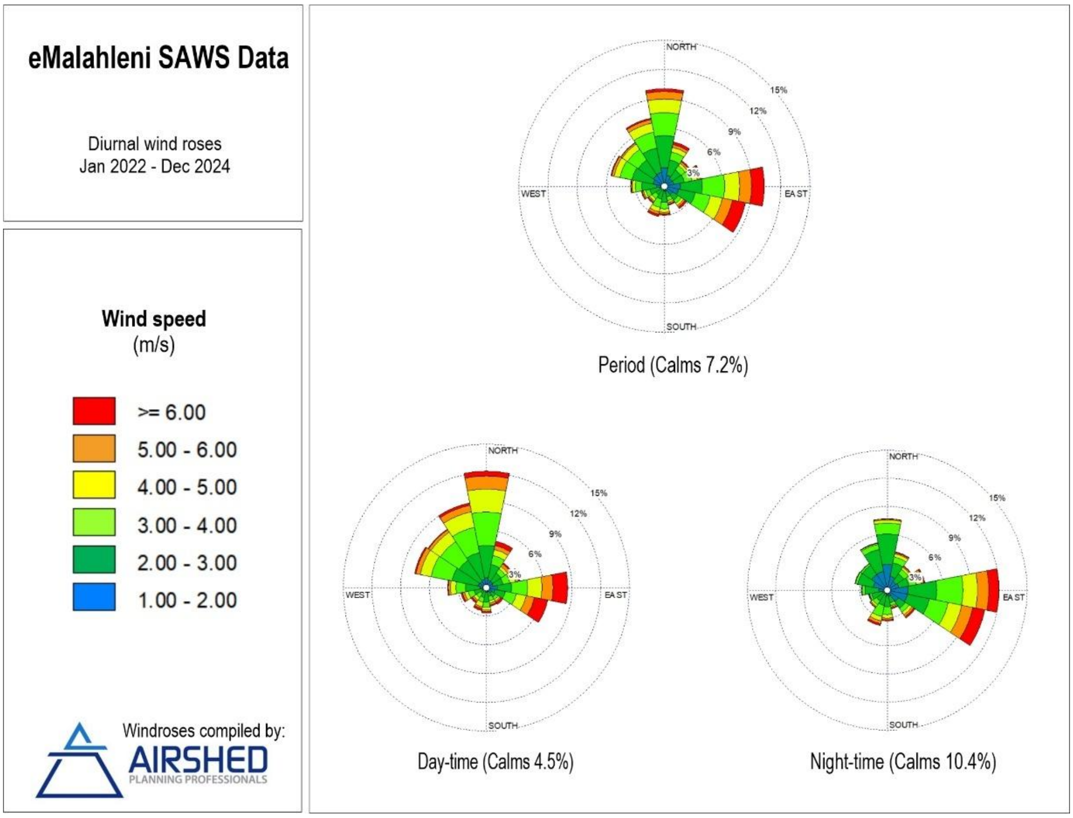


Figure 5-1: Period, day-, and night-time wind roses (eMalahleni SAWS station, January 2022 to December 2024)

5.1.3.2 Ambient Temperature

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

Monthly mean, maximum and minimum temperatures are given in

. Diurnal temperature variability is presented in Figure 5-2. Average monthly temperatures ranged between 13°C in July and 23.5°C in December. During the day, temperatures increase to reach maximum at around 15:00 in the afternoon. Ambient air temperature decreases to reach a minimum at around 06:00 i.e. just before sunrise.

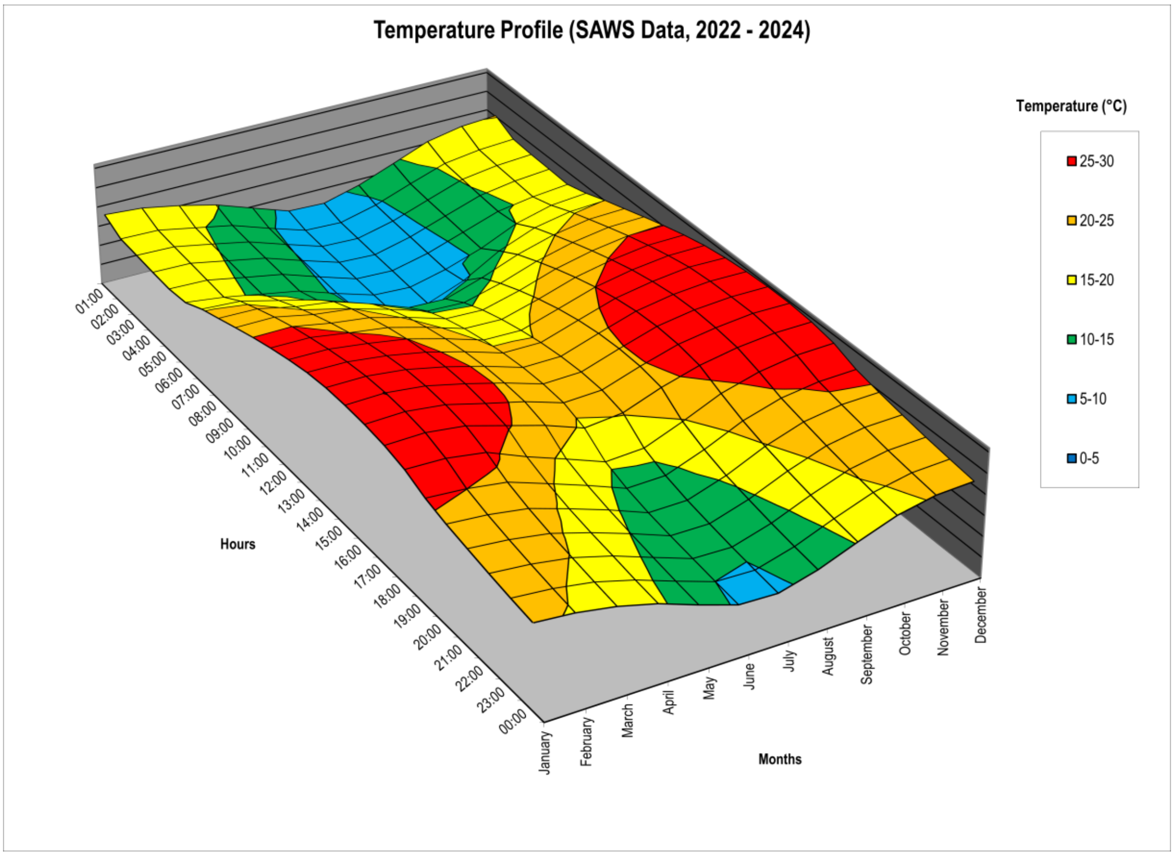


Figure 5-2: Diurnal temperature profile (eMalahleni SAWS data, January 2022 to December 2024)

Table 5-6: Monthly temperature summary (eMalahleni SAWS data, January 2022 to December 2024)

Monthly Minimum, Maximum and Average Temperatures (°C)												
Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Minimum	16.6	16.0	14.2	12.5	9.3	6.2	5.6	8.0	11.0	14.4	15.8	16.7
Average	23.4	23.0	21.5	19.3	16.3	13.2	13.0	15.8	19.2	21.8	23.2	23.5
Maximum	29.8	30.0	29.0	26.8	24.3	21.4	21.6	24.7	27.5	29.0	29.6	29.6

5.1.3.3 Atmospheric Stability and Mixing Depth

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

The mixed layer ranges in depth from a few metres (i.e. stable or neutral layers) during night times, to the base of the lowest-level elevated inversion during unstable, daytime conditions. Elevated inversions may occur for a variety of reasons and on some occasions as many as five may occur in the first 1 000 m above the surface.

Atmospheric stability is frequently categorised into one of six stability classes – these are briefly described in Table 5-7. The most commonly occurring stability class calculated the site is Class C and F, representing Unstable and Very Stable conditions respectively. For elevated releases (e.g. from the plant stack), the highest GLCs would occur during unstable, daytime conditions. For low level releases, such as vehicle and materials handling activities, the highest GLCs would occur during weak wind speeds and stable (night-time) atmospheric conditions. Windblown dust is likely to occur under high winds (neutral conditions).

Table 5-7: Atmospheric stability classes

Stability Class	Stability	Description of Conditions
A	Very unstable	calm wind, clear skies, hot daytime conditions
B	Moderately unstable	clear skies, daytime conditions
C	Unstable	moderate wind, slightly overcast daytime conditions

Stability Class	Stability	Description of Conditions
D	Neutral	high winds or cloudy days and nights
E	Stable	moderate wind, slightly overcast night-time conditions
F	very stable	low winds, clear skies, cold night-time conditions

Diurnal variation in atmospheric stability, as calculated from the eMalahleni SAWS data for the period 2022 to 2024, and described by the inverse Monin-Obukhov length and the boundary layer depth is provided in Figure 5-3. The highest concentrations for ground level, or near-ground level releases from non-wind dependent sources would occur during weak wind speeds and stable (night-time) atmospheric conditions. For elevated releases, unstable conditions can result in very high concentrations of poorly diluted emissions close to the stack. This is called looping and occurs mostly during daytime hours. Neutral conditions disperse the plume fairly equally in both the vertical and horizontal planes and the plume shape is referred to as coning. Stable conditions prevent the plume from mixing vertically, although it can still spread horizontally and is called fanning (Tiwary & Colls, 2010). For ground level releases such as fugitive dust the highest ground level concentrations will occur during stable night-time conditions.

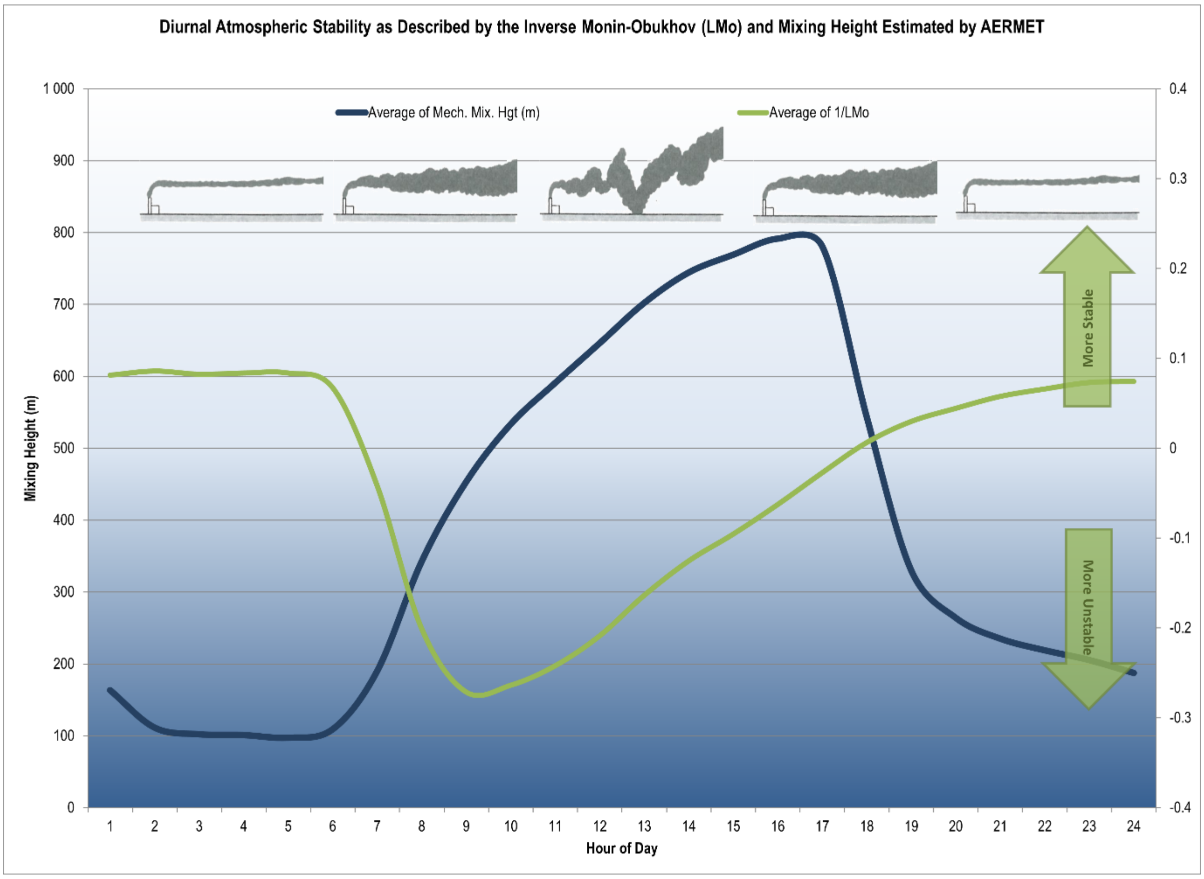


Figure 5-3: Diurnal atmospheric stability (eMalahleni SAWS data, January 2022 to December 2024)

5.1.4 Measured Baseline Ambient Air Quality

Ambient Air Quality Monitoring Stations (AQMS) within the study area include the eMalahleni AQMS managed by the SAWS (~2 km southeast of the VCN Furnace) (location of the AQMS is provided in Figure 1-3).

A summary of the measured ambient air quality data (as downloaded from the SAAQIS website in January 2026) for the period 2023-2025 from the eMalahleni AQMS is provided in Table 5-8. Data availability for the pollutants measured at eMalahleni AQMS was very poor with no ambient measurements available for 2025.

Table 5-8: Summary of the ambient measurements at the AQMS within the study area for the period 2023-2025(a)(b)

Year	Data Availability	Hourly			Daily			Annual Average	No of recorded hourly exceedances	No of recorded daily exceedances
		Maximum	99th Percentile	50th Percentile	Maximum	99th Percentile	50th Percentile			
SO_2 (µg/m³)										
Criteria		*350 µg/m³*			*125 µg/m³*			*50 µg/m³*	*88 hours per year*	*4 days per year*
2023	72%	959.6	200.9	14.5	167.6	113.6	21.7	28.9	20	2
2024	10%	429.4	188.6	19.5	96.9	91.0	28.4	31.8	2	0
2025	0%									
NO_2 (µg/m³)										
Criteria		*200 µg/m³*						*50 µg/m³*	*88 hours per year*	
2023	63%	128.6	90.9	17.0				23.8	0	
2024	10%	111.2	89.1	16.9				23.7	0	
2025	0%									
PM_{10} (µg/m³)										
Criteria					*75 µg/m³*			*40 µg/m³*		*4 days per year*
2023	65%				155.1	131.7	39.3	**48.1**		**71**
2024	11%				43.5	43.4	22.0	26.0		0
2025	0%									
$PM_{2.5}$ (µg/m³)										
Criteria					*40 µg/m³*			*20 µg/m³*		*4 days per year*
2023	60%				84.8	61.9	20.6	**23.4**		**48**
2024	11%				30.1	29.0	12.1	13.1		0
2025	0%									

Notes:
(a) Red text denotes less than 80% data availability
(b) Bold text denotes exceedance of the NAAQS

5.1.5 *Impacts due to Existing Licensed Operations at the Facility*

5.1.5.1 *Emissions Inventory*

The source parameters used for the current assessment are summarised in Section 4.

It should be noted that the existing licensed operations have a range in temperature. To model these sources, the average temperatures as obtained from the latest stack measurements (where available) were used. These temperatures are summarised in Table 5-9.

Table 5-9: Stack temperatures used for dispersion modelling purposes (averages as obtained from stack measurements)

Stacks	Average temperature (°C)	Data origin
ACU		
ACU Retort 1 Stack	537	Assumed to be similar to ACM
ACU Retort 2 Stack	537	
ACU Retort 3 Stack	537	
ACU Retort 4 Stack	537	
ACU Retort 5 Stack	537	
ACU Retort 6 Stack	537	
ACM		
ACM Retort 1 Stack	537	Based on average stack measurements for the period 2022-2024
ACM Retort 2 Stack	537	
ACM Retort 3 Stack	537	
ACM Retort 4 Stack	537	
ACM Retort 5 Stack	537	
ACM Retort 6 Stack	537	
Paste Plant		
Furnace 1 - Stack 1	139	Based on average stack measurements for the period 2022-2025
Furnace 1 - Stack 2	91	
Furnace 2 - Stack 1	186	
Furnace 2 - Stack 2	96	
Furnace 3 - Stack 1	169	
Furnace 3 - Stack 2	106	
Furnace 4 - Stack 1	98	
Furnace 4 - Stack 2	117	
Furnace 5 - Stack 1	219	
Furnace 5 - Stack 2	59	
Tar Dehydration Plant		
Boiler	149	Based on average stack measurements for the period 2021-2023

5.1.5.2 *Simulated Impact Assessment*

The dispersion modelling plots included in this section is summarised in Table 5-10. A summary of the potential exceedances of NAAQS and health effect screening levels at potential sensitive receptors within the study area due to existing licensed operations at the facility is provided in Table 5-11.

Table 5-10: Summary of the plots included in this section for the impacts due to existing licensed operations at the facility

Pollutant	Averaging Period	NAAQS/ International health effect screening level (µg/m³)	Figure
PM_{10}	Daily	75 (99th percentile)	5-4 and 5-5
	Annual	40	5-6 and 5-7
$PM_{2.5}$	Daily	40 (99th percentile) - currently applicable; 25 (99th percentile) - applicable in 2030	5-8 and 5-9
	Annual	20 - currently applicable; 15 - applicable in 2030	5-10 and 5-11
VOC	Annual	200	5-12
Benzene	Annual	5	5-13
PAH	Hourly	0.5	5-14
	Annual	0.05	5-15

The simulated PM_{10} and $PM_{2.5}$ ground level concentrations for highest daily (99th percentile) and annual averaging periods, does not exceed the NAAQS at any identified off-site sensitive receptor. The PM_{10} and $PM_{2.5}$ ground level concentrations are similar in magnitude and special distribution for unmitigated and mitigated operations (assuming 75% control efficiency on unpaved road surfaces).

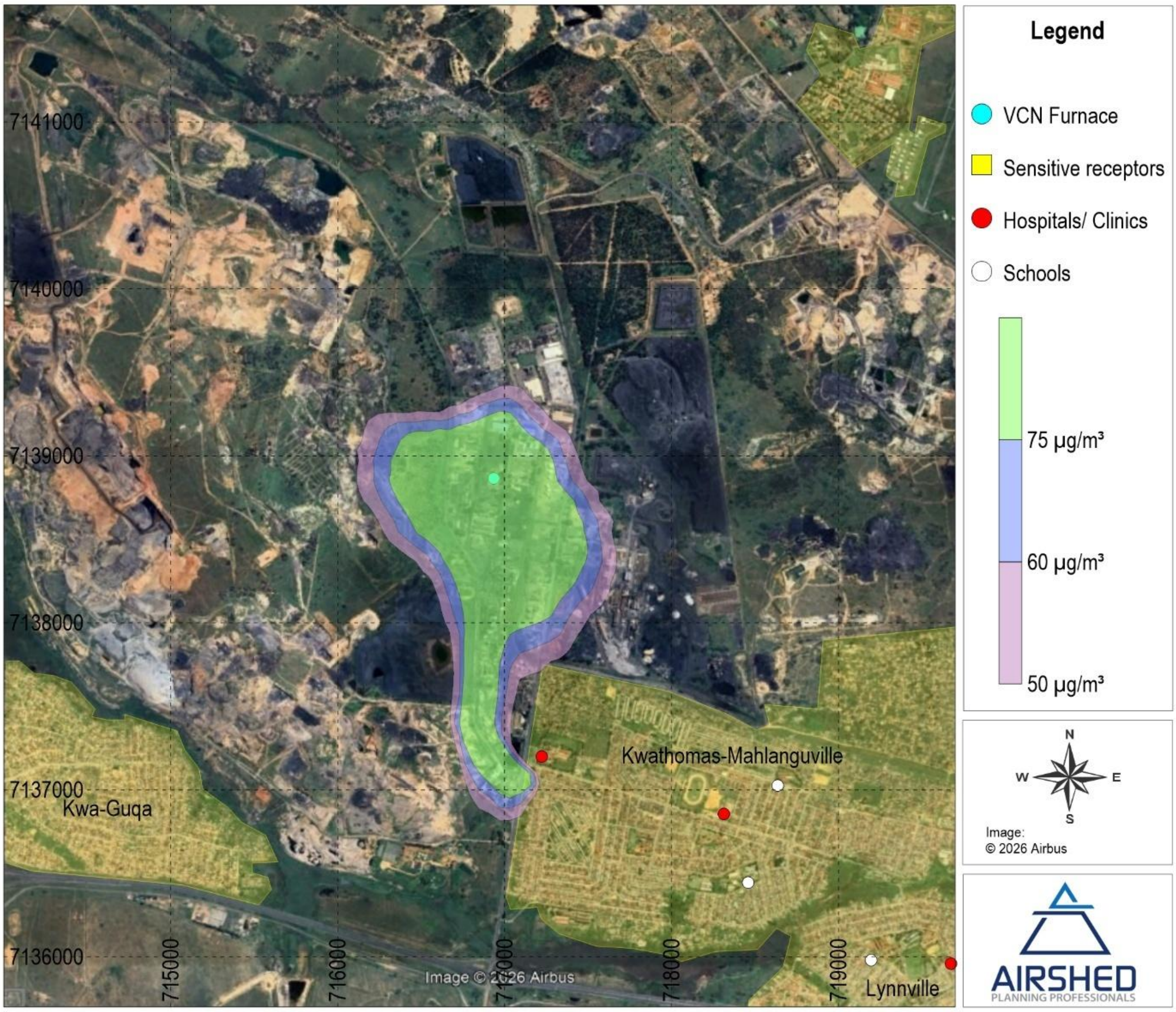
The annual VOC ground level concentrations (maximum within the study area: 128 µg/m³) are well below the inhalation screening criteria of 200 µg/m³.

The annual benzene ground level concentrations are below the NAAQS of 5 µg/m³ at all potential sensitive receptors within the study area.

The acute and chronic polyaromatic hydrocarbons (PAH) ground level concentrations are well below the inhalation screening criteria at all potential sensitive receptors within the study area.

