AIRSHED
PLANNING PROFESSIONALS

Air Quality Impact Assessment for the Proposed Small-Scale Waste Incinerator referred to as an Eco-waste Composter

Project done on behalf of **CES - Environmental and social advisory services**

Report Compiled by:
Gillian Petzer

Project Manager
Gillian Petzer

Report No: 19CES02 Rev 0 | **Date:** October 2019

Address: 480 Smuts Drive, Halfway Gardens | **Postal:** P O Box 5260, Halfway House, 1685
Tel: +27 (0)11 805 1940 | **Fax:** +27 (0)11 805 7010
www.airshed.co.za

Report Details

Reference	19CES02
Status	Rev 0
Report Title	Air Quality Impact Assessment for the Proposed Small-Scale Waste Incinerator referred to as an Eco-waste Composter
Date Submitted	October 2019
Project Consultant	CES - Environmental and social advisory services
Prepared by	**Gillian Petzer,** Pr Eng, (BEng, Chemical, Univ. of Pretoria)
Reviewed by	
Notice	Airshed Planning Professionals (Pty) Ltd is a consulting company located in Midrand, South Africa, specialising in all aspects of air quality, ranging from nearby neighbourhood concerns to regional air pollution impacts as well as noise impact assessments. The company originated in 1990 as Environmental Management Services, which amalgamated with its sister company, Matrix Environmental Consultants, in 2003.
Declaration	I, Gillian Petzer, as authorised representative of Airshed Planning Professionals (Pty) Ltd hereby confirm my independence as a specialist and declare that neither I nor Airshed Planning Professionals (Pty) Ltd have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Airshed Planning Professionals (Pty) Ltd was appointed as air quality specialists in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998); other than fair remuneration for worked performed, specifically in connection with the assessment summarised in this report. I also declare that I have expertise in undertaking the specialist work as required, possessing working knowledge of the acts, regulations and guidelines relating to the application. I further declare that I am able to perform the work relating to the application in an objective manner, even if this result in views and findings that is not favourable to the application; and that I am confident in the results of the studies undertaken and conclusions drawn as a result of it – as is described in this report.
Copyright Warning	

Revision Record

Revision Number	Date	Reason for Revision
0	October 2019	Report for review

Specialist Report Requirements (NEMA Regulation, 2017)

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	Relevant section in report
a	details of- (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Report details (page ii) Section 7 (Appendix B)
b	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Report details (page ii)
c	an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1
cA	an indication of the quality and age of base data used for the specialist report;	Section 3
cB	a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 3
d	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 3.2
e	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Sections 1.3 and 4.1
f	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 alternatives;	Section 3.1
g	an identification of any areas to be avoided, including buffers;	NA
h	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;	NA
i	a description of any assumptions made and any uncertainties or gaps in knowledge;	Sections 1.4, 1.5
j	a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Sections 4.3, 5
k	any mitigation measures for inclusion in the EMPr;	NA
l	any conditions for inclusion in the environmental authorisation;	Section 5
m	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 5
n	a reasoned opinion- (i) as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and (ii) if the opinion is that the proposed activity, activities 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
o	a description of any consultation process that was undertaken during the course of preparing the specialist report;	NA
p	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	NA
q	any other information requested by the competent authority.	NA

Abbreviations

Airshed	Airshed Planning Professionals (Pty) Ltd
APPA	Air Pollution and Prevention Act
AQSR	Air Quality Sensitive Receptor
ASTM	American Society for Testing and Materials
DEA	Department of Environmental Affairs (South Africa)
DEFF	Department of Environment, Forestry and Fisheries (previously DEA)
GLC(s)	Ground level concentration(s)
IFC	International Finance Corporation
NAAQS	National Ambient Air Quality Standards (South Africa)
NDCR	National Dust Control Regulations
NEM:AQA	National Environmental Management Air Quality Act (South Africa)
SA	South Africa(n)
SABS	South African Bureau of Standards
US EPA	United States Environmental Protection Agency

Symbols and Units

°C	Degrees Celsius
µg	Microgram(s)
µg/m³	Micrograms per cubic meter
km	Kilometers
m/s	Metres per second
m²	Metres squared
mg	Milligram(s)
mm	Millimeters
PM	Particulate Matter
PM_{10}	Thoracic particulate matter
$PM_{2.5}$	Respirable particulate matter
tpa	Tonnes per annum

Executive Summary

Introduction

CES has been requested by Vaduba Investments (Pty) Ltd to assist with the Atmospheric Emission License (AEL) Application. In support of the application for an AEL, Airshed Planning Professionals (Pty) Ltd (Airshed) was appointed to do an air quality impact assessment.