Table 5-11: A summary of the potential exceedances of NAAQS and health effect screening levels at potential sensitive receptors within the study area due to existing licensed operations at the facility

Pollutant	Averaging Period	NAAQS/ International health effect screening level (µg/m³)	Exceeding NAAQS/ International health effect screening levels									
			AQMS	Residential areas			Hospitals/ Clinics			Schools		
			eMalahleni - SAWS	Kwa-Guqa	Kwathomas Mahlanguville	Residential area to the NE of VCN Furnace	Witbank Specialised TB Hospital-ER	Ackerville Clinic	Lynville Clinic	Khonzimfundo Primary School	Maloma Primary School	Elukhanyisweni Secondary School
PM_{10}	Daily	75 (99th percentile)	×	×	×	×	×	×	×	×	×	×
	Annual	40	×	×	×	×	×	×	×	×	×	×
$PM_{2.5}$	Daily	40 (99th percentile) - currently applicable; 25 (99th percentile) - applicable in 2030	×	×	×	×	×	×	×	×	×	×
	Annual	20 (currently applicable); 15 (applicable in 2030)	×	×	×	×	×	×	×	×	×	×
VOC	Annual	200	×	×	×	×	×	×	×	×	×	×
Benzene	Annual	5	×	×	×	×	×	×	×	×	×	×
PAH	Hourly	0.5	×	×	×	×	×	×	×	×	×	×
	Annual	0.05	×	×	×	×	×	×	×	×	×	×



VCN Furnace Project

Highest daily (99th percentile) PM_{10} ground level concentrations (µg/m³)

No mitigation on the unpaved onsite roads

Figure 5-4: Highest daily (99th percentile) PM_{10} ground level concentrations due to existing licensed operations

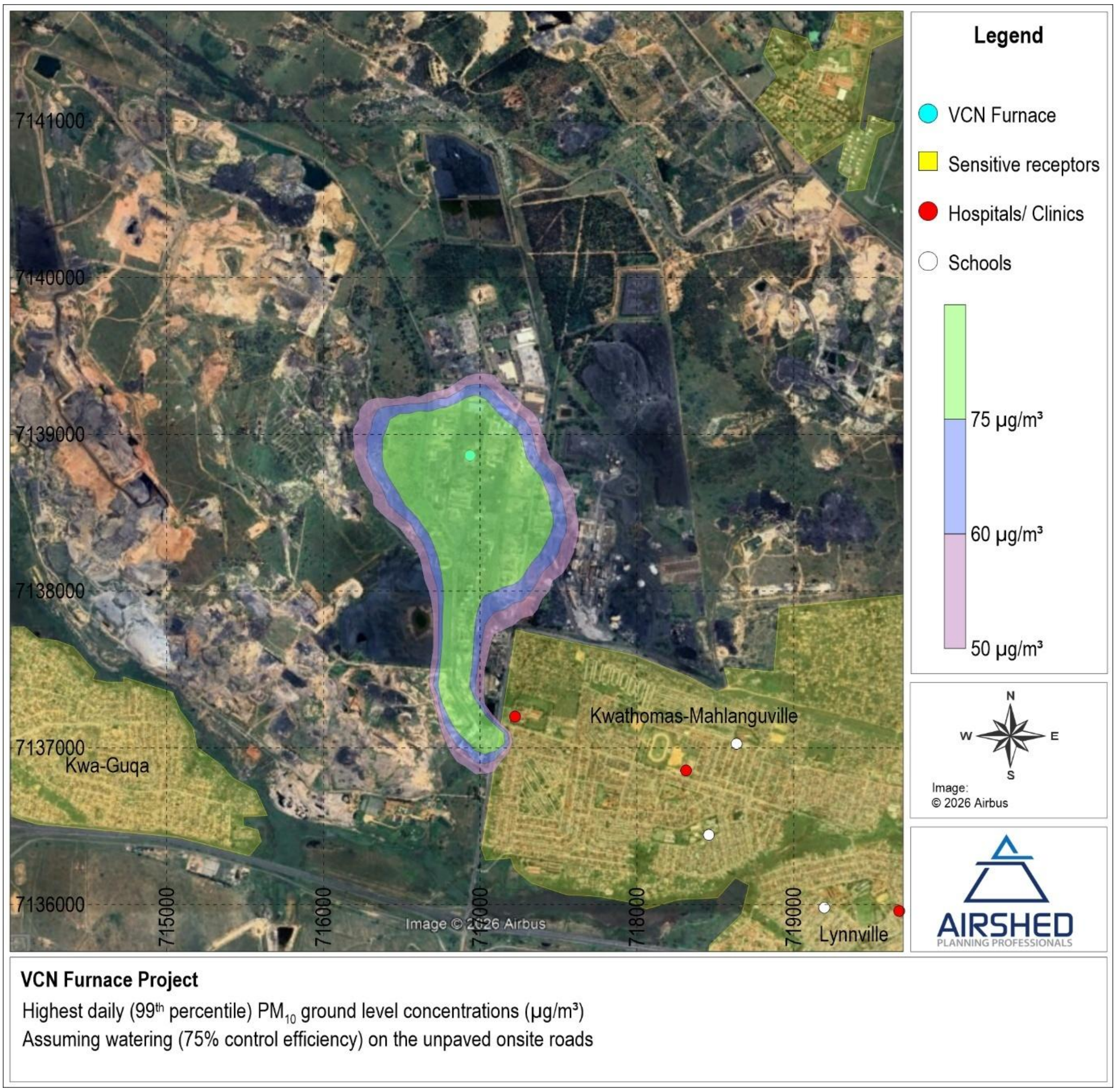


Figure 5-5: Highest daily (99th percentile) PM_{10} ground level concentrations due to existing licensed operations (assuming 75% CE on unpaved road surfaces)

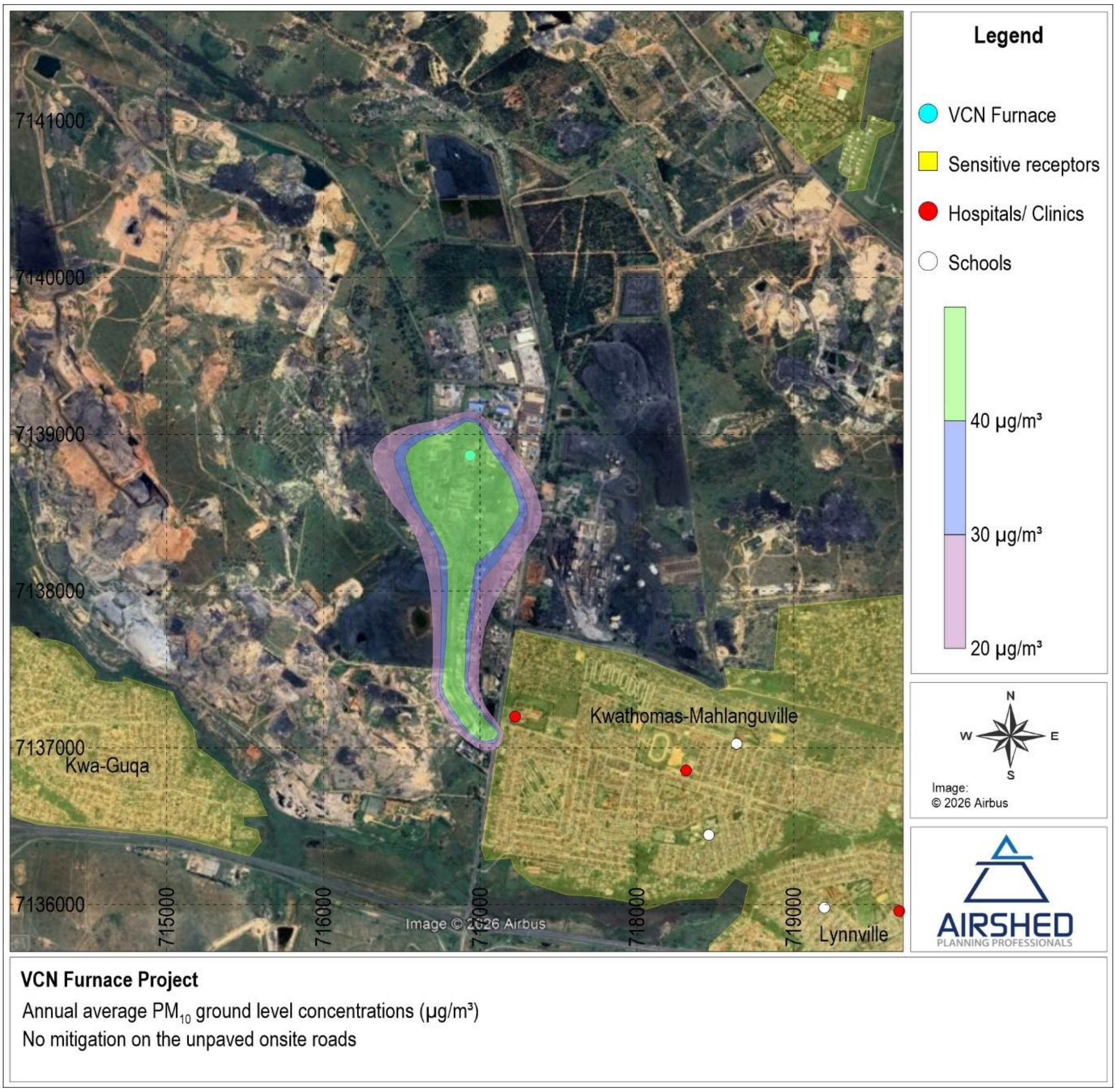


Figure 5-6: Annual average PM_{10} ground level concentrations due to existing licensed operations

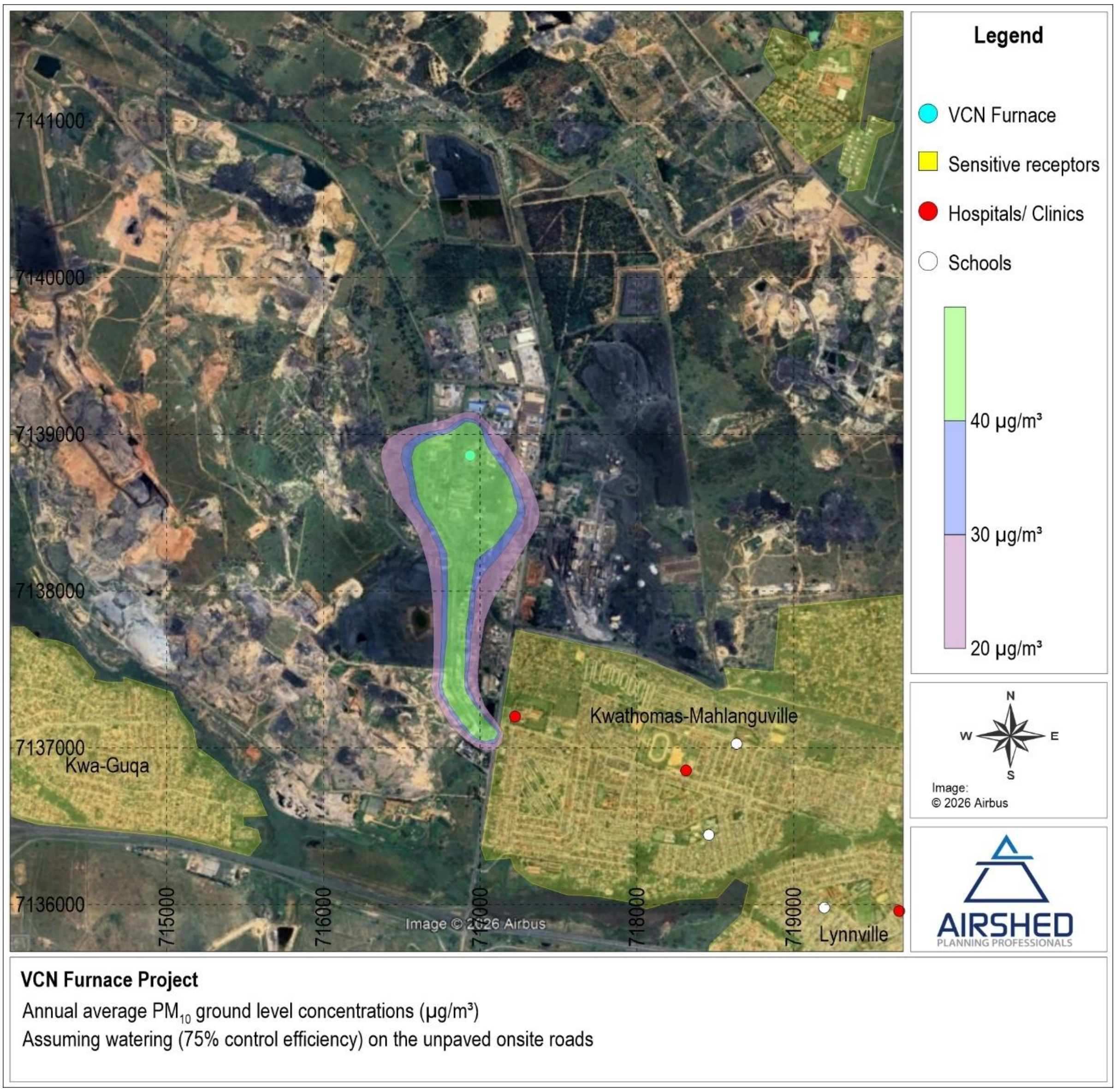


Figure 5-7: Annual average PM_{10} ground level concentrations due to existing licensed operations (assuming 75% CE on unpaved road surfaces)

VCN Furnace Project
Highest daily (99th percentile) $PM_{2.5}$ ground level concentrations (µg/m³)
No mitigation on the unpaved onsite roads

Figure 5-8: Highest daily (99th percentile) $PM_{2.5}$ ground level concentrations due to existing licensed operations

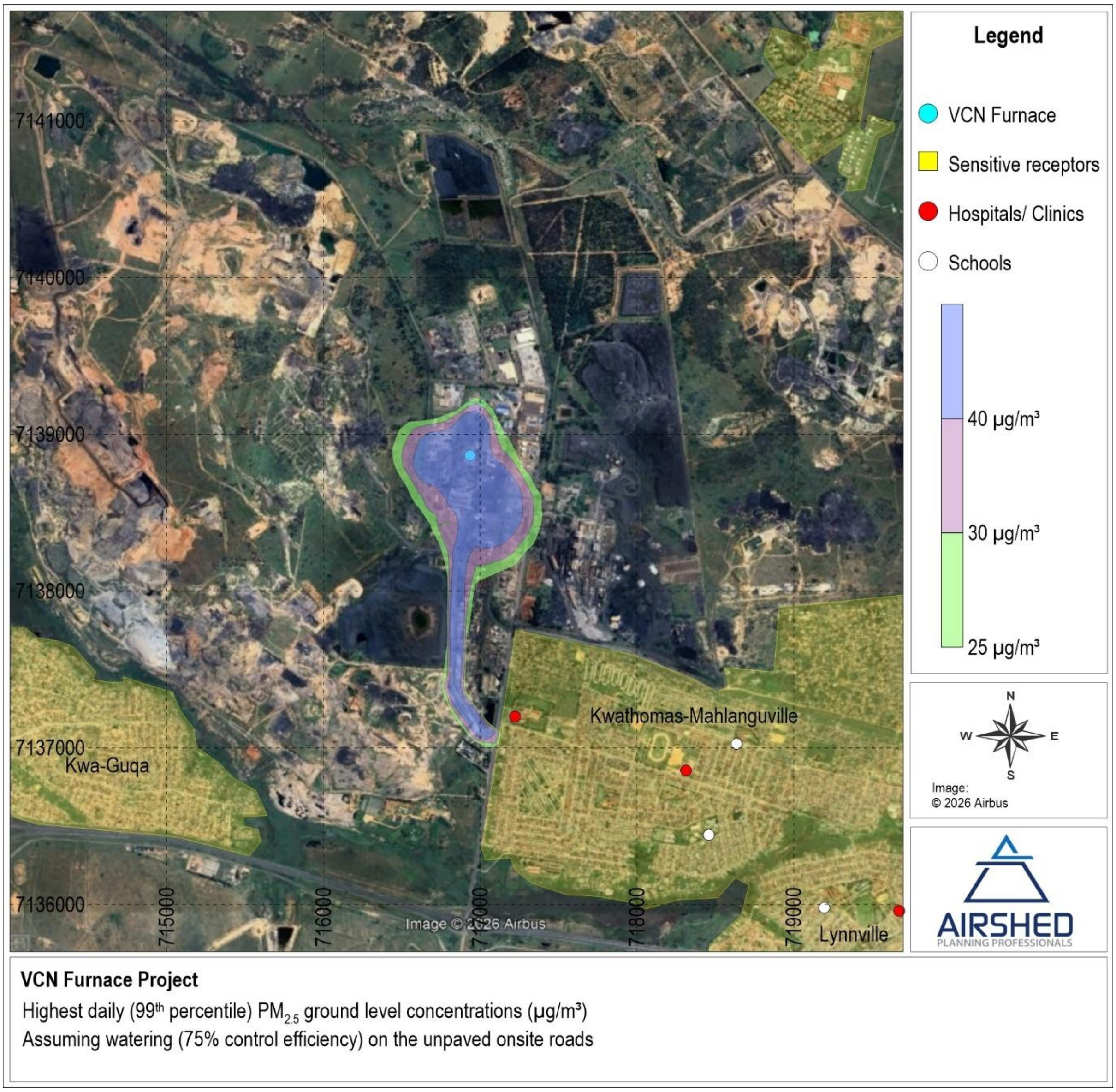


Figure 5-9: Highest daily (99th percentile) $PM_{2.5}$ ground level concentrations due to existing licensed operations (assuming 75% CE on unpaved road surfaces)

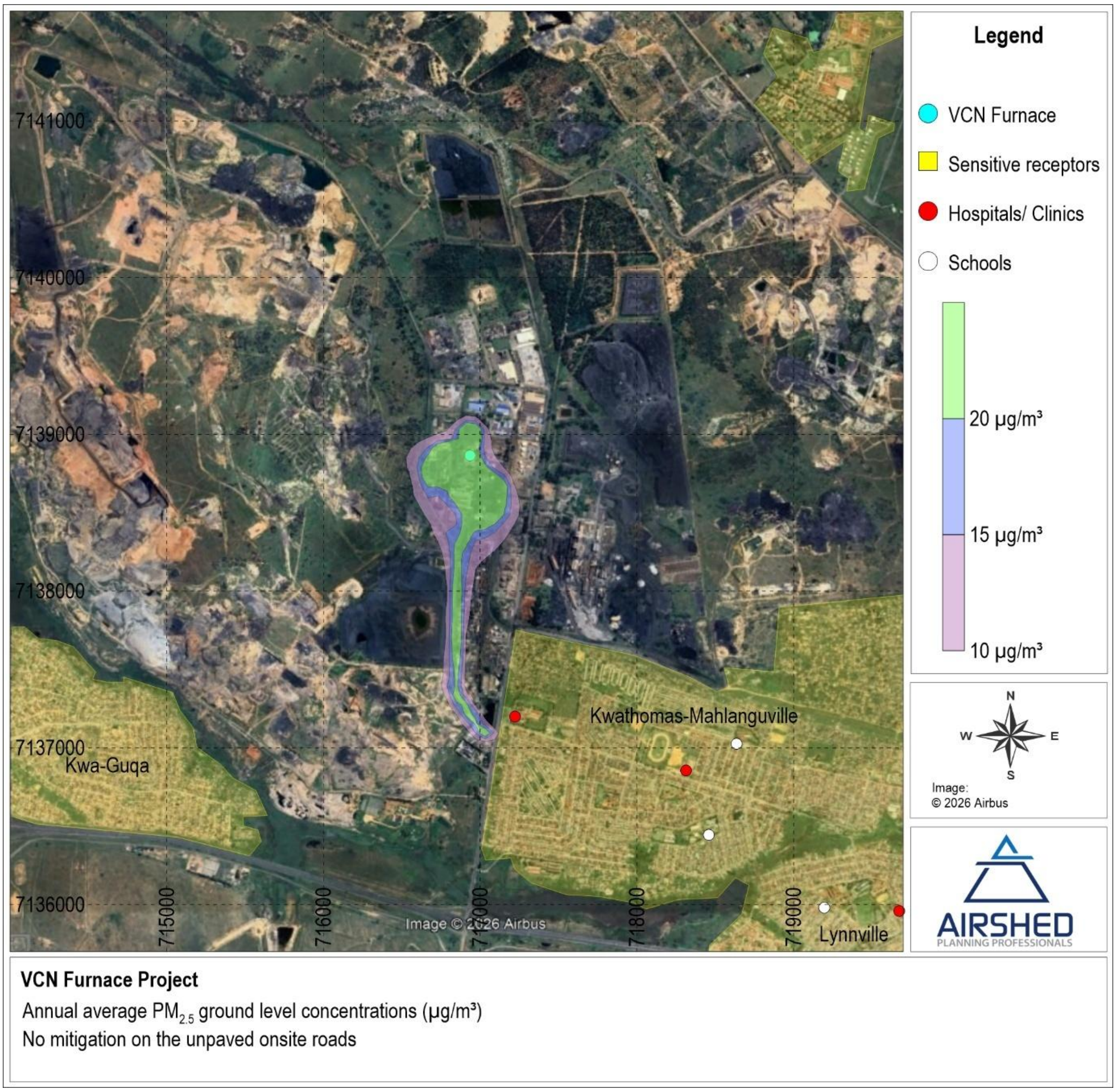


Figure 5-10: Annual average $PM_{2.5}$ ground level concentrations due to existing licensed operations

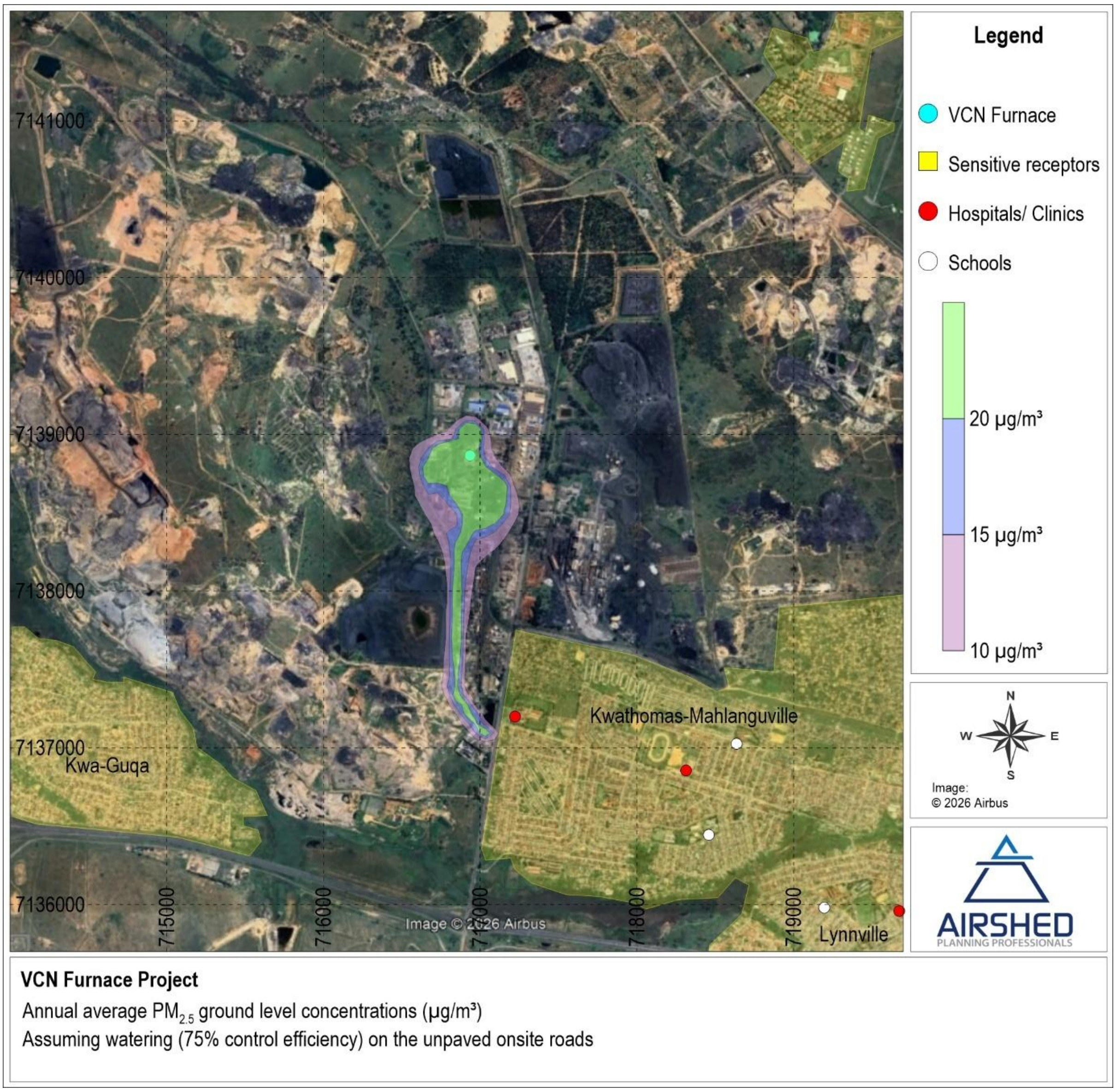


Figure 5-11: Annual average $PM_{2.5}$ ground level concentrations due to existing licensed operations (assuming 75% CE on unpaved road surfaces)

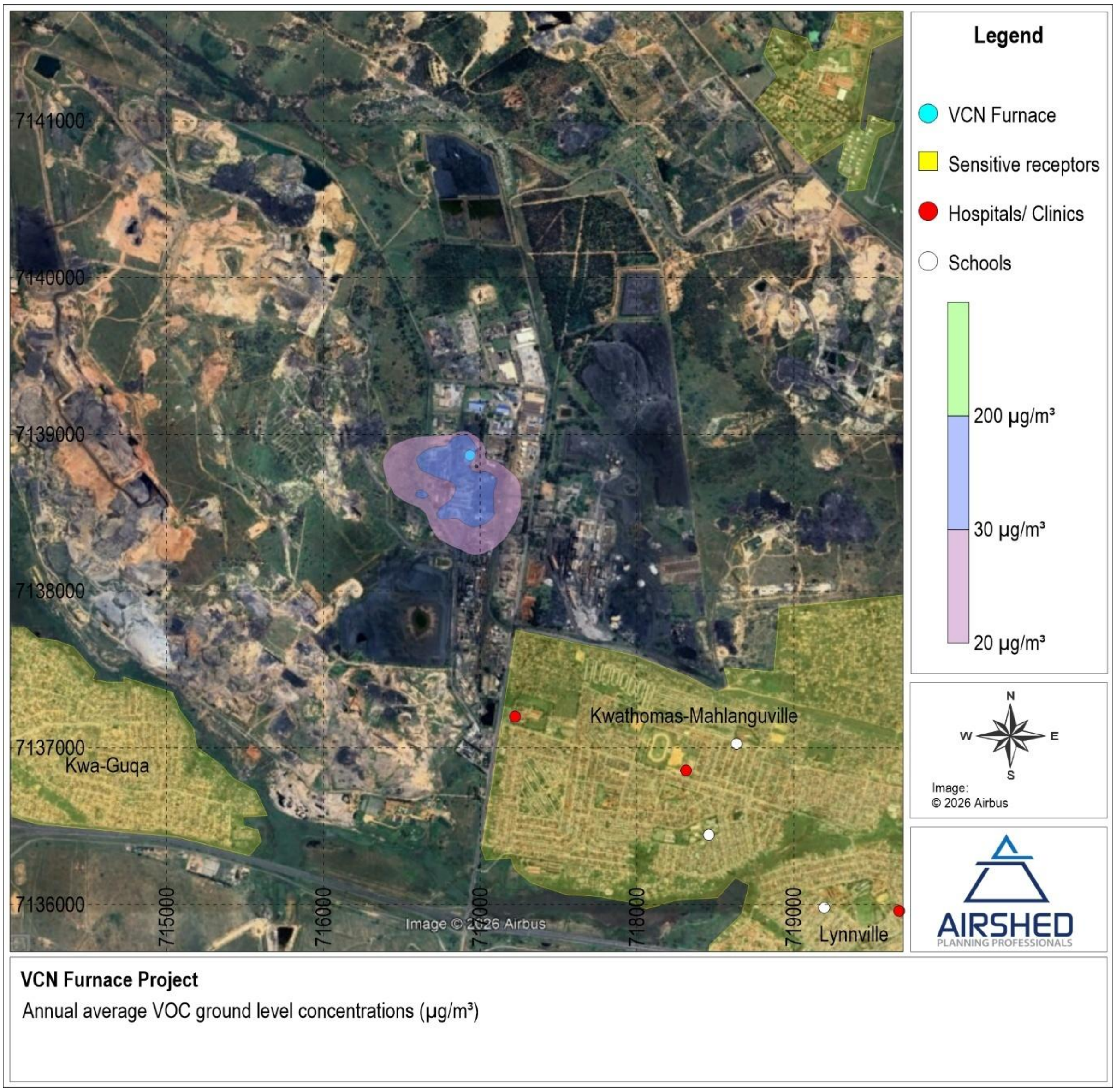
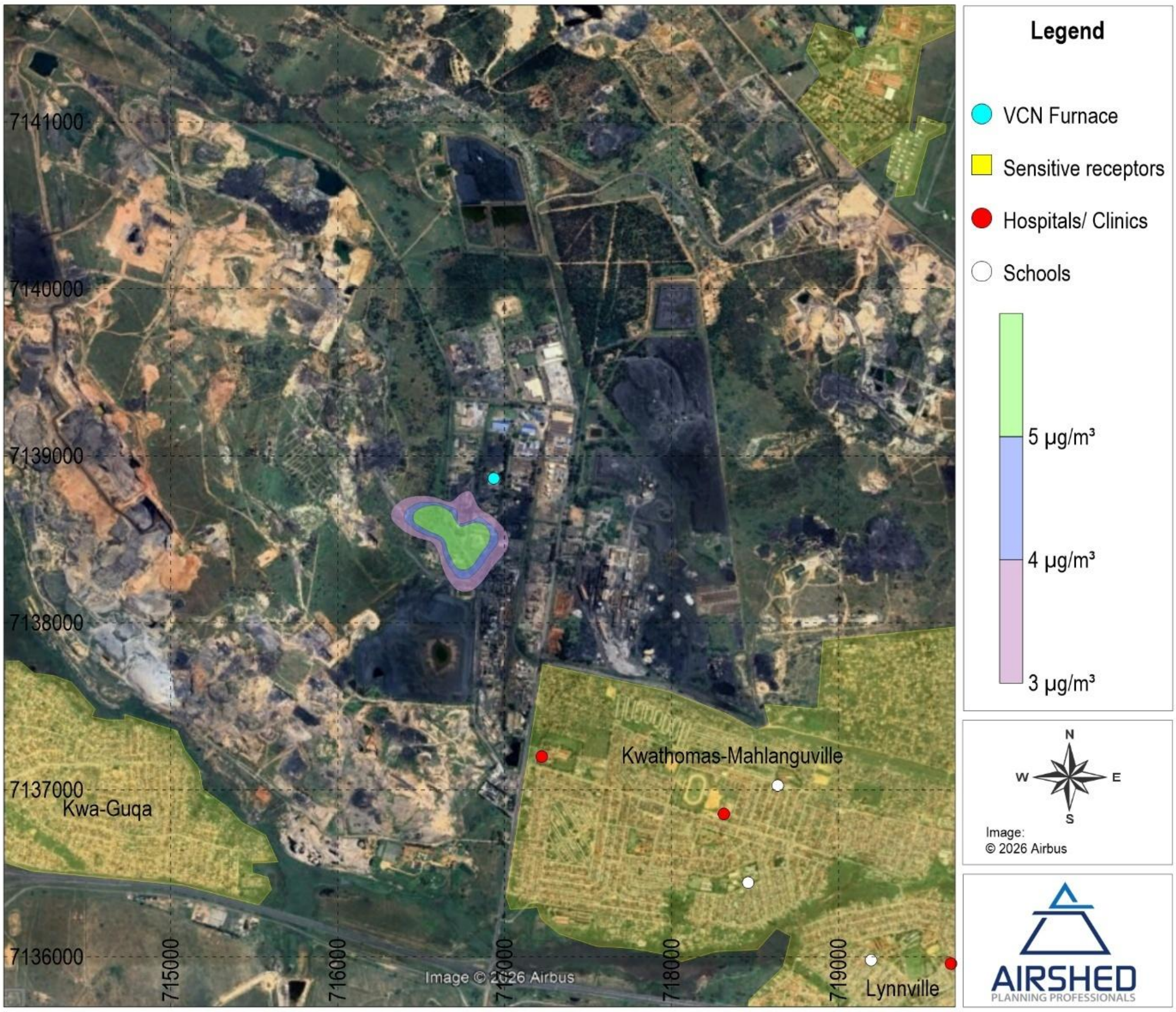


Figure 5-12: Annual average VOC ground level concentrations due to existing licensed operations



VCN Furnace Project

Annual average Benzene ground level concentrations (µg/m³) from the storage tanks

Figure 5-13: Annual average benzene ground level concentrations due to existing licensed operations

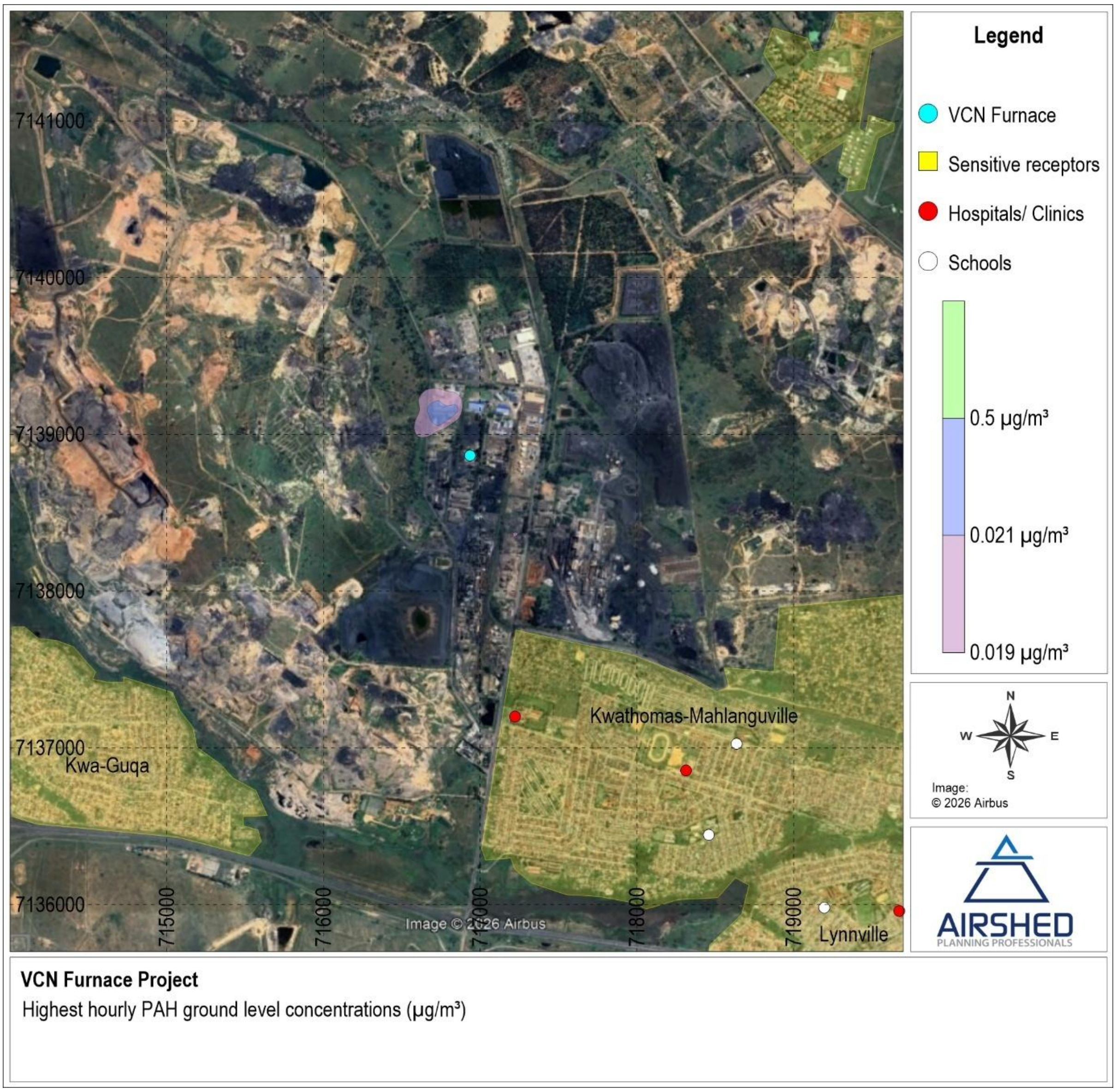


Figure 5-14: Acute PAH ground level concentrations due to existing licensed operations

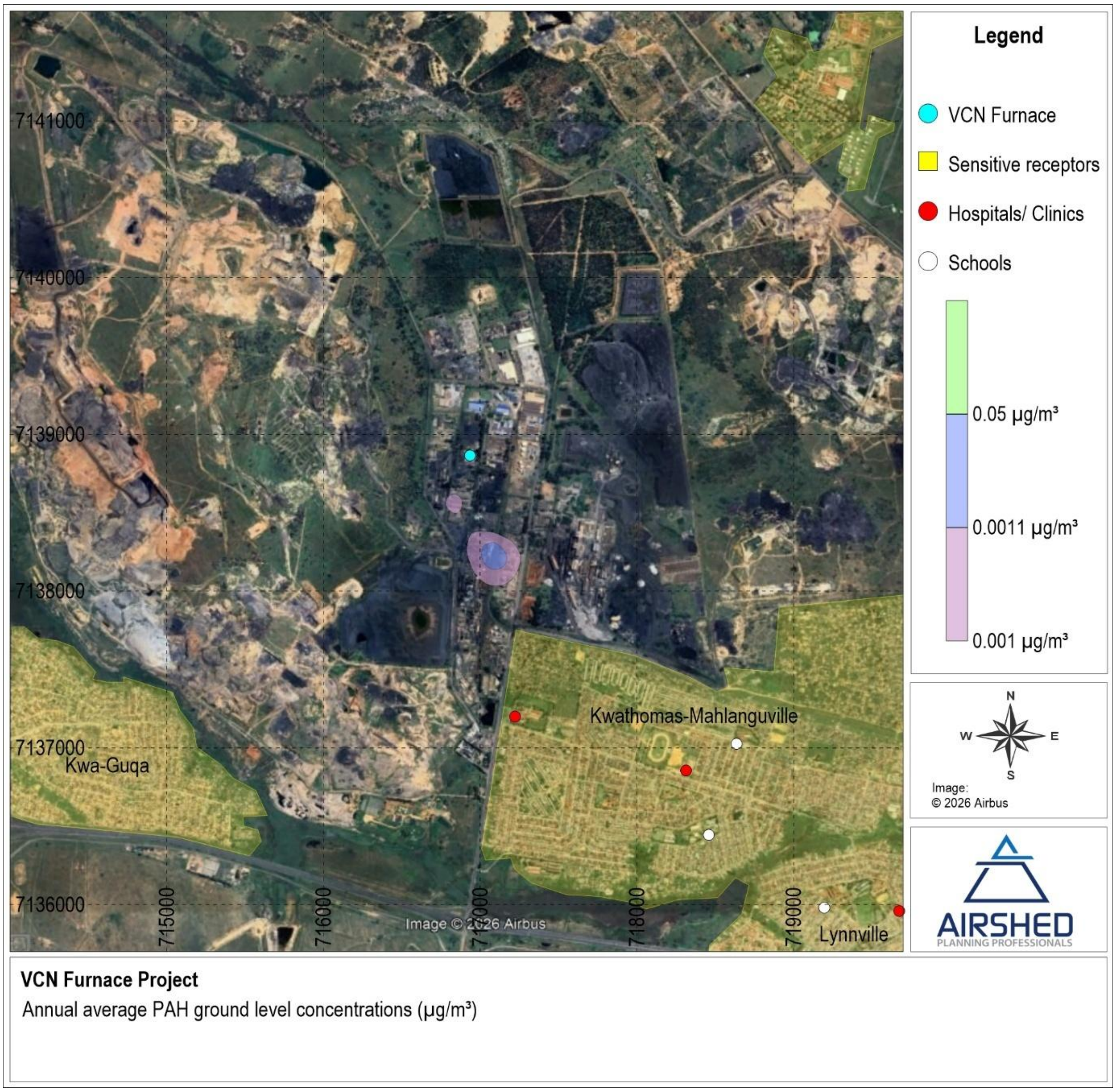


Figure 5-15: Chronic PAH benzene ground level concentrations due to existing licensed operations

5.1.6 Impacts due to Proposed VCN Furnace Operations

At the time of this assessment, the existing licensed operations were under care and maintenance. This, however, may change going forward. The impacts of the proposed VCN Furnace were assessed in isolation from the existing activities. The impacts discussed in this section focus solely on the operation of the VCN Furnace.

The dispersion modelling plots included in this section are summarised in Table 5-12. A summary of the potential exceedances of NAAQS and health effect screening levels at potential sensitive receptors within the study area due to VCN Furnace operations only is provided in Table 5-13.

Table 5-12: Summary of the plots included in this section for the VCN Furnace operation

Pollutant	Averaging Period	NAAQS/ International health effect screening level (µg/m³)	Figure
PM_{10}	Daily	75 (99th percentile)	5-16
	Annual	40	5-17
$PM_{2.5}$	Daily	40 (99th percentile) - currently applicable; 25 (99th percentile) - applicable in 2030	5-18
	Annual	20 - currently applicable; 15 - applicable in 2030	5-19
SO_2	Hourly	350 (99th percentile)	5-20
	Daily	125 (99th percentile)	5-21
	Annual	50	5-22
NO_2	Hourly	200 (99th percentile)	5-23
	Annual	40	5-24
NH_3	Hourly	1184	5-25
	Annual	500	5-26

The PM_{10} and $PM_{2.5}$ ground level concentrations for highest daily (99th percentile) and annual averaging periods, is well below the NAAQS at all identified off-site sensitive receptors.

The SO_2 and NO_2 ground level concentrations are well below the NAAQS for all averaging periods at all off-site identified sensitive receptors.

The acute and chronic NH_3 ground level concentrations are well below the inhalation screening criteria at all potential sensitive receptors within the study area.

Table 5-13: A summary of the potential exceedances of NAAQS and health effect screening levels at potential sensitive receptors within the study area due to the proposed VCN Furnace activities only

Pollutant	Averaging Period	NAAQS/ International health effect screening level (µg/m³)	Exceeding NAAQS/ International health effect screening levels									
			AQMS	Residential areas			Hospitals/ Clinics			Schools		
			eMalahleni - SAWS	Kwa-Guqa	Kwathomas Mahlanguville	Residential area to the NE of VCN Furnace	Witbank Specialised TB Hospital-ER	Ackerville Clinic	Lynville Clinic	Khonzimfundo Primary School	Maloma Primary School	Elukhanyisweni Secondary School
PM_{10}	Daily	75 (99th percentile)	×	×	×	×	×	×	×	×	×	×
	Annual	40	×	×	×	×	×	×	×	×	×	×
$PM_{2.5}$	Daily	40 (99th percentile) - currently applicable; 25 (99th percentile) - applicable in 2030	×	×	×	×	×	×	×	×	×	×
	Annual	20 (currently applicable); 15 (applicable in 2030)	×	×	×	×	×	×	×	×	×	×
SO_2	Hourly	350 (99th percentile)	×	×	×	×	×	×	×	×	×	×
	Daily	125 (99th percentile)	×	×	×	×	×	×	×	×	×	×
	Annual	50	×	×	×	×	×	×	×	×	×	×
NO_2	Hourly	200 (99th percentile)	×	×	×	×	×	×	×	×	×	×
	Annual	40	×	×	×	×	×	×	×	×	×	×
NH_3	Hourly	1184	×	×	×	×	×	×	×	×	×	×
	Annual	500	×	×	×	×	×	×	×	×	×	×

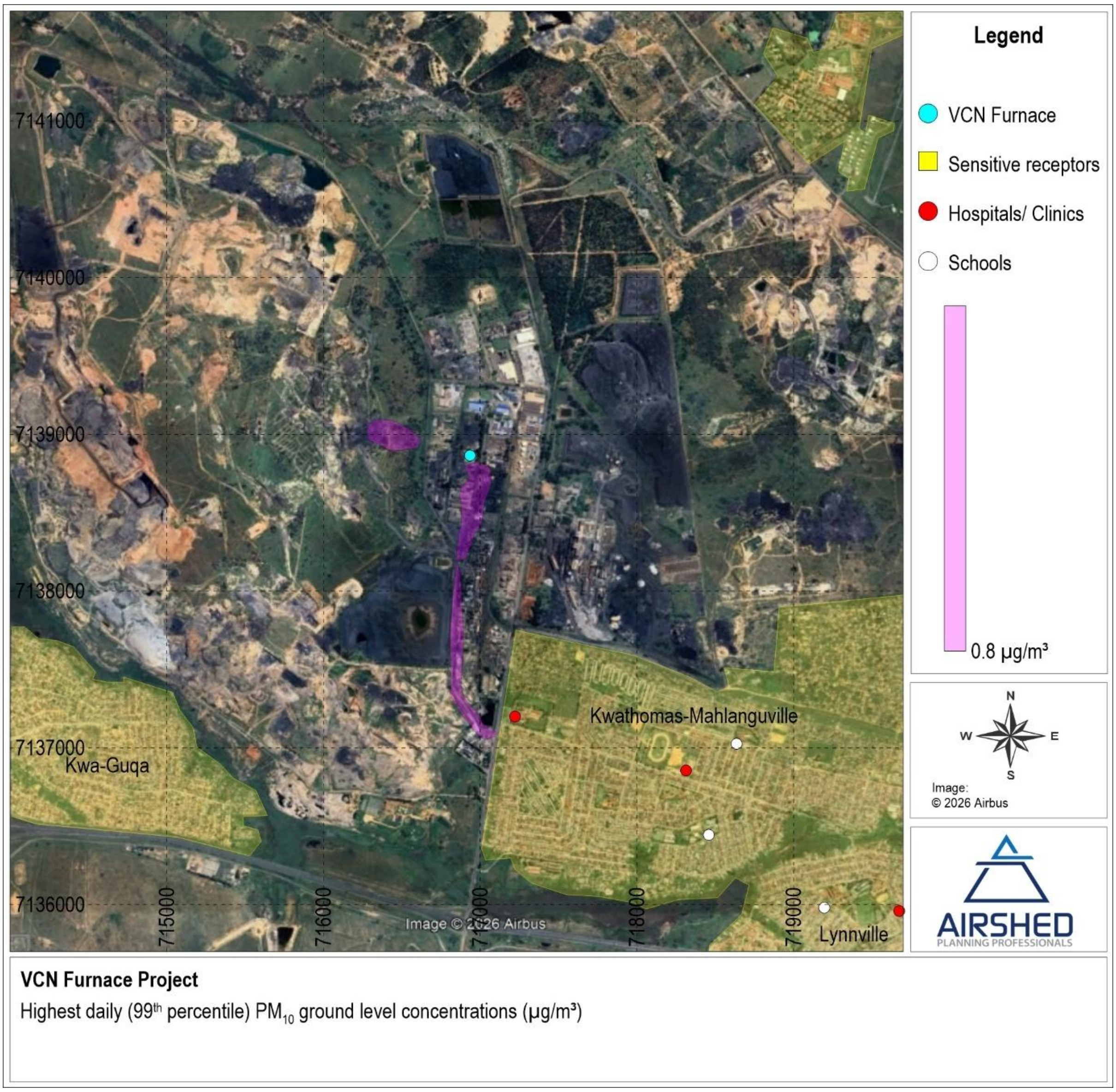


Figure 5-16: Highest daily (99th percentile) PM_{10} ground level concentrations due to the VCN Furnace operations

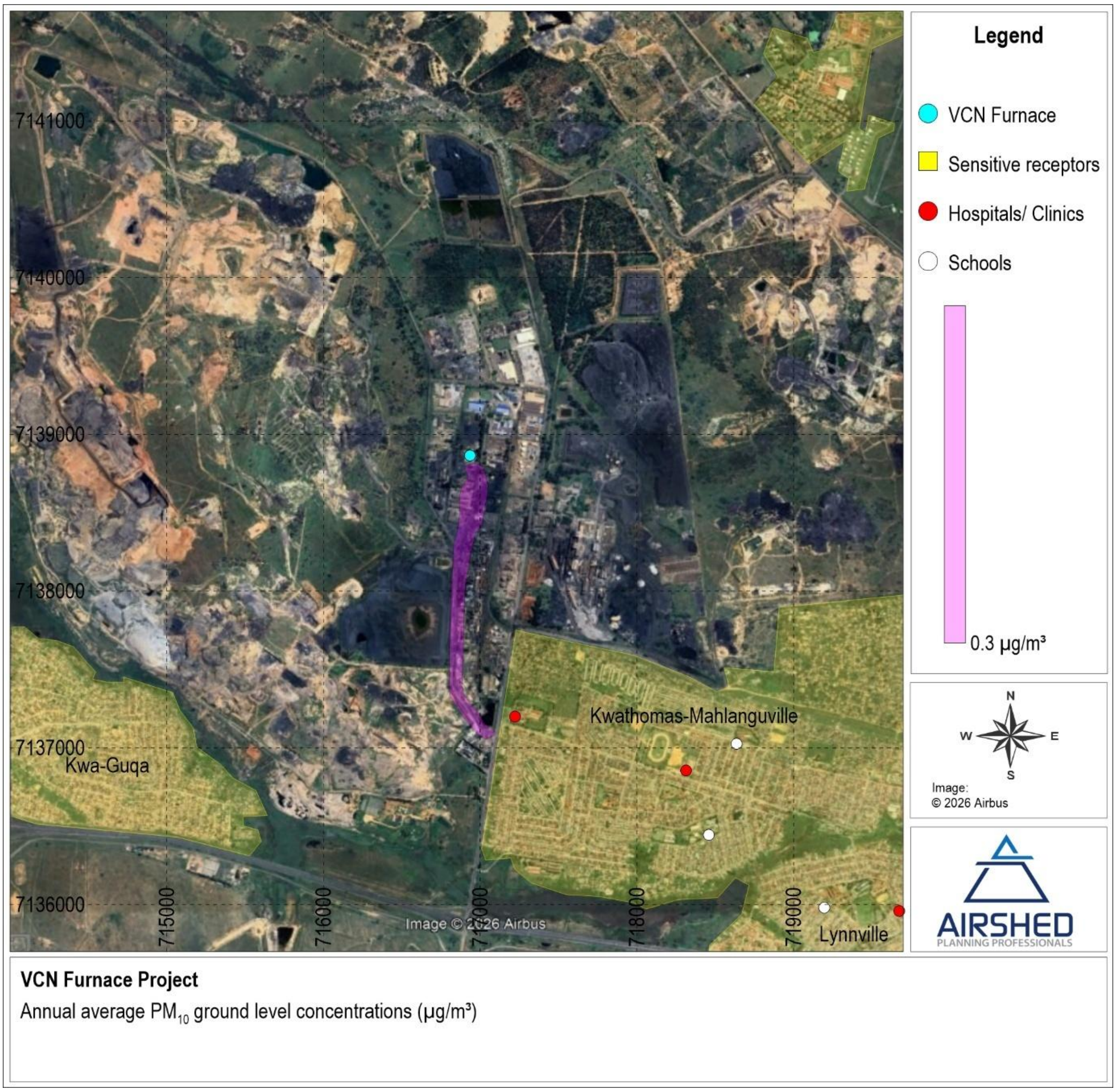


Figure 5-17: Annual average PM_{10} ground level concentrations due to the VCN Furnace operations

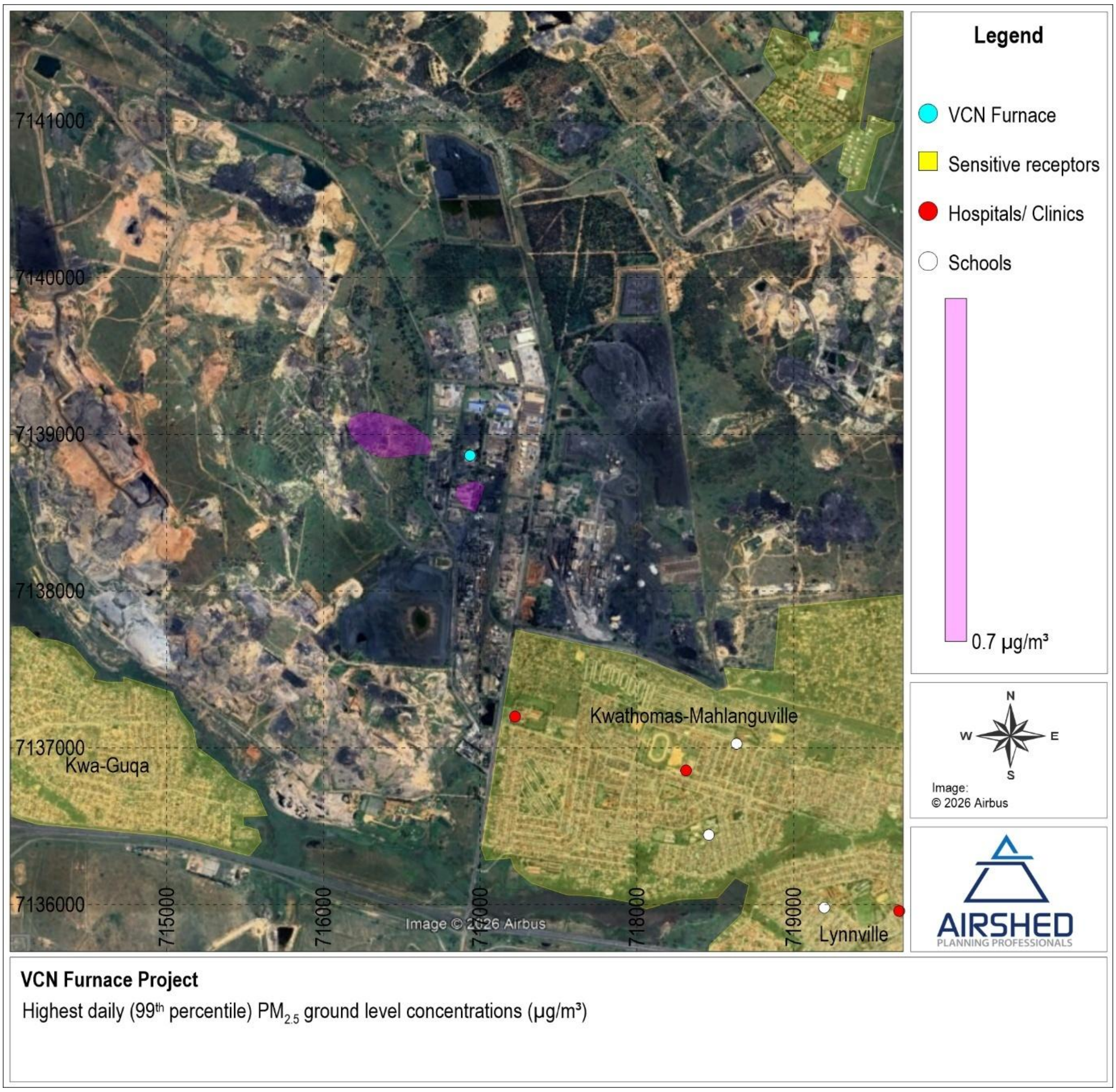


Figure 5-18: Highest daily (99th percentile) $PM_{2.5}$ ground level concentrations due to the VCN Furnace operations

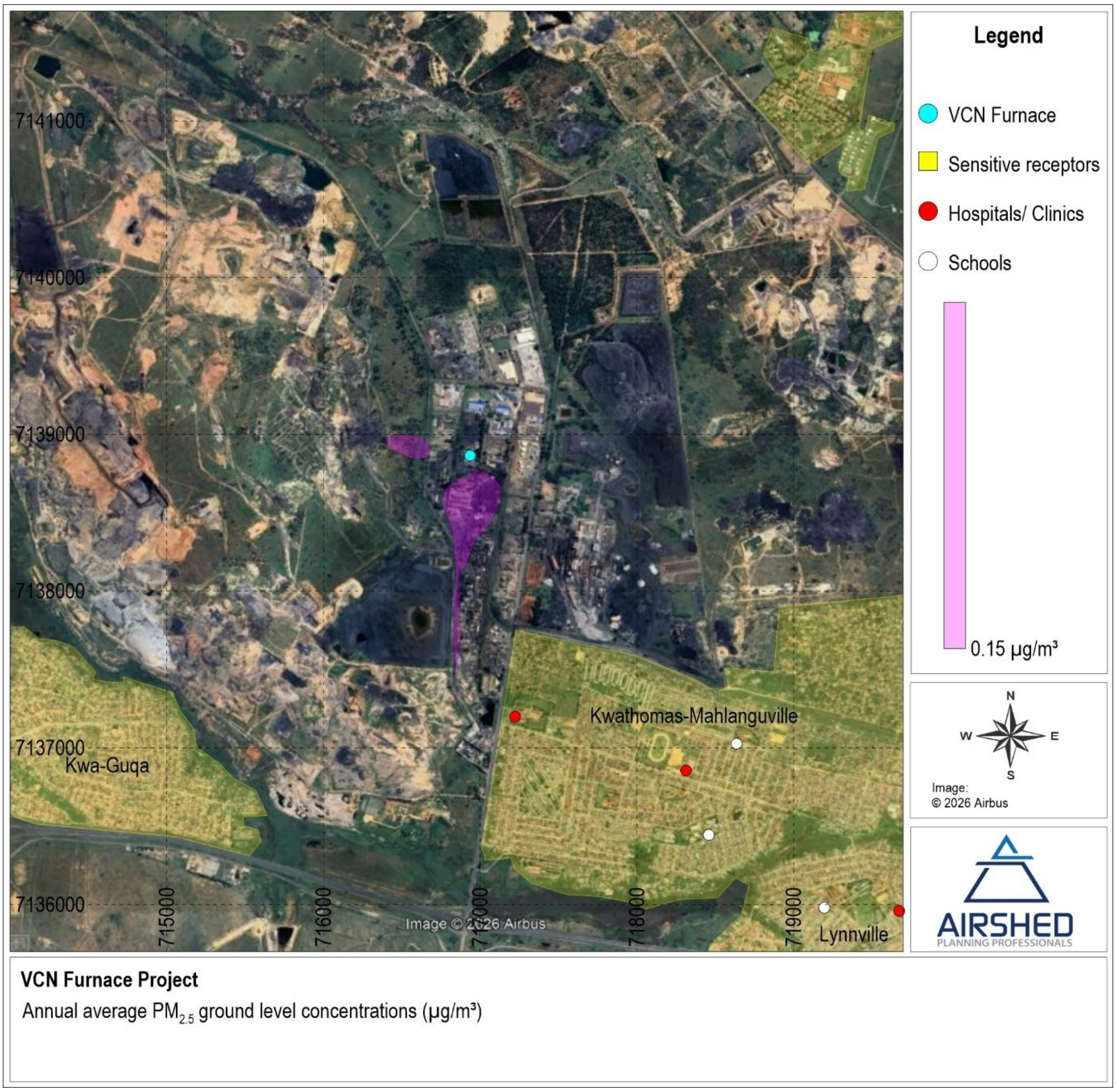


Figure 5-19: Annual average $PM_{2.5}$ ground level concentrations due to the VCN Furnace operations

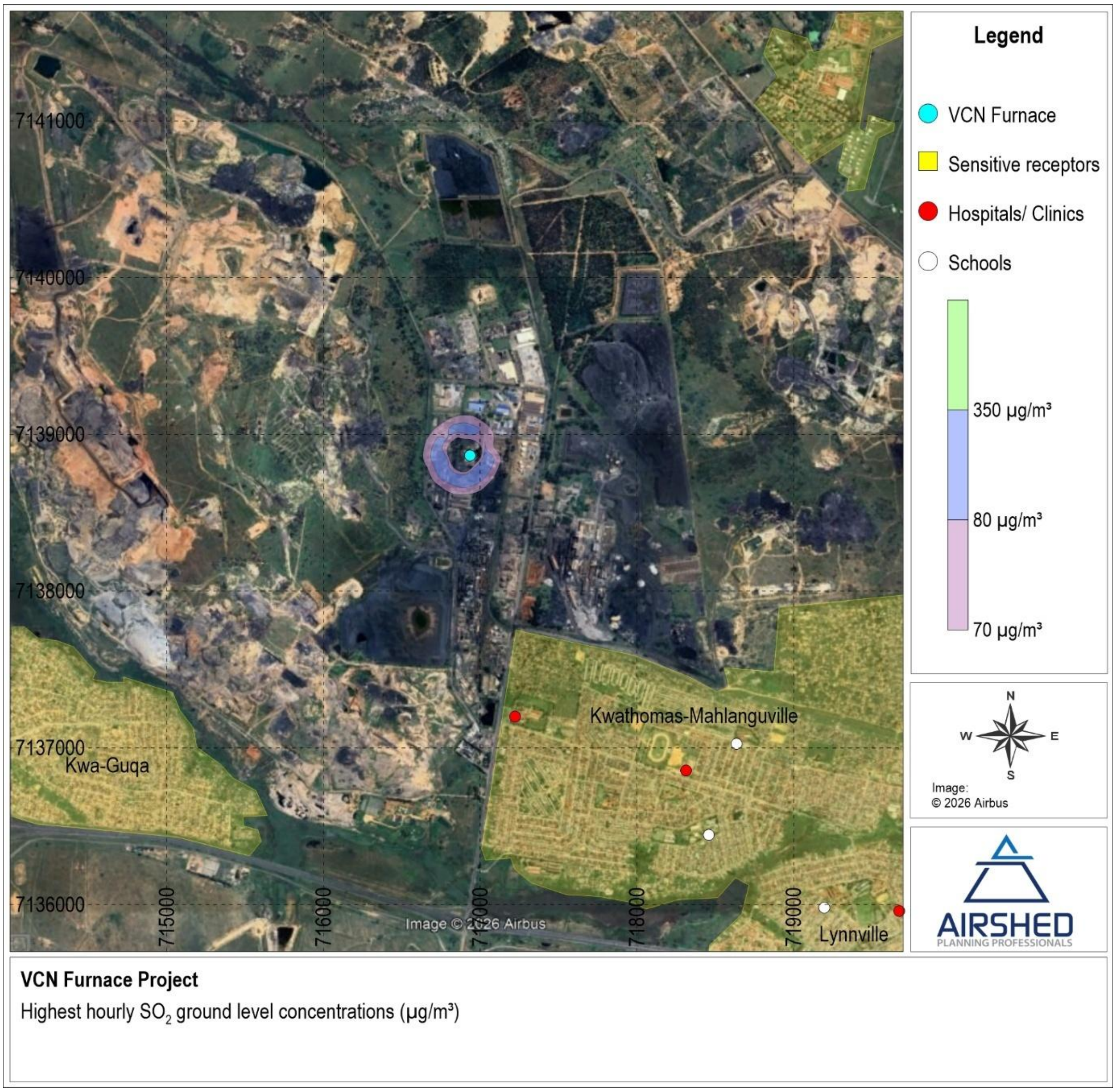


Figure 5-20: Highest hourly SO_2 ground level concentrations due to the VCN Furnace operations

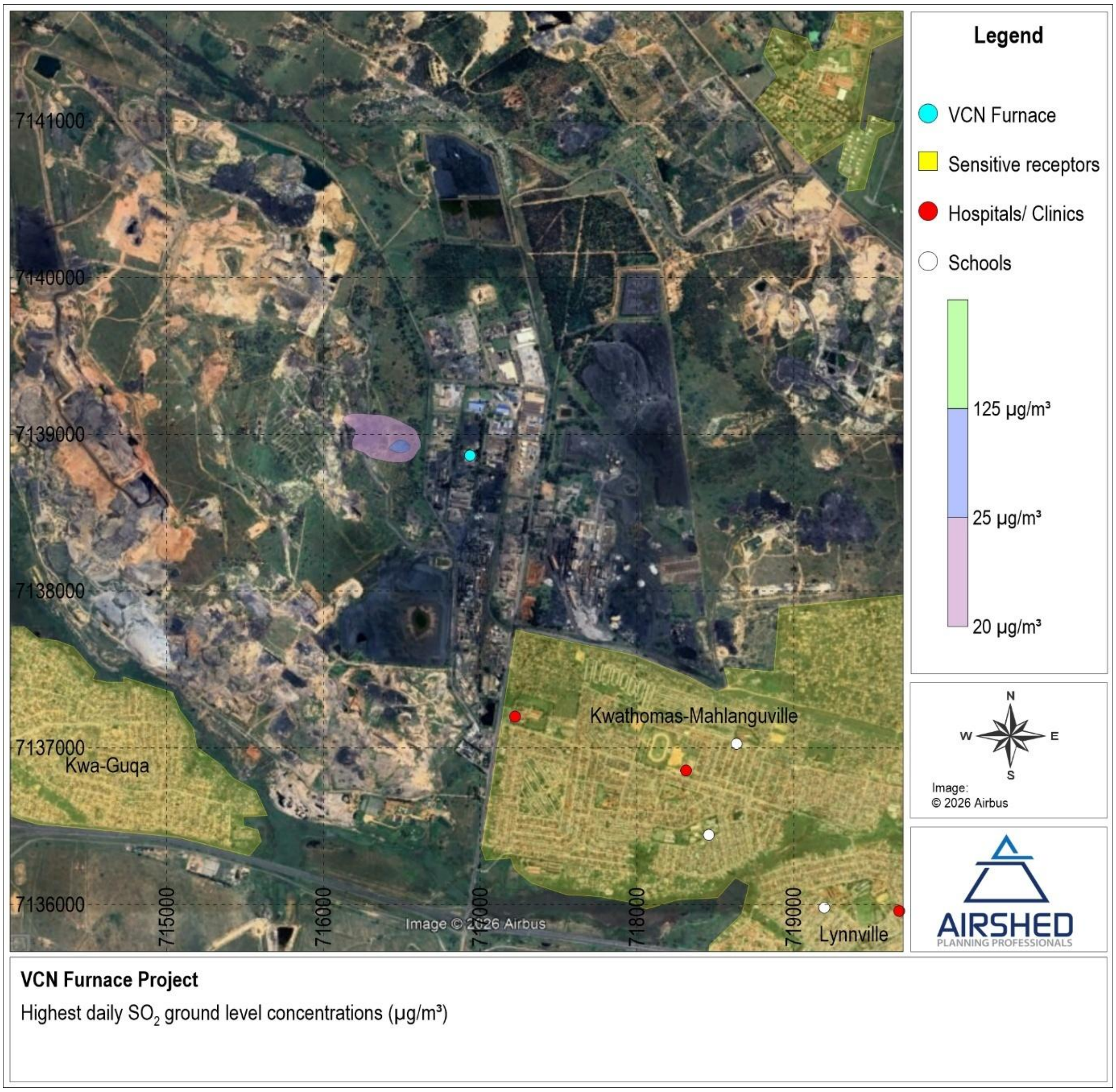


Figure 5-21: Highest daily SO_2 ground level concentrations due to the VCN Furnace operations

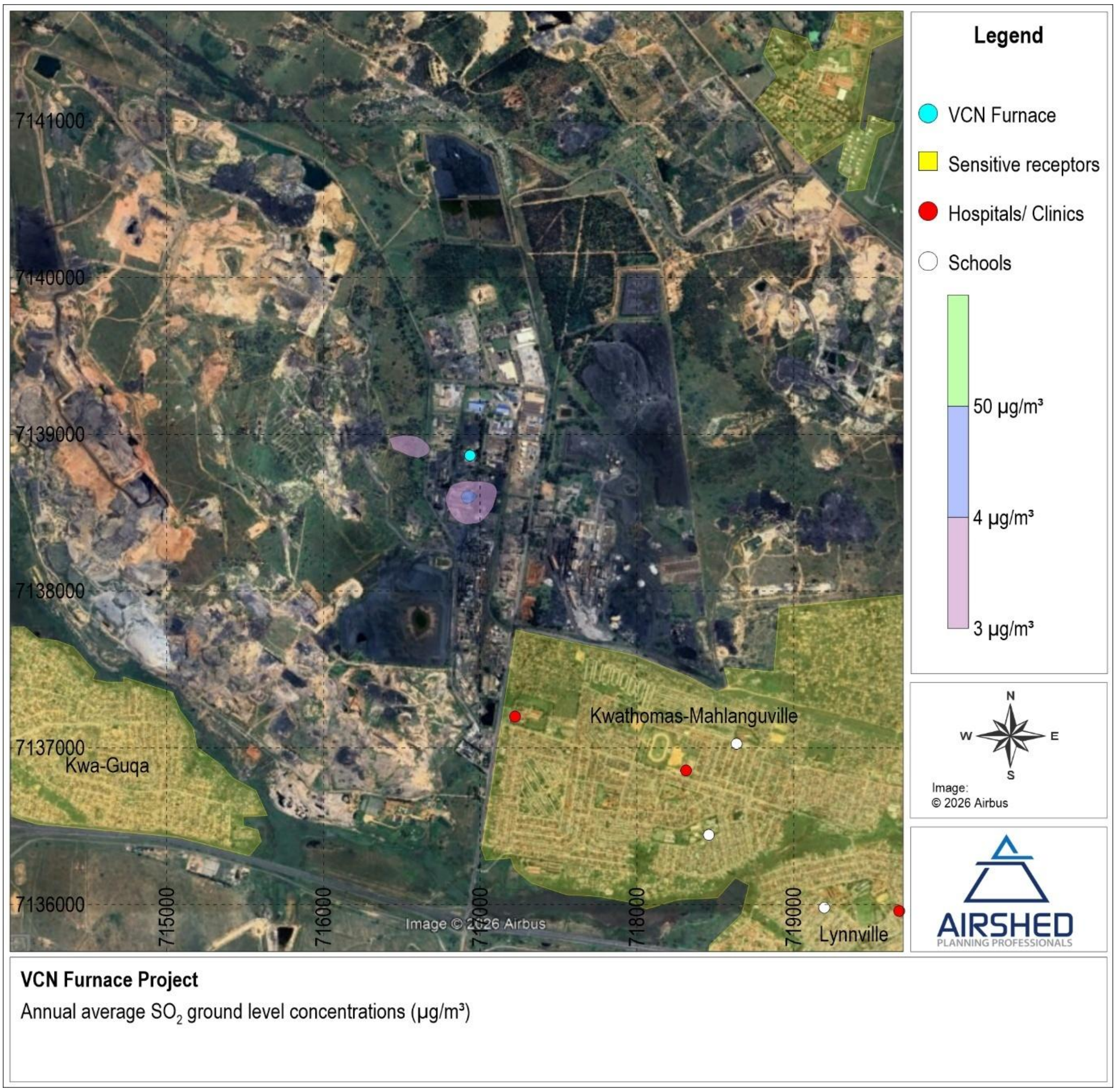


Figure 5-22: Annual average SO_2 ground level concentrations due to the VCN Furnace operations

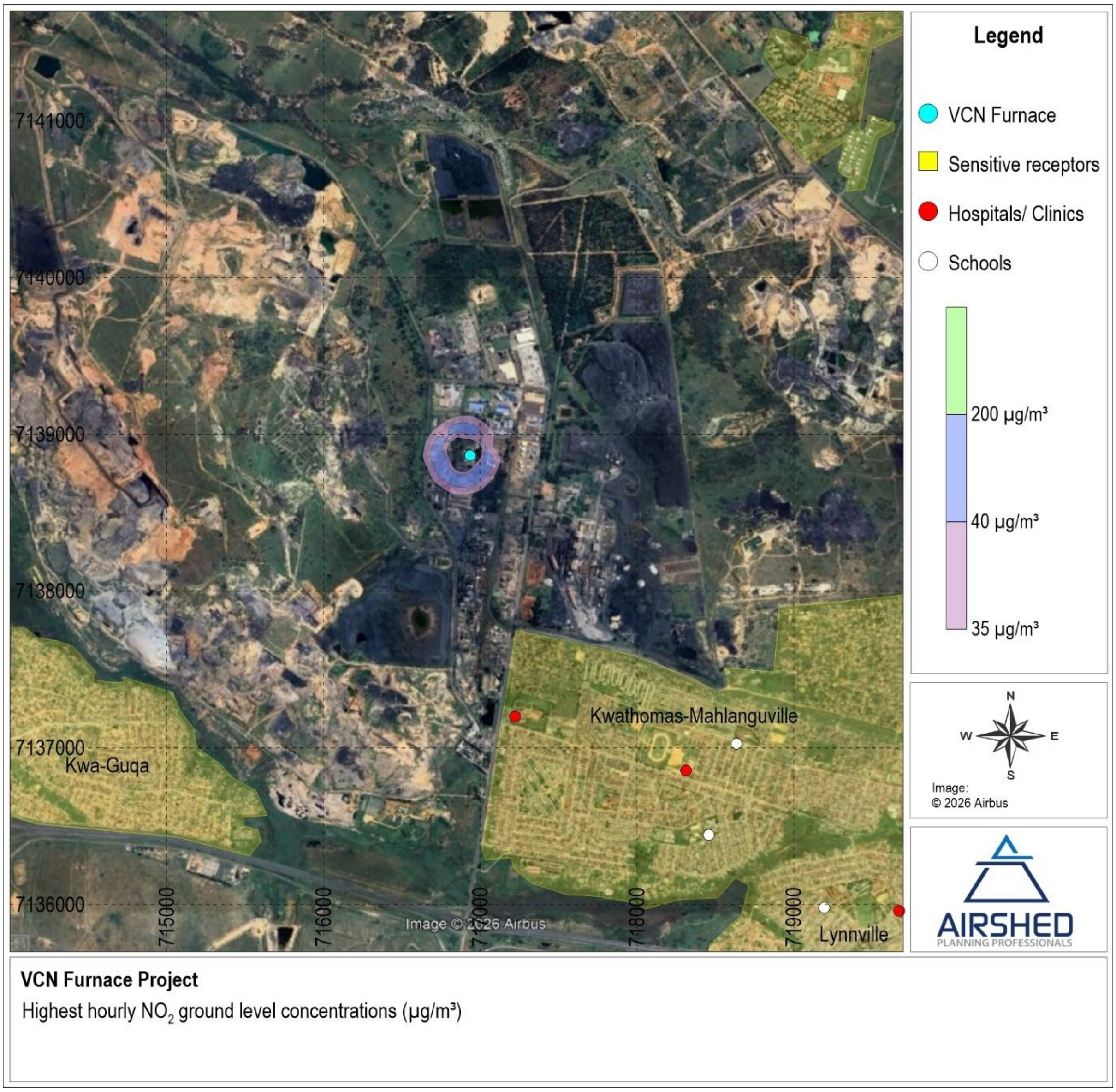


Figure 5-23: Highest hourly NO_2 ground level concentrations due to the VCN Furnace operations

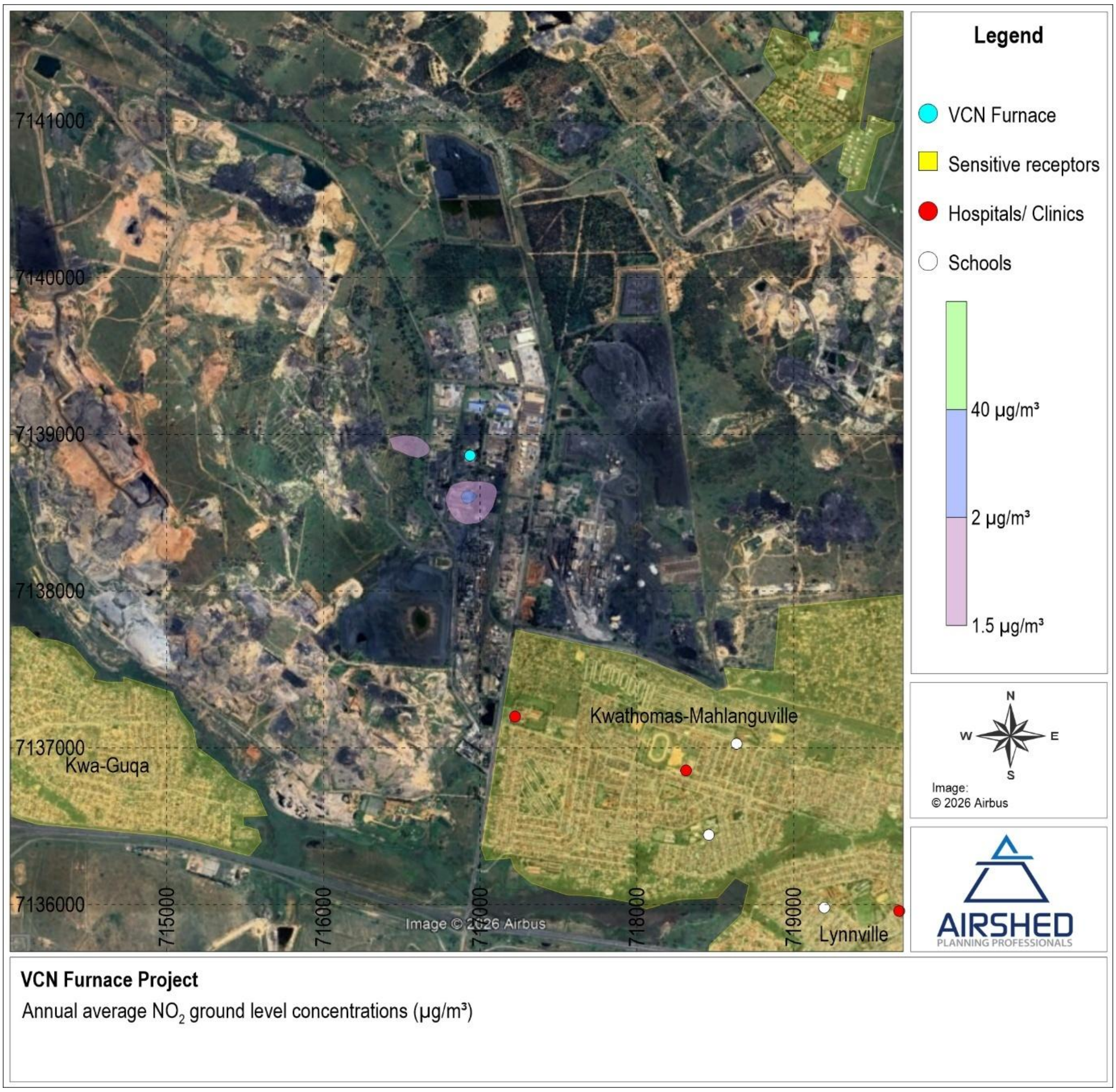


Figure 5-24: Annual average NO_2 ground level concentrations due to the VCN Furnace operations

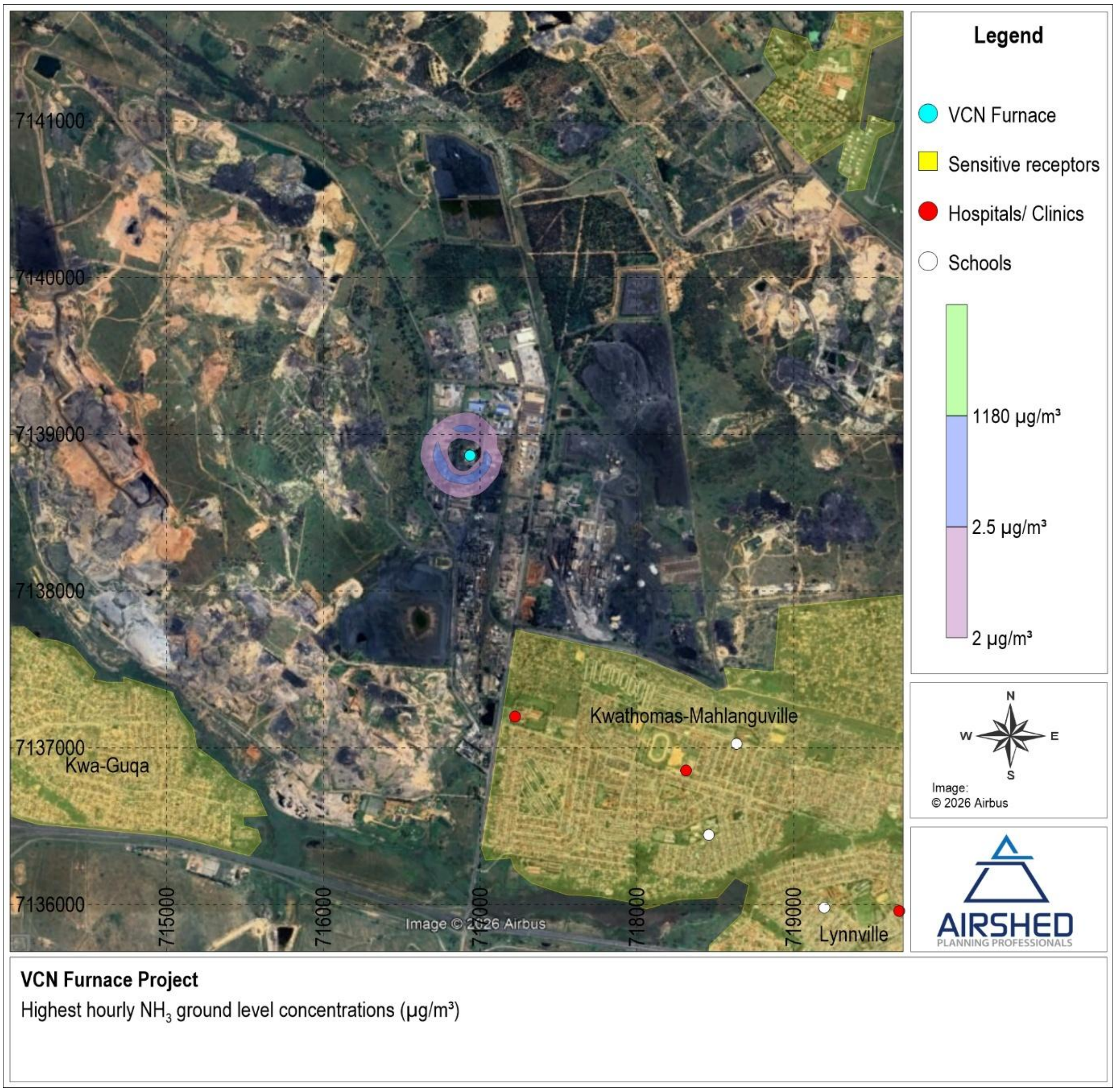


Figure 5-25: Acute NH_3 ground level concentrations due to the VCN Furnace operations

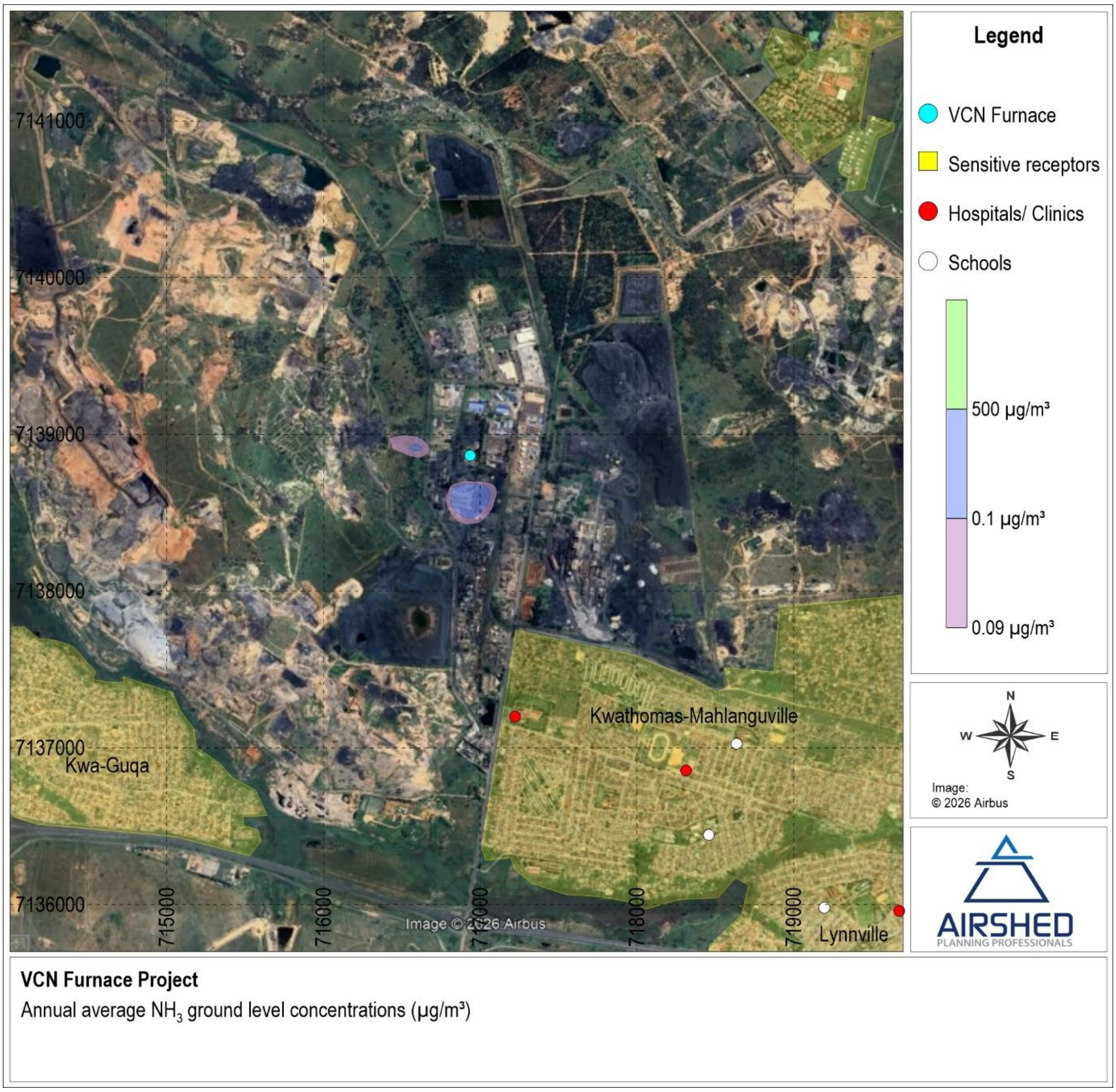


Figure 5-26: Annual average NH_3 ground level concentrations due to the VCN Furnace operations

5.1.7 Impacts due to Existing licensed operations and Proposed VCN Furnace Operations

If the existing licensed activities operate with the proposed VCN Furnace, the pollutant (as per the MES) that would cumulatively be influenced would be particulate matter. The impacts due to particulate matter are provided in the plots for this section and are summarised in Table 5-14. A summary of the potential exceedances of NAAQS and health effect screening levels at potential sensitive receptors within the study area due to existing licensed operations at the facility and the VCN Furnace operations is provided in Table 5-15.

Table 5-14: Summary of the plots included in this section for the existing licensed operations and the VCN Furnace

Pollutant	Averaging Period	NAAQS/ International health effect screening level (µg/m³)	Figure
PM_{10}	Daily	75 (99th percentile)	5-27 and 5-28
	Annual	40	5-29 and 5-30
$PM_{2.5}$	Daily	40 (99th percentile) - currently applicable; 25 (99th percentile) - applicable in 2030	5-31 and 5-32
	Annual	20 - currently applicable; 15 - applicable in 2030	5-33 and 5-34

The PM_{10} and $PM_{2.5}$ ground level concentrations for highest daily (99th percentile) and annual averaging periods, is within the NAAQS at all identified off-site sensitive receptors. The PM_{10} and $PM_{2.5}$ ground level concentrations are similar for unmitigated operations and mitigated operations (assuming 75% control efficiency on unpaved road surfaces). The PM_{10} and $PM_{2.5}$ impacts due to existing licensed operations are similar in magnitude and spatial distribution to the PM_{10} and $PM_{2.5}$ impacts for existing licensed operations and VCN Furnace combined. The particulate matter impacts due to the VCN Furnace operations, therefore, do not significantly contribute to baseline activities.

Table 5-15: A summary of the potential exceedances of NAAQS and health effect screening levels at potential sensitive receptors within the study area due to existing licensed operations and the proposed VCN Furnace operations

Pollutant	Averaging Period	NAAQS/ International health effect screening level (µg/m³)	Exceeding NAAQS/ International health effect screening levels									
			AQMS	Residential areas			Hospitals/ Clinics			Schools		
			eMalahleni - SAWS	Kwa-Guqa	Kwathomas Mahlanguville	Residential area to the NE of VCN Furnace	Witbank Specialised TB Hospital-ER	Ackerville Clinic	Lynville Clinic	Khonzimfundo Primary School	Maloma Primary School	Elukhanyisweni Secondary School
PM_{10}	Daily	75 (99th percentile)	×	×	×	×	×	×	×	×	×	×
	Annual	40	×	×	×	×	×	×	×	×	×	×
$PM_{2.5}$	Daily	40 (99th percentile) - currently applicable; 25 (99th percentile) - applicable in 2030	×	×	×	×	×	×	×	×	×	×
	Annual	20 (currently applicable); 15 (applicable in 2030)	×	×	×	×	×	×	×	×	×	×
VOC	Annual	200	×	×	×	×	×	×	×	×	×	×
Benzene	Annual	5	×	×	×	×	×	×	×	×	×	×
PAH	Hourly	0.5	×	×	×	×	×	×	×	×	×	×
	Annual	0.05	×	×	×	×	×	×	×	×	×	×
SO_2	Hourly	350 (99th percentile)	×	×	×	×	×	×	×	×	×	×
	Daily	125 (99th percentile)	×	×	×	×	×	×	×	×	×	×
	Annual	50	×	×	×	×	×	×	×	×	×	×
NO_2	Hourly	200 (99th percentile)	×	×	×	×	×	×	×	×	×	×
	Annual	40	×	×	×	×	×	×	×	×	×	×
NH_3	Hourly	1184	×	×	×	×	×	×	×	×	×	×
	Annual	500	×	×	×	×	×	×	×	×	×	×

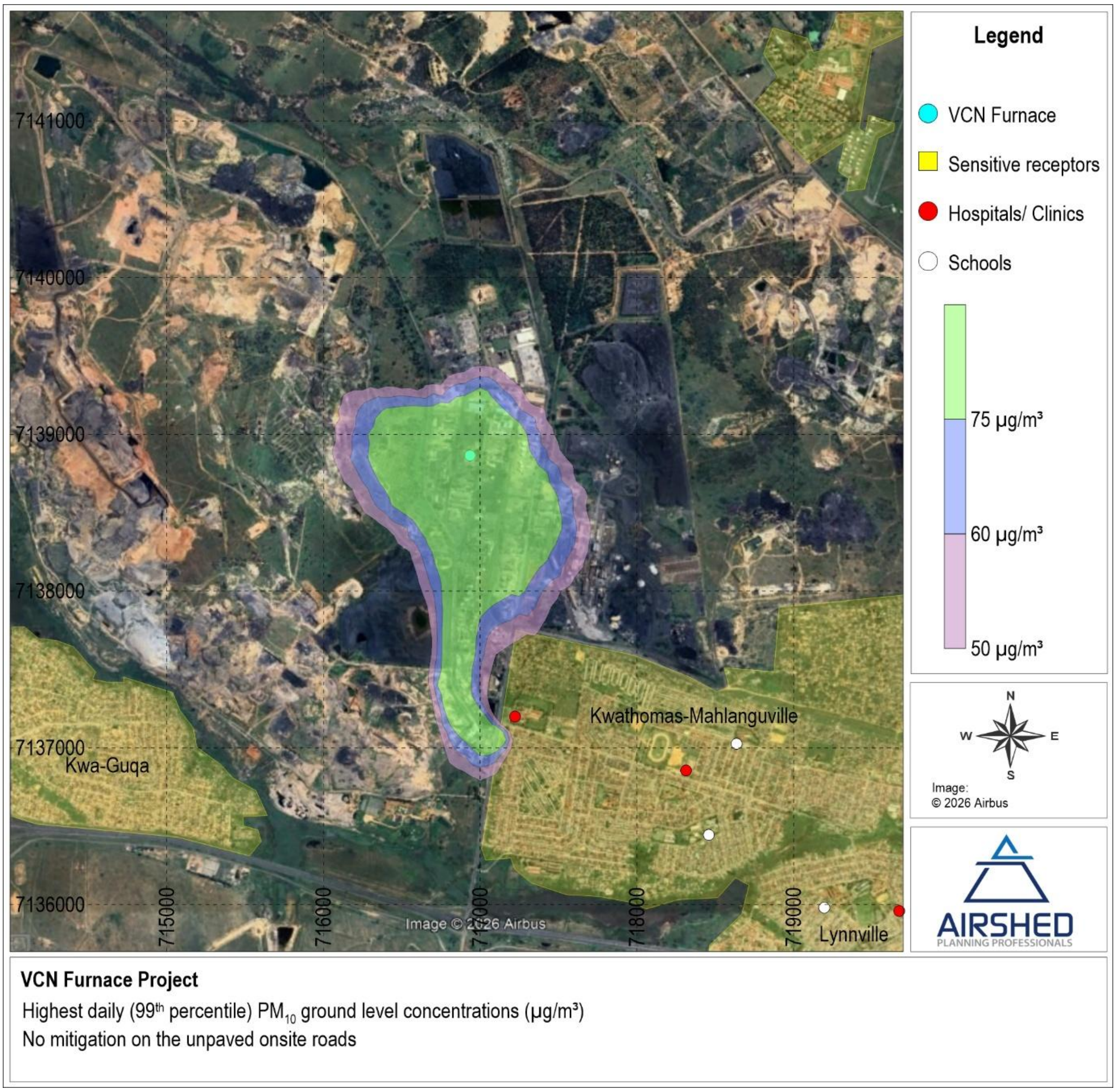


Figure 5-27: Highest daily (99th percentile) PM_{10} ground level concentrations due to existing licensed operations and the VCN Furnace operations

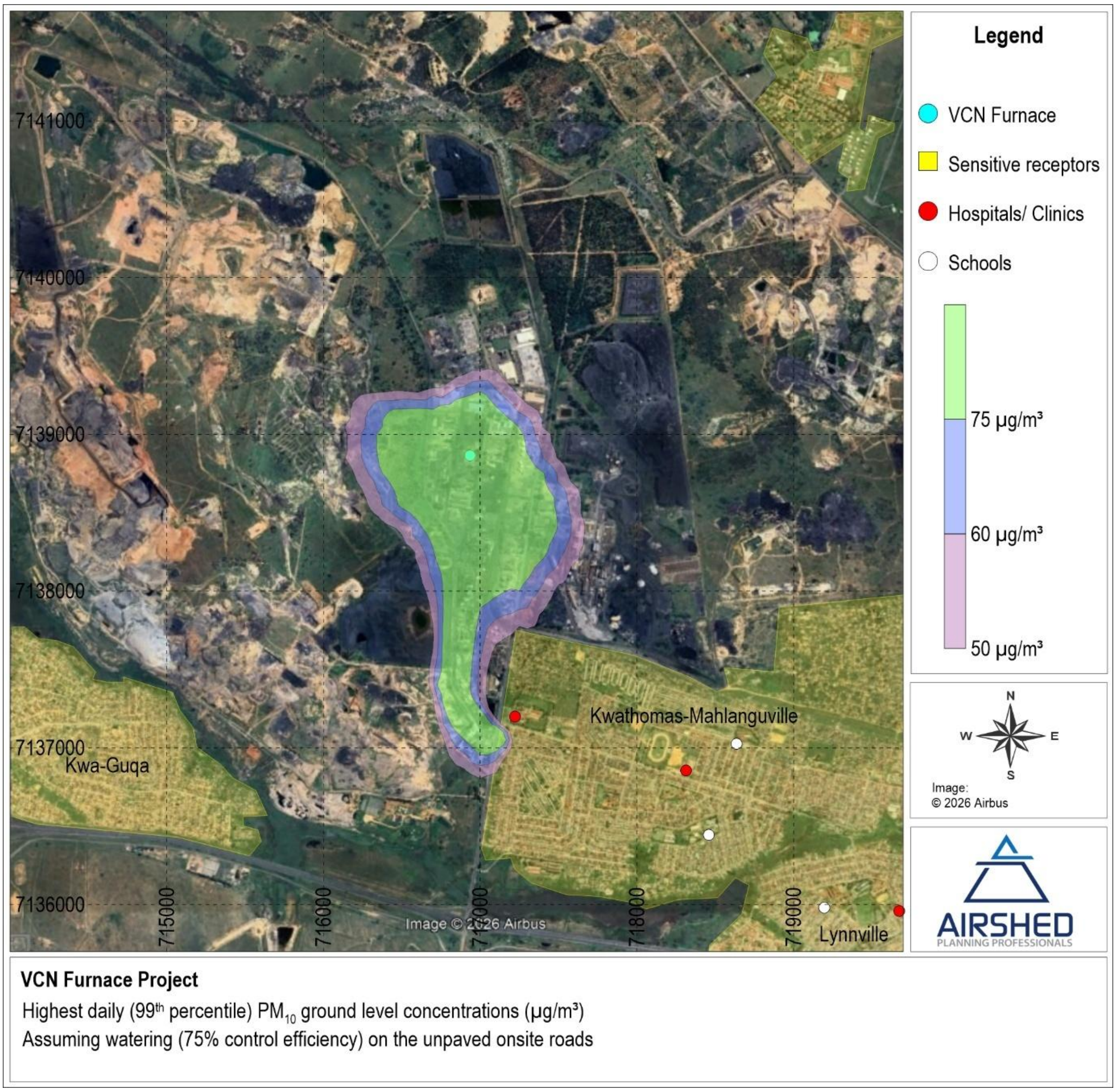


Figure 5-28: Highest daily (99th percentile) PM_{10} ground level concentrations due to existing licensed operations and the VCN Furnace operations (assuming 75% CE on unpaved roads)

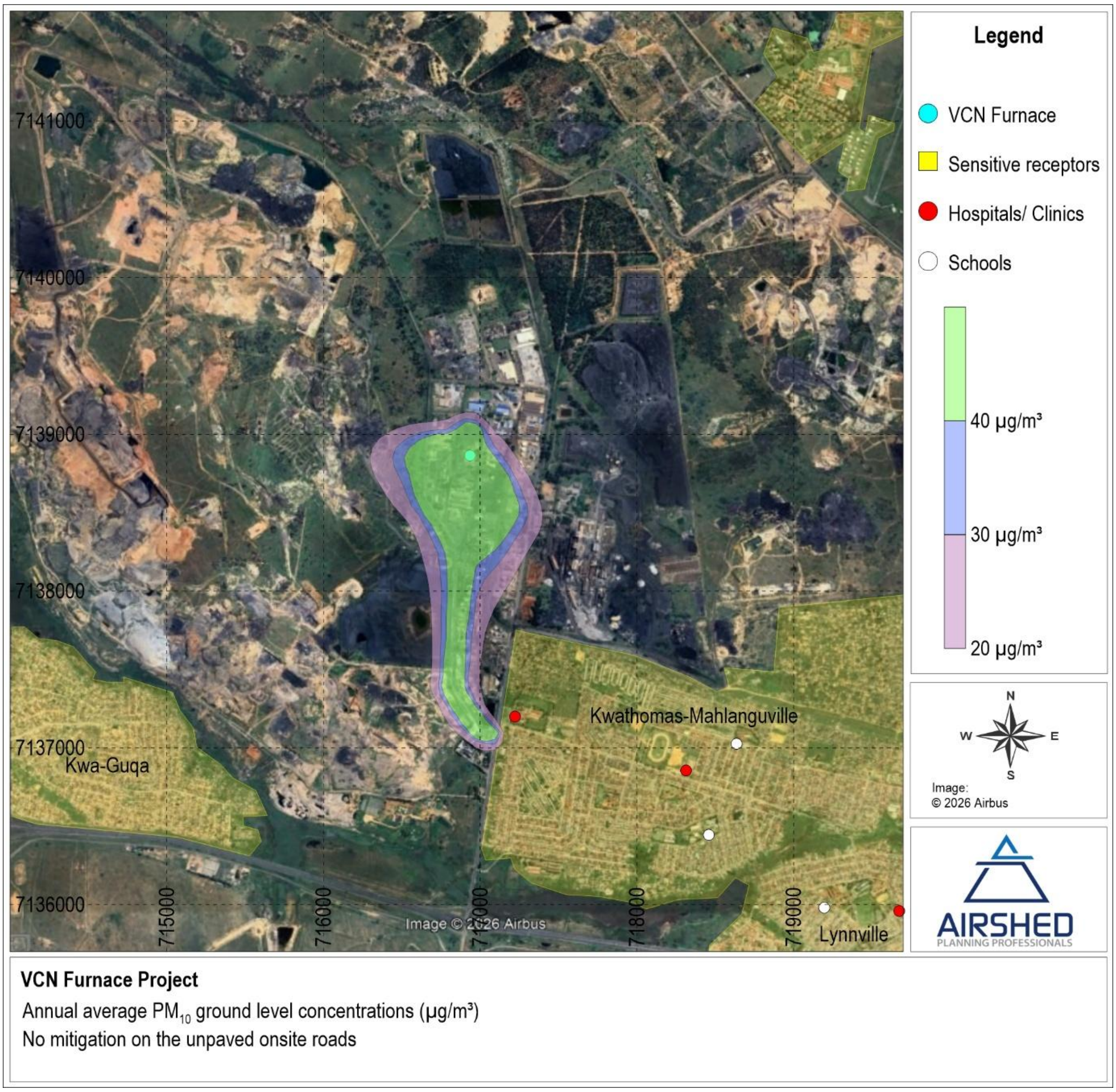


Figure 5-29: Annual average PM_{10} ground level concentrations due to existing licensed operations and the VCN Furnace operations

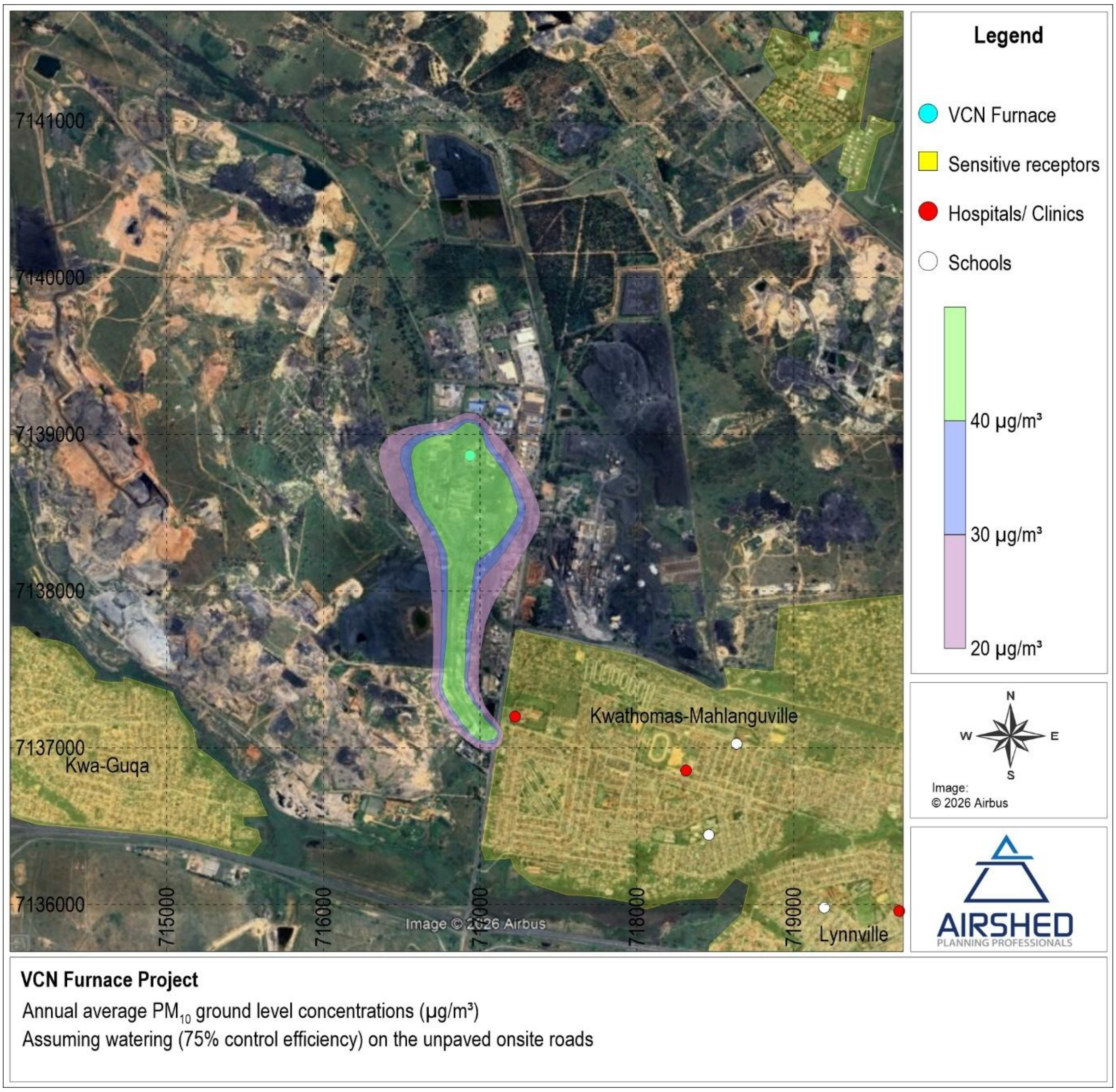


Figure 5-30: Annual average PM_{10} ground level concentrations due to existing licensed operations and the VCN Furnace operations (assuming 75% CE on unpaved roads)

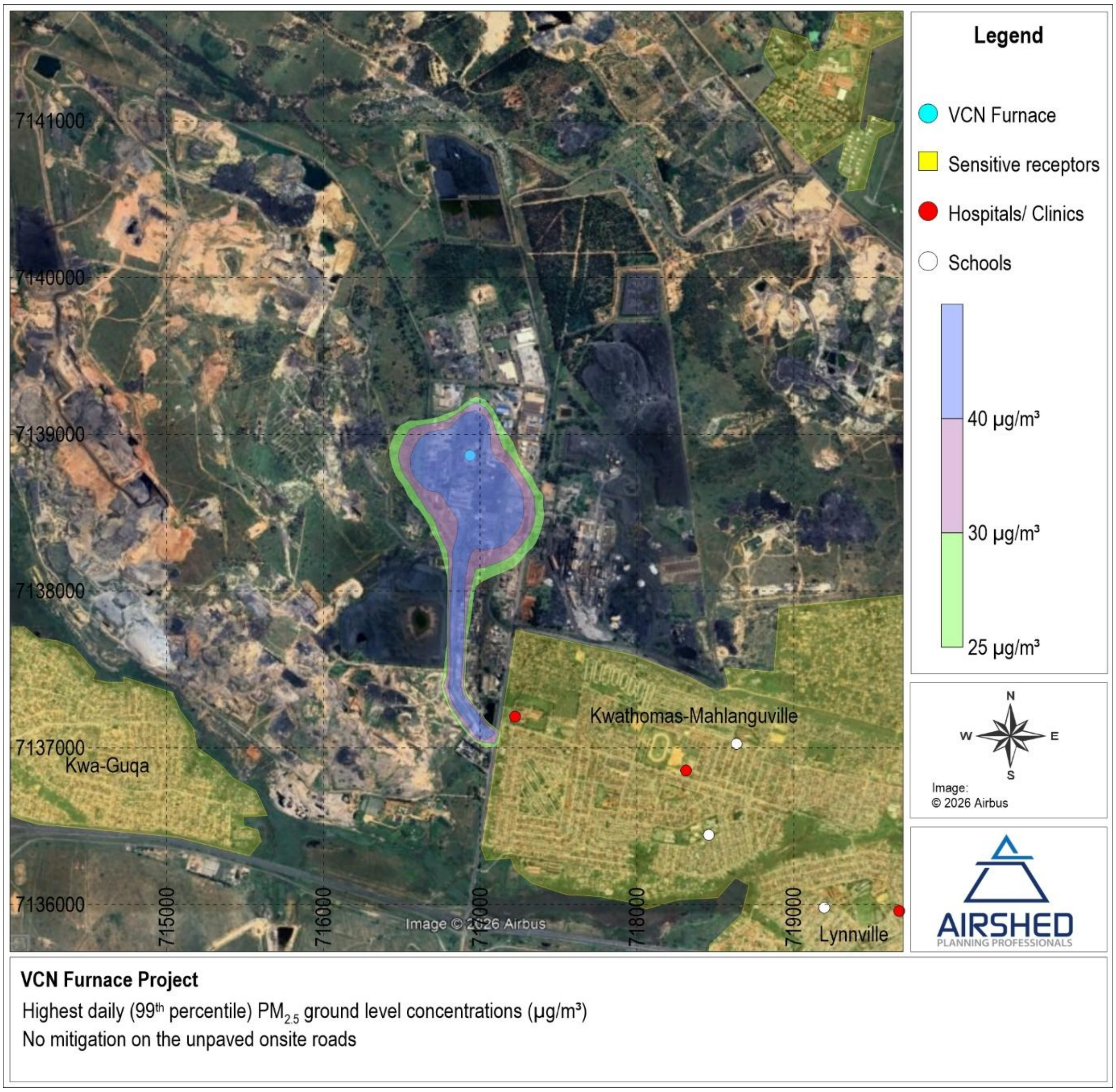


Figure 5-31: Highest daily (99th percentile) $PM_{2.5}$ ground level concentrations due to existing licensed operations and the VCN Furnace operations

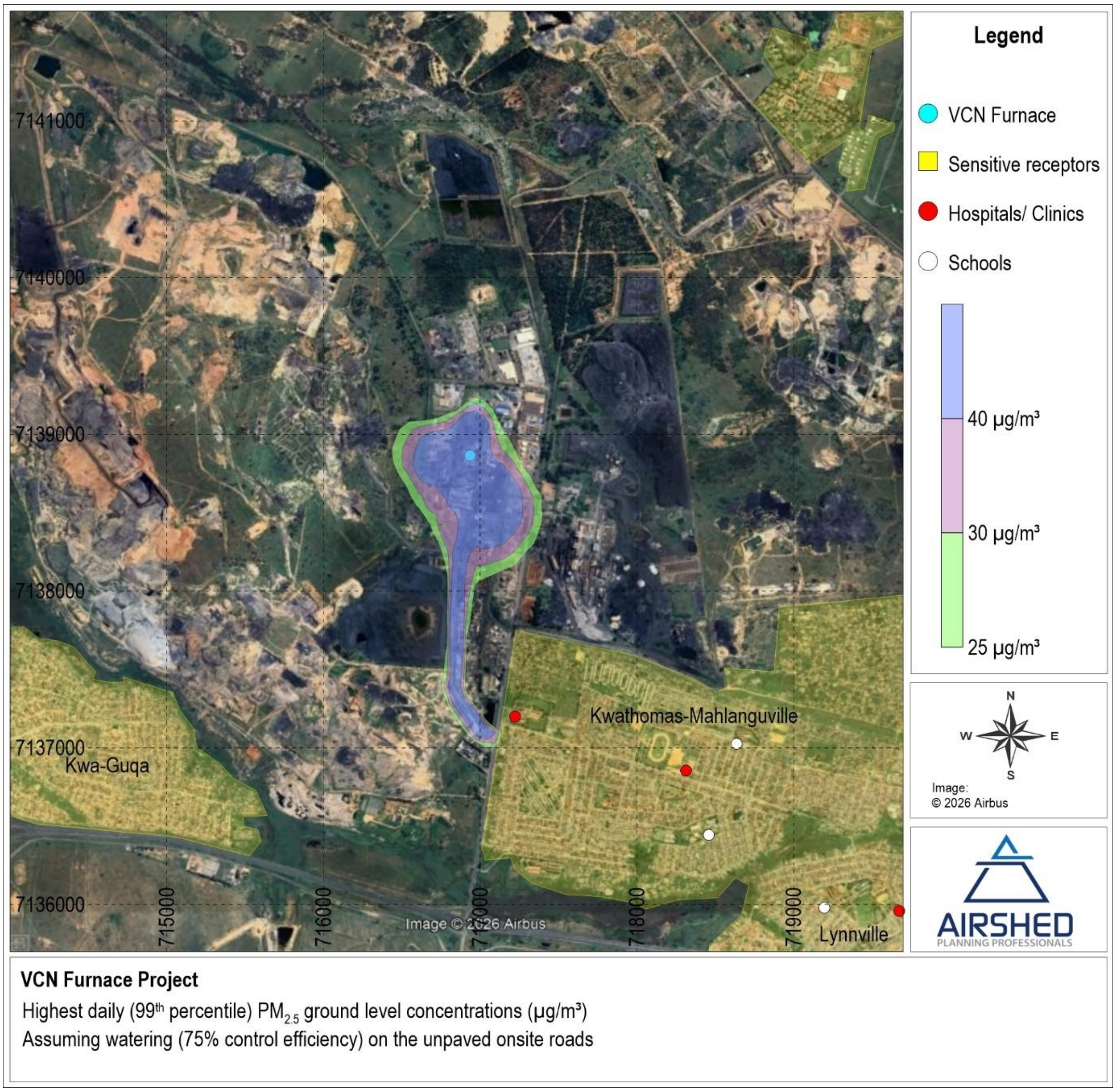


Figure 5-32: Highest daily (99th percentile) $PM_{2.5}$ ground level concentrations due to existing licensed operations and the VCN Furnace operations (assuming 75% CE on unpaved roads)

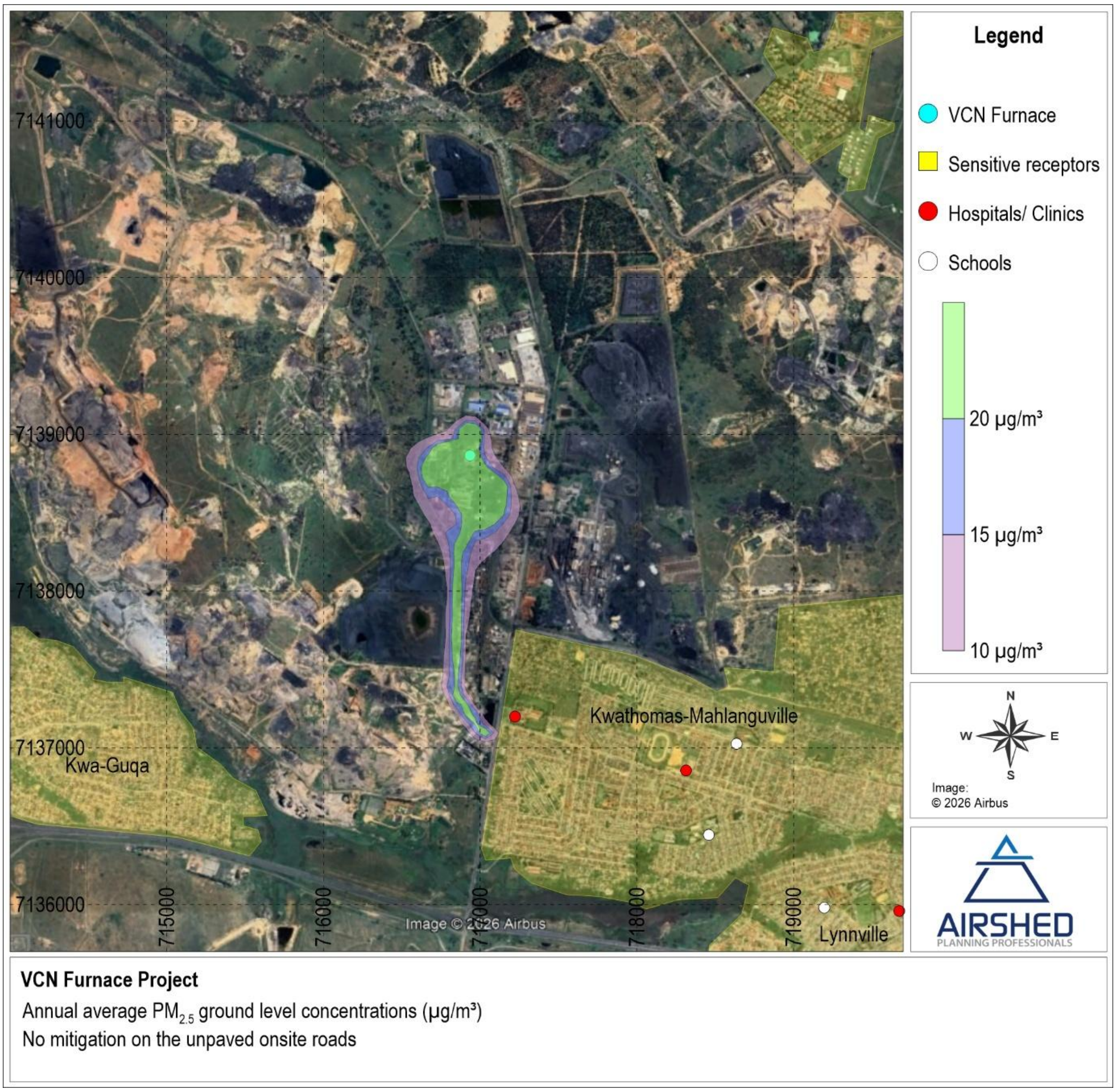


Figure 5-33: Annual average $PM_{2.5}$ ground level concentrations due to existing licensed operations and the VCN Furnace operations

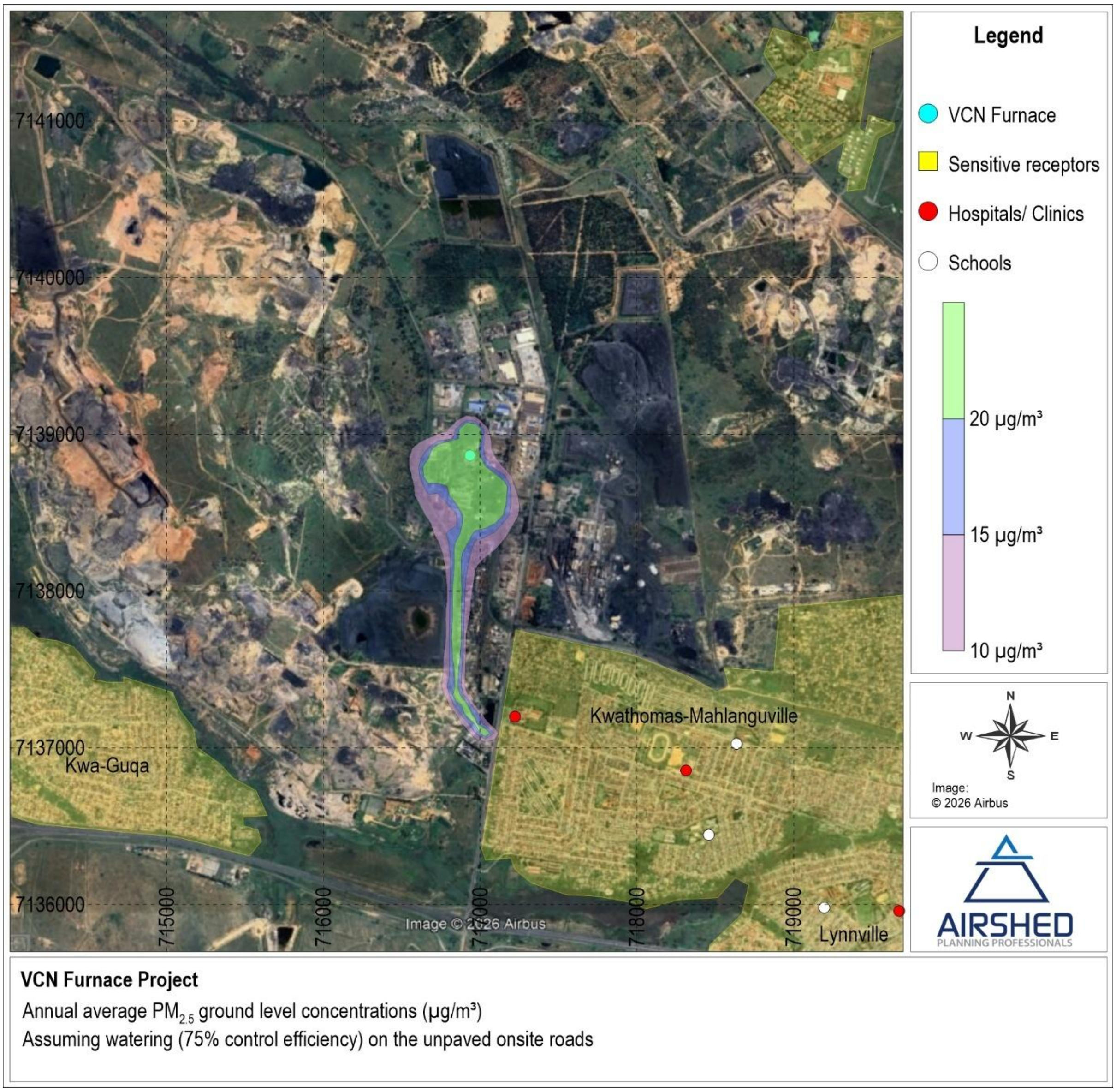


Figure 5-34: Annual average $PM_{2.5}$ ground level concentrations due to existing licensed operations and the VCN Furnace operations (assuming 75% CE on unpaved roads)

5.1.8 Cumulative Impacts

Literature states that by adding the peak model concentrations to the background concentrations, this can result in severe overestimation of the source contribution and that a more realistic method is to add twice the annual mean background concentrations to the peak (or 99.9th percentile) (Ministry for the Environment, 2004). Sulfur dioxide (SO_2), NO_2, PM_{10} and $PM_{2.5}$ have been sampled at the eMalahleni AQMS within the study area.

Taking measured annual average SO_2, NO_2, PM_{10} and $PM_{2.5}$ ambient concentrations at the eMalahleni AQMS for the period 2023 (as this has the highest data availability for the period 2023 – 2025), the cumulative impact at this site is summarised in Table 5-16.

Table 5-16: Cumulative impacts due to VCN Furnace operations at the eMalahleni AQMS

Description	SO_2	NO_2	PM_{10}	$PM_{2.5}$
Measured **annual** average concentrations for the period 2023 (µg/m³)	28.9	23.8	48.1	23.4
Assumed **peak** baseline concentration (µg/m³)	57.8	47.6	96.2	46.8
Modelled **annual** average concentrations at the AQMS due to VCN Furnace operations (µg/m³)	0.45	0.23	0.03	0.02
Modelled **daily** concentrations at the AQMS due to VCN Furnace operations (µg/m³)	4.2		0.16	0.15
Modelled **hourly** concentrations at the AQMS due to VCN Furnace operations (µg/m³)	27.7	13.8		
Cumulative **annual** average concentrations at the AQMS due to VCN Furnace operations (µg/m³)	29.35	24.03	48.13	23.42
Cumulative **daily** concentrations at the AQMS due to VCN Furnace operations (µg/m³)	62		96.36	46.95
Cumulative **hourly** concentrations at the AQMS due to VCN Furnace operations (µg/m³)	85.5	61.4		

5.1.9 Mitigation Measures Recommended

The following mitigation measures are recommended for the proposed VCN Furnace:

- Measure stack emissions once the facility is operational to verify pollutants and emission concentrations from the VCN process.
- Stack emissions must comply with the emission limits stipulated in the MES (new plant MES) applicable to the VCN furnace listed activities.
- Operate VCN furnace stack with baghouse abatement (identified as the control technology for the VCN furnace stack).
- Receive briquettes in sealed bags and store indoors on impermeable surface.
- Movements of raw materials to be done via paved/concrete/impermeable surfaces.
- Install/maintain double mechanical seals situated between the water cooling section and the auto rotator to reduce fugitive dust.

- Packaging and internal transfers: pack cooled VCN in sealed bags (<20 kg), palletise; internal transfers occur on concrete paved surfaces.

5.1.10 Significance Rating

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

The project is expected to have the following significance rating (Table 5-17):

- Construction Phase:
  - Without mitigation: low-medium negative significance rating.
  - With mitigation (good housekeeping practices): low negative significance rating.
  - Overall significance rating: low negative.
- Operation Phase:
  - Without mitigation: low-medium negative significance rating.
  - With mitigation (this is the same as for scenario without mitigation as all controls assuming MES were modelled for operational phase): low-medium negative significance rating.
  - Overall significance rating: low-medium negative.
- Decommissioning Phase:
  - Without mitigation: low-medium negative significance rating.
  - With mitigation (good housekeeping practices): low negative significance rating.
  - Overall significance rating: low-medium negative.

Table 5-17: Significance rating for potential air quality impacts due to the VCN Furnace operations

Impact Description		Pre-Mitigation						Pre-mitigation significance	Post Mitigation						Post-mitigation significance	Confidence	Priority Factor Criteria		Priority Factor	Final score
Impact	Phase	Nature	Extent	Duration	Magnitude	Reversibility	Probability		Nature	Extent	Duration	Magnitude	Reversibility	Probability			Cumulative Impact	Irreplaceable loss		
Ambient air quality	Construction	-1	1	2	2	1	3	-4.5 (low-medium)	-1	1	2	2	1	2	-3 (low)	Medium	2	1	1.125	-3.75
Ambient air quality	Operation	-1	2	4	2	1	3	-6.75 (low-medium)	-1	2	4	2	1	3	-6.75 (low-medium)	Medium	2	1	1.125	-5.625
Ambient air quality	Decommission-ing	-1	2	2	2	1	3	-5.25 (low-medium)	-1	2	2	2	1	2	-3.5 (low)	Medium	2	1	1.125	-4.375

5.1.11 Main Findings and Recommendations

5.1.11.1 Main Findings

The findings from the human health impact assessment are as follows:

1. The wind regime for the area largely reflects the synoptic scale circulation with dominant northerly and easterly flow fields.
2. Ambient ground level concentrations were available for the eMalahleni AQMS managed by the SAWS for the period 2023 and 2024:
   a. Ambient SO_2 concentrations were compliant with NAAQS;
   b. Ambient NO_2 concentrations were compliant with NAAQS;
   c. Ambient PM_{10} and $PM_{2.5}$ concentrations were non-compliant with NAAQS.
3. The ground level concentrations due to the VCN Furnace operations (assuming maximum allowable emissions according to the MES) were well within NAAQS and health effect screening levels at the closest sensitive receptors for all averaging periods.
4. The ground level concentrations due to the current licensed activities were within NAAQS and health effect screening levels at the closest sensitive receptors for all averaging periods.
5. The ground level concentrations due to the current licensed activities and proposed VCN Furnace operations were within NAAQS and health effect screening levels at the closest sensitive receptors for all averaging periods.
6. The PM_{10} and $PM_{2.5}$ impacts due to existing licensed operations are similar in magnitude and spatial distribution to the PM_{10} and $PM_{2.5}$ impacts for existing licensed operations and VCN Furnace combined.
7. The significance rating due to VCN Furnace operations was low negative for construction, and low-medium negative for operation and decommissioning phases.

5.1.11.2 Recommendations

From an air quality perspective, it is recommended that the proposed VCN Furnace be authorised and that stack emissions be measured once the facility is operational in order to verify pollutants and emission concentrations from the process.

5.2 Analysis of Emissions' Impact on the Environment

In the absence of a prescribed methodology (in the Regulations Prescribing the Format of the Atmospheric Impact Report, Government Gazette No. 36904, Notice Number 747 of 2013; 11 October 2013), the impact of emissions from the proposed VCN Furnace on the environment was assessed using the pollutant critical levels that may affect vegetative productivity, and nuisance dustfall. The same dispersion modelling approach was used as in the assessment of impact of the facility on human health (described in Section 5.1.1).

5.2.1 Critical Levels for Vegetation

The impact of emissions from the proposed facility on surrounding vegetation was assessed by comparing the simulated annual SO_2 and NO_2 concentrations for the operational phase scenario against the critical levels for vegetation as defined by the United Nations Economic Commission for Europe (UNECE) Convention on Long Range Trans-boundary Air Pollution Limits (CLRTAP, 2015) (Table 5-18).

Table 5-18: Critical levels for SO_2 and NO_2 by vegetation type (CLRTAP, 2015)

Pollutant	Vegetation type	Critical Level (µg/m³)	Time Period[a]
SO_2	Cyanobacterial lichens	10	Annual average
	Forest ecosystems (including understorey vegetation)	20	Annual average and Half-year mean (winter)
	(Semi-) natural vegetation	20	Annual average and Half-year mean (winter)
	Agricultural crops	30	Annual average and Half-year mean (winter)
NO_2	All	30	Annual average and Half-year mean (winter)
		75	Daily average

Notes:

(a) For the purposes of mapping of critical levels and exceedances CLRTAP recommend using only the annual average, due to increased reliability of mapped and simulated data for the longer period. It is also noted that long-term effects of NO_X are more significant than short-term effects (CLRTAP, 2015).

The simulated maximum annual concentrations of SO_2 for the VCN Furnace is 4 µg/m³ and is within the critical level for lichens and other vegetation types.

Maximum annual concentrations for NO_2 for the VCN Furnace is 2 µg/m³ and is within the critical level for all vegetation types.

5.2.2 Dustfall Rates

5.2.2.1 National Dust Control Regulations

The NDCR was gazetted on 1 November 2013 (GG 36974) with updated NDCR gazetted on 8 March 2024 (GG 50272). The purpose of the regulations is to prescribe general measures for the control of dust in residential and non-residential areas. The standard for acceptable dustfall rate is set out in Table 5-19. The method to be used for measuring dustfall rate and the guideline for locating sampling points shall be in accordance with the latest version of the South African National Standard 1137. It is important to note that dustfall is assessed for nuisance impact and not inhalation health impact.

Table 5-19: Acceptable dustfall rates

Restriction Area	Dustfall Rate (mg/m².day; 30-day average)	Permitted Frequency of Exceeding Dustfall Rate
Residential area [(a)]	D≤600	Twice within a year, not occurring on sequential months.
Non-residential area [(b)]	D≤1200	Twice within a year, not occurring on sequential months.
Notes: (a) Applicable to any area that is used for the purposes as prescribed under schedule 2 of the Spatial Planning and Land Use Management Act, 2013 (Act No 16 of 2013) excluding the land that is scheduled for agricultural, industrial and mining purposes. (b) Applicable to any area that is scheduled for agricultural, industrial and mining purposes as prescribed under schedule 2 of the Spatial Planning and Land Use Management Act, 2013 (Act No 16 of 2013).		

5.2.2.2 Simulated Dustfall Rates

Dustfall deposition rates were estimated from PM emissions during the operations phase of the VCN Furnace. The simulated PM concentrations were converted to deposition rates by assuming a settling velocity of 3.62 cm/s (based on a 10 µm particle) (Zhu, Liu, Cong, & Zhang, 2016).

Daily dustfall rates as a result of the existing licensed operations at the facility and the VCN Furnace operations is provided in Figure 5-35 to Figure 5-37. The dust deposition rate due to existing licensed operations and the VCN Furnace operations is below 600 mg/m²/day (NDCR for residential areas) at all sensitive receptors within the study area.

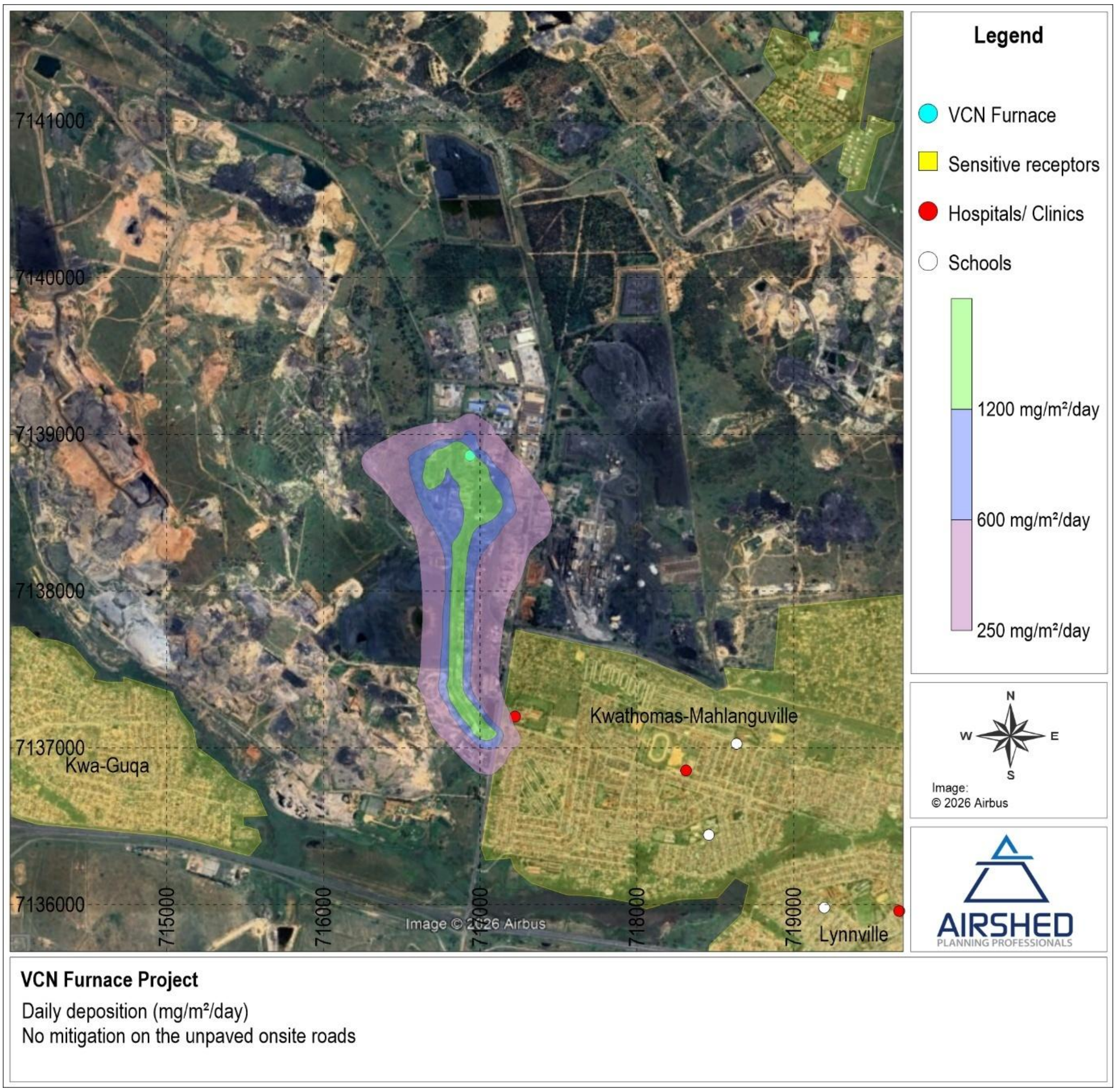


Figure 5-35: Daily dust deposition due to existing licensed operations at the facility

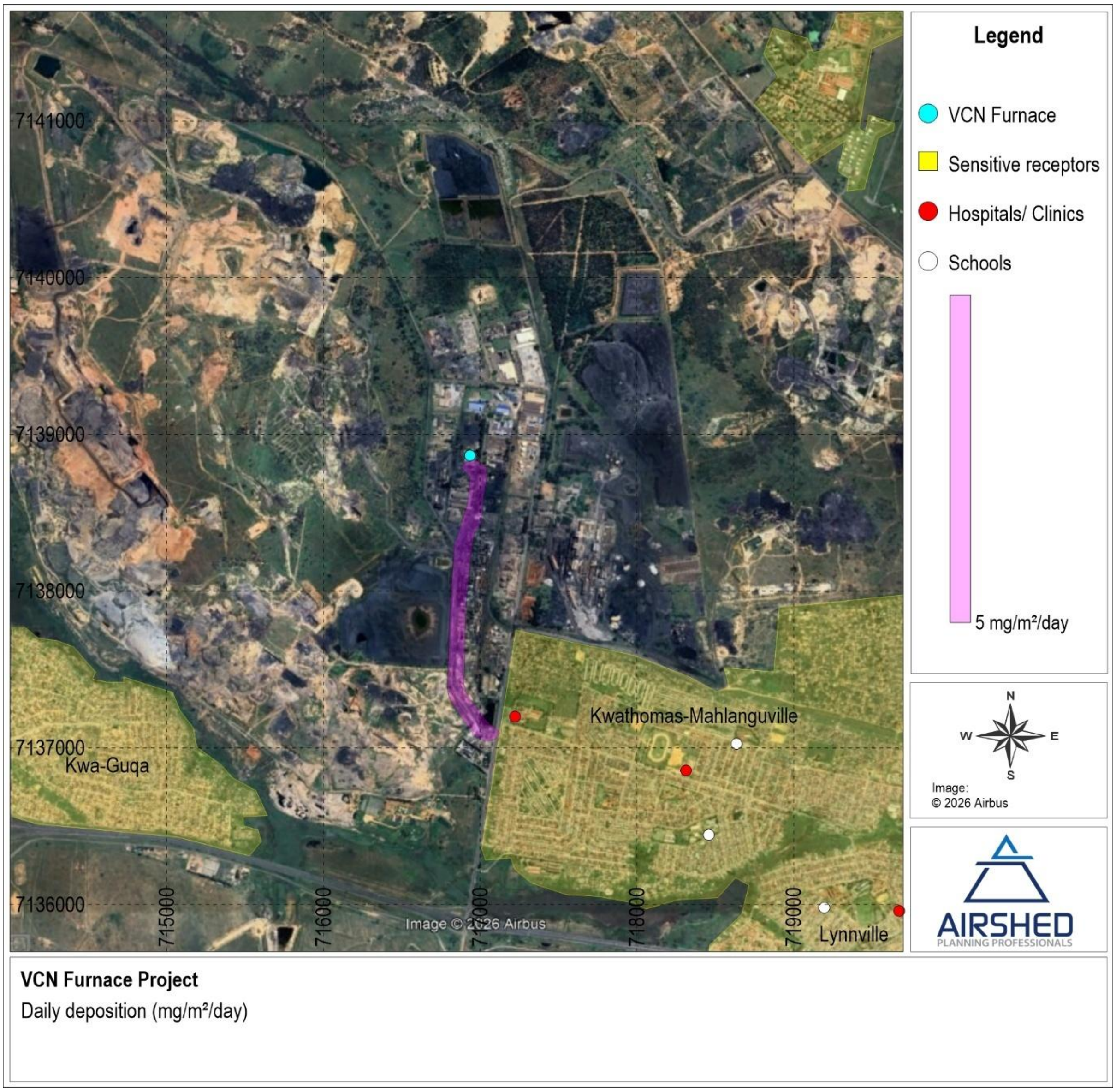


Figure 5-36: Daily dust deposition due to the VCN Furnace operations only

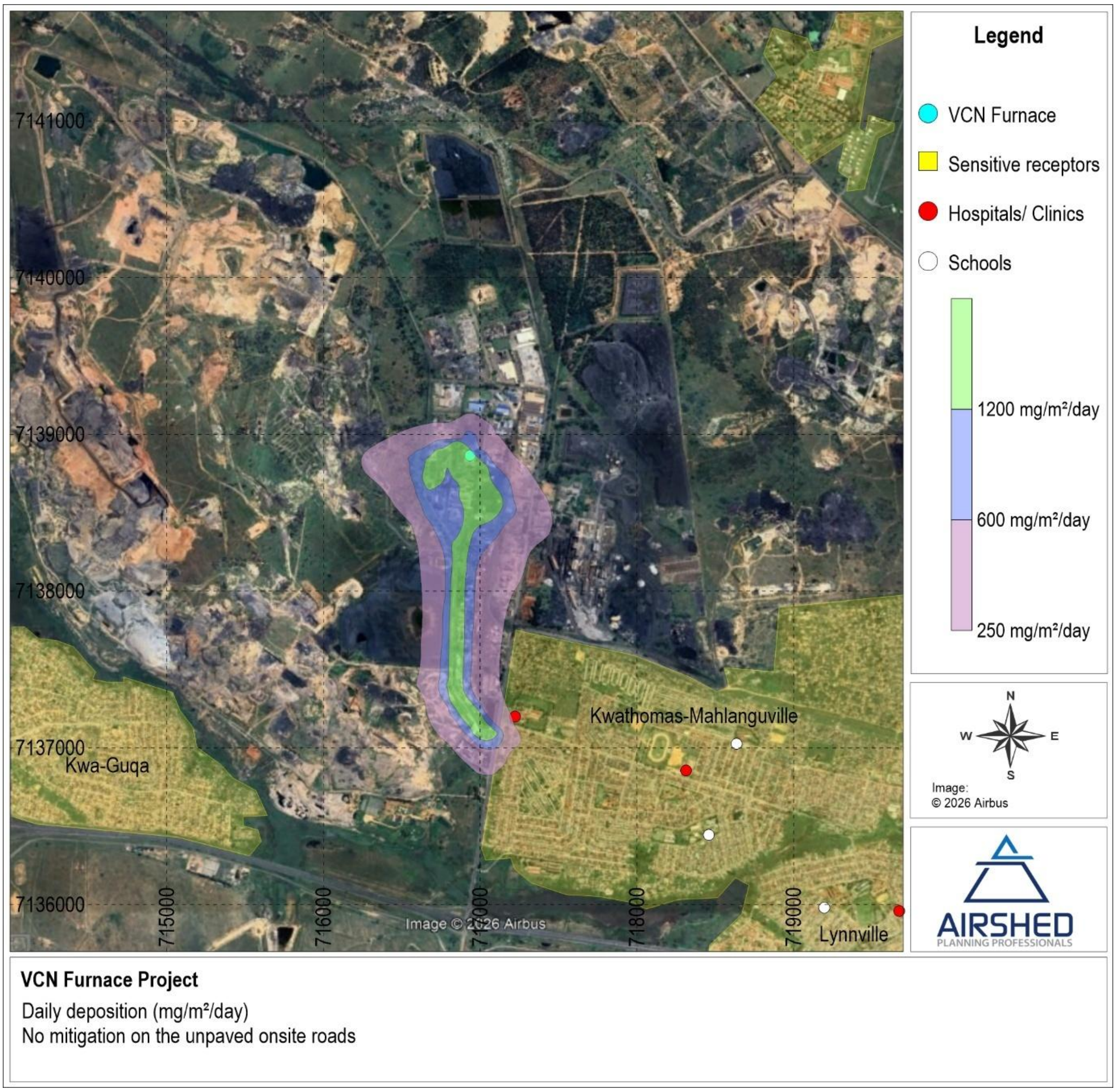


Figure 5-37: Daily dust deposition due to existing licensed operations at the facility and the VCN Furnace operations

6 REFERENCES

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ANNEXURE A

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ANNEXURE A

DECLARATION OF ACCURACY OF INFORMATION – APPLICANT

Name of Enterprise: Char Technology Pty Ltd

Declaration of accuracy of information provided:

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

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

Signed at EMalahleni on this 10 day of February 2026

DocuSigned by:
B9A6D18D0EF54FC...
SIGNATURE

Engineering Manager
CAPACITY OF SIGNATORY

ANNEXURE B

forestry, fisheries & the environment

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

Private Bag X447, Pretoria, 0001, Environment House, 473 Steve Biko Road, Pretoria, 0002 Tel: +27 12 399 9000, Fax: +27 86 625 1042

SPECIALIST DECLARATION FORM – AUGUST 2023

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

REPORT TITLE
Atmospheric Impact Report: Vanadium Carbonitride (VCN) Furnace, Mpumalanga

Kindly note the following:

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

1. SPECIALIST INFORMATION

Title of Specialist Assessment	Air Quality Impact Assessment
Specialist Company Name	Airshed Planning Professionals (Pty) Ltd
Specialist Name	Reneé von Gruenewaldt
Specialist Identity Number	7805130128080
Specialist Qualifications:	MSc.(Earth Sciences)
Professional affiliation/registration:	South African Council for Natural Scientific Professionals: 400304/07
Physical address:	62 Constantia Ave, Pretoria
Postal address:	PostNet Suite #18, Private Bag x59
Postal address	Halfway House, 1685
Telephone	011 805 1940
Cell phone	083 222 6916
E-mail	renee@airshed.co.za

SPECIALIST DECLARATION FORM – AUGUST 2023

2. DECLARATION BY THE SPECIALIST

I, Reneé von Gruenewaldt declare that –

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

[signature]
Signature of the Specialist

Airshed Planning Professionals (Pty) Ltd
Name of Company:

05/02/2026
Date

SPECIALIST DECLARATION FORM – AUGUST 2023

3. UNDERTAKING UNDER OATH/ AFFIRMATION

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

Signature of the Specialist

Airshed Planning Professionals (Pty) Ltd

Name of Company

05/02/2026

Date

7132566-2 Moloko Sgt

Signature of the Commissioner of Oaths

2026-02-05

Date

Ek sertifiseer dat bostaande verklaring deur my afgeneem is en dat die verklaarder erken dat hy/sy vertroud is met die inhoud van die verklaring en dit begryp. Hierdie verklaring is voor my beëdig/bevestig en verklaarder se handtekening/duimafdruk is in my teenwoordigheid daarop aangebring—

I certify that the above statement was taken by me and that the deponent has acknowledged that he/she knows and understands the contents of this statement. This statement was sworn to/affirmed before me and deponent's signature/thumbprint was placed thereon in my presence—

te/at Brooklyn op/on 20260205 om/at 07:05

7132566-2 Moloko Sgt

(HANDTEKENING) KOMMISSARIS VAN EDE
(SIGNATURE) COMMISSIONER OF OATHS

Sello Ben Moloko

VOLLE VOORNAME EN VAN IN DRUKSKRIF
FULL FIRST NAMES AND SURNAME IN BLOCK LETTERS

119 Duxbury Road

BESIGHEIDSADRES (STRAATADRES)
BUSINESS ADDRESS (STREET ADDRESS)

Hillcrest

Sgt

RANG

SOUTH AFRICAN POLICE SERVICE
VISIBLE POLICING
2026 -02- 05
FLASH
BROOKLYN
SUID-AFRIKAANSE POLISIEDIENS

***Batho pele*- putting people first**

Page 3 of 3

APPENDIX A: IMPACT SIGNIFICANCE RATING METHODOLOGY

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

Determination of Environmental Risk:

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

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

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

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

Table A-1: Criteria for determining impact consequence

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. Highly localised, limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property or site boundary, or the area within a few hundred meters of the site)
	3	Local (i.e. beyond the site boundary within the Local administrative boundary (e.g. Local Municipality) or within consistent local geographical features, or the area within 5 km of the site)
	4	Regional (i.e. Far beyond the site boundary, beyond the Local administrative boundaries within the Regional administrative boundaries (e.g. District Municipality), or extends into different distinct geographical features, or extends between 5 and 50 km from the site)
	5	Provincial / National / International (i.e. extends into numerous distinct geographical features, or extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years)

Aspect	Score	Definition
	3	Medium term (6-15 years)
	4	Long term (15 – 65 years, the impact will cease after the operational life span of the project)
	5	Permanent (> 65 years, no mitigation measure of natural process will reduce the impact after construction/operation/decommissioning)
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected)
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected)
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way)
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease)
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease)
Reversibility	1	Impact is reversible without any time and cost
	2	Impact is reversible without incurring significant time and cost
	3	Impact is reversible only by incurring significant time and cost
	4	Impact is reversible only by incurring prohibitively high time and cost
	5	Irreversible Impact

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

Table A-2: Probability scoring

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

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

$$S = C \times P$$

Table A-3: Determination of significance

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

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

Table A-4: Significance scores

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

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

Impact Prioritisation:

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

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

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

Table A-5: Criteria for determining prioritisation

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

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in Table A-5. The impact priority is therefore determined as follows:

$$Priority = CI + LR$$

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

Table A-6: Determination of prioritisation factor

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

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

Table A-7: Final environmental significance rating

Significance Rating	Description

< -25	Very High (Impacts in this class are extremely significant and pose a very high environmental risk. In certain instances, these may represent a fatal flaw. They are likely to have a major influence on the decision and may be difficult or impossible to mitigate. Offset's may be necessary.
-13.75 to -25	High negative (These impacts are significant and must be carefully considered in the decision-making process. They have a high environmental risk or impact and require extensive mitigation measures).
-8.5 to -13.75	Medium-High negative (i.e. Impacts in this class are more substantial and could have a significant environmental risk. They may influence the decision to develop in the area and require more robust mitigation measures).
-4.25 to -8.5	Medium- Low negative (i.e. These impacts are slightly more significant than low impacts but still do not pose a major environmental risk. They might require some mitigation measures but are generally manageable).
-1 to -4.25	Low negative (i.e. Impacts in this class are minor and unlikely to have a significant environmental risk. They do not influence the decision to develop in the area and are typically easily mitigated.
0	No impact
1 to 4.25	Low positive
4.25 to 8.5	Medium-Low positive
8.5 to 13.75	Medium-High positive
>13.75	High positive

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

APPENDIX B: CURRICULUM VITAE OF AUTHOR

FULL CURRICULUM VITAE

Name of Firm	Airshed Planning Professionals (Pty) Ltd
Name of Staff	Reneé von Gruenewaldt (*nee* Thomas)
Profession	Air Quality and Environmental Noise Scientist
Position	Principal consultant
Date of Birth	13 May 1978
Years with Firm	Since January 2002
Nationalities	South African

MEMBERSHIP OF PROFESSIONAL SOCIETIES

- Registered Professional Natural Scientist (Registration Number 400304/07) with the South African Council for Natural Scientific Professions (SACNASP)
- Member of the National Association for Clean Air (NACA)

KEY QUALIFICATIONS

Reneé von Gruenewaldt (Air Quality Scientist): Reneé joined Airshed Planning Professionals (Pty) Ltd (previously known as Environmental Management Services cc) in 2002. She has, as a Specialist, attained over twenty (20) years of experience in the Earth and Natural Sciences sector in the field of Air Quality and nine (9) years of experience in the field of environmental noise assessments. As an environmental practitioner, she has provided solutions to both large-scale and smaller projects within the mining, minerals, and process industries.

She has developed technical and specialist skills in various air quality modelling packages including the AMS/EPA Regulatory Models (AERMOD and AERMET), UK Gaussian plume model (ADMS), EPA Regulatory puff-based model (CALPUFF and CALMET), puff-based HAWK model and line-based models, Lagrangian GRAL model. Her experience with air emission models includes Tanks 4.0 (for the quantification of tank emissions), WATER9 (for the quantification of wastewater treatment works) and GasSim (for the quantification of landfill emissions). Noise propagation modelling proficiency includes CONCAWE, South African National Standards (SANS 10210) for calculating and predicting road traffic noise and CadnaA for propagation of industrial, road and rail noise sources.

Having worked on projects throughout Africa (i.e., South Africa, Mozambique, Malawi, Kenya, Angola, Democratic Republic of Congo, Namibia, Madagascar and Egypt for Air Quality Impact Assessments and Mozambique, Namibia, Botswana, Kenya, Ghana, Suriname and Afghanistan for Environmental Noise Impact Assessments) Reneé has developed a broad experience base. She has a good understanding of the laws and regulations associated with ambient air quality and emission limits in South Africa and various other African countries, as well as the World Bank Guidelines, European Community Limits and World Health Organisation.

RELEVANT EXPERIENCE (AIR QUALITY)

Mining and Ore Handling

Reneé has undertaken numerous air quality impact assessments and management plans for coal, platinum, uranium, copper, cobalt, chromium, fluorspar, bauxite, manganese and mineral sands mines. These include: compilation of emissions databases for Landau and New Vaal coal collieries (SA), impact assessments and management plans for numerous mines over Mpumalanga (viz. Schoonoord, Belfast, Goedgevonden, Mbila, Evander South, Driefontein, Hartogshoop, Belfast, New Largo, Geluk, etc.), Mmamabula Coal Colliery (Botswana), Moatize Coal Colliery (Mozambique), Revuboe Coal Colliery (Mozambique), Toliera Sands Heavy Minerals Mine and Processing (Madagascar), Corridor Sands Heavy Minerals Mine monitoring assessment, El Burullus Heavy Minerals Mine and processing (Egypt), Namakwa Sands Heavy Minerals Mine (SA), Tenke Copper Mine and Processing Plant (DRC), Rössing Uranium (Namibia), Lonmin platinum mines including operations at Marikana, Baobab, Dwaalkop and Doornvlei (SA), Impala Platinum (SA), Pilannesburg Platinum (SA), Aquarius Platinum, Hoogland Platinum Mine (SA), Tamboti PGM Mine (SA), Sari Gunay Gold Mine (Iran), chrome mines in the Steelpoort Valley (SA), Mecklenburg Chrome Mine (SA), Naboom Chrome Mine (SA), Kinsenda Copper Mine (DRC), Kassinga Mine (Angola) and Nokeng Flourspar Mine (SA), etc.

Mining monitoring reviews have also been undertaken for Optimum Colliery's operations near Hendrina Power Station and Impunzi Coal Colliery with a detailed management plan undertaken for Morupule (Botswana) and Glencor (previously known as Xstrata Coal South Africa).

Air quality assessments have also been undertaken for mechanical appliances including the Durban Coal Terminal and Nacala Port (Mozambique) as well as rail transport assessments including BHP-Billiton Bauxite transport (Suriname), Nacala Rail Corridor (Mozambique and Malawi), Kusile Rail (SA) and WCL Rail (Liberia).

Metal Recovery

Air quality impact assessments have been carried out for Highveld Steel, Scaw Metals, Lonmin's Marikana Smelter operations, Saldanha Steel, Tata Steel, Afro Asia Steel and Exxaro's Manganese Pilot Plant Smelter (Pretoria).

Chemical Industry

Comprehensive air quality impact assessments have been completed for NCP (including Chloorkop Expansion Project, Contaminated soils recovery, C3 Project and the 200T Receiver Project), Revertex Chemicals (Durban), Stoppani Chromium Chemicals, Foskor (Richards Bay), Straits Chemicals (Coega), Tenke Acid Plant (DRC), and Omnia (Sasolburg).

Petrochemical Industry

Numerous air quality impact assessments have been completed for Sasol (including the postponement/exemption application for Synfuels, Infrachem, Natref, MIBK2 Project, Wax Project, GTL Project, re-commissioning of boilers at Sasol Sasolburg and Ekandustria), Engen Emission Inventory Functional Specification (Durban), Sapref refinery (Durban), Sasol (at Elrode) and Island View (in Durban) tanks quantification, Petro SA and Chevron (including the postponement/exemption application).

Pulp and Paper Industry

Air quality studies have been undertaken or the expansion of Mondi Richards Bay, Multi-Boiler Project for Mondi Merebank (Durban), impact assessments for Sappi Stanger, Sappi Enstra (Springs), Sappi Ngodwana (Nelspruit) and Pulp United (Richards Bay).

Power Generation

Air quality impact assessments have been completed for numerous Eskom coal fired power station studies including the ash expansion projects at Kusile, Kendal, Hendrina, Kriel and Arnot; Fabric Filter Plants at Komati, Grootvlei, Tutuka, Lethabo and Kriel Power Stations; the proposed Kusile, Medupi (including the impact assessment for the Flue Gas Desulphurization) and Vaal South Power Stations. Reneé was also involved and the cumulative assessment of the existing and return to service Eskom power stations assessment and the optimization of Eskom's ambient air quality monitoring network over the Highveld.

In addition to Eskom's coal fired power stations, various Eskom nuclear power supply projects have been completed including the air quality assessment of Pebble Bed Modular Reactor and nuclear plants at Duynefontein, Bantamsklip and Thyspunt.

Apart from Eskom projects, power station assessments have also been completed in Kenya (Rabai Power Station) and Namibia (Paratus Power Plant).

Waste Disposal

Air quality impact assessments, including odour and carcinogenic and non-carcinogenic pollutants were undertaken for the Waste Water Treatment Works in Magaliesburg, proposed Waterval Landfill (near Rustenburg), Tutuka Landfill, Mogale General Waste Landfill (adjacent to the Leipardsvlei Landfill), Cape Winelands District Municipality Landfill, the Tsoeneng Landfill (Lesotho) and the FG Landfill (near the Midstream Estate). Air quality impact assessments have also been completed for the BCL incinerator (Cape Town), the Ergo Rubber Incinerator and the Ecorevert Pyrolysis Plant.

Cement Manufacturing

Impact assessments for ambient air quality have been completed for the Holcim Alternative Fuels Project (which included the assessment of the cement manufacturing plants at Ulco and Dudfield as well as a proposed blending platform in Roodepoort).

Management Plans

Reneé undertook the quantification of the baseline air quality for the first declared Vaal Triangle Airshed Priority Area. This included the establishment of a comprehensive air pollution emissions inventory, atmospheric dispersion modelling, focusing on impact area "hotspots" and quantifying emission reduction strategies. The management plan was published in 2009 (Government Gazette 32263).

Reneé has also been involved in the Provincial Air Quality Management Plan for the Limpopo Province.

RELEVANT EXPERIENCE (GREENHOUSE GAS EMISSION FOOT-PRINTING AND CLIMATE CHANGE IMPACT STATEMENTS)

Mining and Tailings Storage Facilities

Reneé has quantified the direct and indirect (Scope 2 and Scope 3) emissions for numerous mines over the highveld of South Africa and the Democratic Republic of Congo. She has also assessed the climate risks and vulnerabilities of the project and surrounding communities due to increasing ambient temperatures, water scarcity, risk of intense storms.

Gas to Power Plants

Reneé has quantified the direct and indirect (Scope 2 and Scope 3) emissions for gas to power plants proposed for South Africa. She has also assessed the climate risks and vulnerabilities of the project and surrounding communities due to increasing ambient temperatures, water scarcity, risk of intense storms.

RELEVANT EXPERIENCE (NOISE)

Mining

Reneé has undertaken numerous environmental noise assessments for mining operations. These include environmental noise impact assessments including baseline noise surveys for numerous coal, platinum, manganese, tin and zinc mines. Projects include, but are not limited to, Balama (Mozambique), Masama Coal (Botswana), Lodestone (Namibia), Osino (Namibia), Kurmuk (Ethiopia), Gamsberg (SA), Prieska (SA), Kolomela (SA), Heuningkranz (SA), Syferfontein (SA), South 32 (SA), Mamatwan (SA), Alexander (SA) and Marula Platinum Mine (SA), etc.

Power Generation

Environmental noise assessments have been completed for numerous Eskom coal fired power station studies in SA including the Kriel Fabric Filter Plant, Kendal ash facility, Medupi ash facility. Apart from Eskom projects, power plant assessments have also been completed in Botswana (Morupule), Kenya (Or Power geothermal power plants), Suriname (EBS power plant) and SA (Richards Bay combined cycle power plant).

Process Operations

Environmental noise assessments have been undertaken for various process operations including waste disposal facilities (Bon Accord in Gauteng), bottling and drink facilities (Imali and Isanti Project in Gauteng) and Smelter (Gamsberg in Northern Cape).

Transport

An environmental noise assessment was completed for the Obetsebi road expansion and flyover project in Ghana, the Scorpion Zinc Mine transport route in Namibia and the Sisian-Kajaran (North-South Corridor) Road Project in Armenia.

Gas Pipelines

An environmental noise assessment was completed for the Sheberghan gas pipeline in Afghanistan.

Baseline Noise Surveys

Baseline noise surveys have been undertaken for numerous mining and process operation activities (including Raumix quarries, Kolomela and Sibanye Stillwater Platinum Mines (SA)) in support of onsite Environmental Management Programmes.

OTHER EXPERIENCE (2001)

Research for B.Sc Honours degree was part of the "Highveld Boundary Layer Wind" research group and was based on the identification of faulty data from the Majuba Sodar. The project was THRIP funded and was a joint venture with the University of Pretoria, Eskom and Sasol (2001).

EDUCATION

M.Sc Earth Sciences	University of Pretoria, RSA, Cum Laude (2009) Title: *An Air Quality Baseline Assessment for the Vaal Airshed in South Africa*
B.Sc Hons. Earth Sciences	University of Pretoria, RSA, Cum Laude (2001) Environmental Management and Impact Assessments
B.Sc Earth Sciences	University of Pretoria, RSA, (2000) Atmospheric Sciences: Meteorology

ADDITIONAL COURSES

CALMET/CALPUFF	Presented by the University of Johannesburg, RSA (March 2008)
Air Quality Management	Presented by the University of Johannesburg, RSA (March 2006)

COUNTRIES OF WORK EXPERIENCE

South Africa, Mozambique, Botswana, Ghana, Suriname, Afghanistan, Malawi, Liberia, Kenya, Angola, Democratic Republic of Congo, Ethiopia, Afghanistan, Lesotho, Namibia, Madagascar, Egypt, Suriname and Iran.

EMPLOYMENT RECORD

January 2002 - Present

Airshed Planning Professionals (Pty) Ltd, (previously known as Environmental Management Services cc until March 2003), Principal Air Quality and Environmental Noise Scientist, Midrand, South Africa.

2001

University of Pretoria, Demi for the Geography and Geoinformatics department and a research assistant for the Atmospheric Science department, Pretoria, South Africa.

Department of Environmental Affairs and Tourism, assisted in the editing of the Agenda 21 document for the world summit (July 2001), Pretoria, South Africa.

1999 - 2000

The South African Weather Services, vacation work in the research department, Pretoria, South Africa.

CONFERENCE AND WORKSHOP PRESENTATIONS AND PAPERS

- Understanding the Synoptic Systems that lead to Strong Easterly Wind Conditions and High Particulate Matter Concentrations on The West Coast of Namibia, H Liebenberg-Enslin, R von Gruenewaldt, H Rauntenbach and L Burger. National Association for Clean Air (NACA) conference, October 2017.
- Topographical Effects on Predicted Ground Level Concentrations using AERMOD, R.G. von Gruenewaldt. National Association for Clean Air (NACA) conference, October 2011.
- Emission Factor Performance Assessment for Blasting Operations, R.G. von Gruenewaldt. National Association for Clean Air (NACA) conference, October 2009.
- Vaal Triangle Priority Area Air Quality Management Plan – Baseline Characterisation, R.G. Thomas, H Liebenberg-Enslin, N Walton and M van Nierop. National Association for Clean Air (NACA) conference, October 2007.
- A High-Resolution Diagnostic Wind Field Model for Mesoscale Air Pollution Forecasting, R.G. Thomas, L.W. Burger, and H Rautenbach. National Association for Clean Air (NACA) conference, September 2005.
- Emissions Based Management Tool for Mining Operations, R.G. Thomas and L.W. Burger. National Association for Clean Air (NACA) conference, October 2004.
- An Investigation into the Accuracy of the Majuba Sodar Mixing Layer Heights, R.G. Thomas. Highveld Boundary Layer Wind Conference, November 2002.

LANGUAGES

	Speak	Read	Write
English	Excellent	Excellent	Excellent
Afrikaans	Fair	Fair	Fair

CERTIFICATION

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

Signature of staff member

29/07/2024

Date (Day / Month / Year)

Full name of staff member: Reneé Georgeinna von Gruenewaldt

APPENDIX C – COMPARISON WITH REGULATIONS

C.1 Regulations Regarding Report Writing for Environmental Impact Assessments

This report complies with the requirements of the National Environmental Management Act, 1998 (NEMA, No. 107 of 1998) and the Environmental Impact Assessment (EIA) regulations (Government Notice [GN] R982 as amended by GN 326 of 7 April 2017; GN 706 of 13 July 2018 and GN 320 of 20 March 2020). The table below provides a summary of the requirements, with cross references to the report sections where these requirements have been addressed.

Table C-1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (Government Notice [GN] R982 as amended by GN 326 of 7 April 2017; GN 706 of 13 July 2018 and GN 320 of 20 March 2020)

A specialist report prepared in terms of the Environmental Impact Regulations must contain:	Relevant section in report
Details of the specialist who prepared the report	Preface
The expertise of that person to compile a specialist report including a curriculum vitae	Preface Appendix A
A declaration that the person is independent in a form as may be specified by the competent authority	Preface Addendum B
An indication of the scope of, and the purpose for which, the report was prepared	Preface
An indication of the quality and age of base data used for the specialist report;	Section 5.1.3 Section 5.1.4
A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 5.1.7 Section 5.1.8
The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 5.1.3 Section 5.1.4
A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Preface Section 5.1.1
Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternative;	Section 1.3
An identification of any areas to be avoided, including buffers	Section 1.3
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5.1
A description of any assumptions made and any uncertainties or gaps in knowledge;	Preface
A description of the findings and potential implications of such findings on the impact of the proposed activity or activities	Section 5.1
Any mitigation measures for inclusion in the EMPr	Mitigation measures to be included in the AEL.
Any conditions for inclusion in the environmental authorisation	Conditions will be included in the AEL

A specialist report prepared in terms of the Environmental Impact Regulations must contain:	Relevant section in report
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Monitoring requirements will be stipulated in the AEL
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 5.1.10.2
Regarding the acceptability of the proposed activity or activities; and	Section 5.1 Section 5.2
If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 5.1.10.2
A description of any consultation process that was undertaken during the course of carrying out the study	Not applicable
A summary and copies if any comments that were received during any consultation process	Recorded by the Environmental Assessment Practitioner
Any other information requested by the competent authority.	None received

C.2 Regulations Regarding Atmospheric Impact Reports

The Regulations prescribing the format of the Atmospheric Impact Report (AIR) (Government Gazette No 36094; published 11 October 2013) were referenced for the air dispersion modelling approach used in this study. Table C-2 compares the AIR Regulations with the approach used.

Table C-1: Comparison of Regulations for the AIR with study approach

Chapter	Name	AIR regulations requirement	Status in AIR
1	Enterprise details	Enterprise Details Location and Extent of the Plant Atmospheric Emission Licence and other Authorisations	Enterprise details included. Location of plant included. Details of existing AEL included.
2	Nature of process	Listed Activities Process Description Unit Processes	All detail included in the regulated format
3	Technical Information	Raw Materials Used and Production Rates Appliances and Abatement Equipment Control Technology	Included in Section 3
4	Atmospheric Emissions	Point Source Emissions Point Source Parameters Point Source Maximum Emission Rates during Normal Operating Conditions Point Source Maximum Emission Rates during Start-up, Maintenance and/or Shut-down Fugitive Emissions	Included in Section 4

Chapter	Name	AIR regulations requirement	Status in AIR
		Emergency Incidents	
5	Impact of enterprise on receiving environment		
5.1	Analysis of emissions impact on human health	Must conduct dispersion modelling, must be done in accordance with Regulations; must use NAAQS	Completed as set out by the Regulations.
5.2	Analysis of emissions impact on environment	Must be undertaken at discretion of Air Quality Officer.	Impact on vegetation and nuisance dustfall was quantified for the operational phase of the VCN Furnace (Section **Error! Reference source not found.**)
6	Complaints	Details on complaints received for last two years	Proposed facility.
7	Current or planned air quality management interventions	Interventions currently being implemented and scheduled and approved for next 5 years.	Proposed facility.
8	Compliance and enforcement history	Must set out all air quality compliance and enforcement actions undertaken against the enterprise in the last 5 years. Includes directives, compliance notices, interdicts, prosecution, fines	Proposed facility; no compliance and enforcement actions yet.
9	Additional information		None

C.3 Regulations Regarding Air Dispersion Modelling

The promulgated Regulations regarding Air Dispersion Modelling (Gazette No. 37804, vol. 589; 11 July 2014) were consulted to ensure that the dispersion modelling process used in this assessment agreed with the regulations. Table C-3 compares the Air Dispersion Modelling Regulations with the approach used in Section 5.

Table C-3: Comparison of Regulations regarding the Air Dispersion Modelling with study approach

AIR Regulations	Compliance with Regulations	Comment
Levels of assessment		
• Level 1: where worst-case air quality impacts are assessed using simpler screening models • Level 2: for assessment of air quality impacts as part of license application or amendment processes, where impacts are the greatest within a few kilometers downwind (less than 50km) • Level 3: requires more sophisticated dispersion models (and corresponding input data, resources and model operator expertise) in situations:	Level 2 assessment using AERMOD	This gaussian plume model is well suited to simulate facilities with impacts less than 50 km.

AIR Regulations	Compliance with Regulations	Comment
– where a detailed understanding of air quality impacts, in time and space, is required; – where it is important to account for causality effects, calms, non-linear plume trajectories, spatial variations in turbulent mixing, multiple source types, and chemical transformations; – when conducting permitting and/or environmental assessment process for large industrial developments that have considerable social, economic and environmental consequences; – when evaluating air quality management approaches involving multi-source, multi-sector contributions from permitted and non-permitted sources in an airshed; or, – when assessing contaminants resulting from non-linear processes (e.g. deposition, ground-level ozone (O_3), particulate formation, visibility)		
Model Input		
Source characterisation	Yes	Source characterisation provided in Section 4.
Emission rates: For new or modified existing sources the maximum allowed amount, volume, emission rates and concentration of pollutants that may be discharged to the atmosphere should be used	Yes	Emission rates used for each scenario are provided in 4.
Meteorological data		
Full meteorological conditions are recommended for regulatory applications.	Yes	Measured SAWS meteorological data used (Section **Error! Reference source not found.**).
Data period	Yes	3 years (2022 to 2024)
Geographical Information		
Topography and land-use		Topography not required for the study area as no significant topographical features are present. Land-use is included in the AERMET processor.
Domain and co-ordinate system	Yes	• Dispersion modelling domain: 5.7 x 6 km

AIR Regulations	Compliance with Regulations	Comment
		• UTM co-ordinate system (WGS84)
General Modelling Considerations		
Ambient Background Concentrations, including estimating background concentrations in multi-source areas	Yes	Section 5.1.4
NAAQS analyses for new or modified sources: impact of source modification in terms of ground-level concentrations should be assessed within the context of the background concentrations	Yes	Model predicted, 99th percentile ground-level concentrations compared against NAAQS (Section 5.1.5 to Section 5.1.7)
Land-use classification	Yes	
Surface roughness	Yes	
Albedo	Yes	
Temporal and spatial resolution		
Receptors and spatial resolutions	Yes	Sections **Error! Reference source not found.**
Building downwash	Yes	Included for tank emission simulations
Chemical transformations	No	
General Reporting Requirements		
Model accuracy and uncertainty	No	
Plan of study	Yes	Section **Error! Reference source not found.**
Air Dispersion Modelling Study Reporting Requirements	Yes	As per the Regulations Prescribing the Format of the Atmospheric Impact Report, Government Gazette No. 36904, Notice Number 747 of 2013 (11 October 2013) and as per the Regulations Regarding Air Dispersion Modelling (Government Gazette No. 37804 Notice R533, 11 July 2014).

AIR Regulations	Compliance with Regulations	Comment
Plotted dispersion contours	Yes	Sections 5.1