The project involves the use of an Eco-Waste Composter that will be situated at the Stone Ridge Quarry Site in Fort Jackson, East London. At this stage, Vaduba Investments propose to treat waste using the Eco-waste composter at the Stone Ridge Quarry site as a pilot study to potentially expand in terms of location and capacity of waste treated at the facility.

The thermal treatment of hazardous and general waste (subcategory 8.1) and veterinary waste incineration (subcategory 8.2) are Listed Activities under the National Environmental Management Air Quality Act (NEMAQA), Act no. 39 of 2004 and require an AEL to operate.

Scope and Approach

The purpose of this investigation was to determine baseline air quality conditions, identify sensitive receptors and quantify and assess the potential impact that the proposed incinerator may have on the receiving environment.

The following tasks, typical of an air quality impact assessment, were included in the scope of work:

- A review of surrounding activities in order to identify sources of emission and associated pollutants;
- A study of regulatory requirements and inhalation thresholds for identified key pollutants against which compliance need to be assessed and health risks screened;
- A study of the environment in the vicinity of the proposed development; including:
    - The identification of potential air quality sensitive receptors (AQSRs); and
    - The analysis of all available ambient air quality information/data to determine pre-development ambient pollutant levels and dustfall rates.
- The compilation of a comprehensive emissions inventory:
- Atmospheric dispersion modelling to simulate ambient air pollutant concentrations.
- A screening assessment to determine:
    - Compliance of simulated criteria pollutant concentrations with ambient air quality standards and screening criteria.
- The compilation of a comprehensive air quality specialist report detailing the study approach, limitations, assumption, results and recommendations.

Main Findings and Recommendation

The main findings from the air quality impact assessment are:

- The proposed incinerator will need to comply with new plant minimum emissions standards (MES). These emission limits were used in the dispersion modelling exercise as a conservative estimate of the incremental impact of the incinerator.

- No ambient criteria pollutant data is available close to site and therefore it was only possible to estimate the incremental impact.
- Dust fallout data at the quarry indicates non-compliance with National Dust Control Regulations (NDCR). The proposed incinerator will however not have significant dust fallout.
- Simulated ambient criteria pollutant (PM_{10}, NO_2, SO_2, CO and Pb) concentrations were well below the National Ambient Air Quality Standards (NAAQS) at all the nearby residential areas, schools and hospitals.
- Simulated non-criteria pollutants concentrations were all low and within relevant health screening criteria at all the nearby residential areas, schools and hospitals.
- The contribution from the proposed incinerator to cumulative ambient air quality is regarded very low based on the simulated ground-level concentrations.

The proposed incinerator triggers the Subcategory 8.1 and this has numerous special arrangements (see section 2.1). It is recommended that these are carefully reviewed and it is ensured that they are met. It is recommended that in-stack monitoring be scheduled soon after incinerator operations are initiated, assuming an AEL is granted, in order to ensure MES compliance. It could also trigger the Subcategory 8.2 if veterinary waste is incinerated.

In conclusion, it is the specialist opinion that the proposed incinerator may be authorised, however it is recommended that a stack monitoring campaign confirm that the pollutant concentrations are within the MES as assumed in the dispersion modelling exercise to determine air quality impact.

Table of Contents

List of Tables

List of Figures

Air Quality Impact Assessment for the Proposed Small-Scale Waste Incinerator referred to as an Eco-waste Composter

1 INTRODUCTION

CES - Environmental and social advisory services (CES) has been requested by Vaduba Investments (Pty) Ltd to assist with the Atmospheric Emission License (AEL) Application. In support of the application for an AEL, Airshed Planning Professionals (Pty) Ltd (Airshed) was appointed to do an air quality impact assessment.

The project involves the use of an Eco-Waste Composter that will be situated at the Stone Ridge Quarry Site in Fort Jackson, East London. At this stage, Vaduba Investments propose to treat waste using the Eco-waste composter at the Stone Ridge Quarry site as a pilot study to potentially expand in terms of location and capacity of waste treated at the facility. The proposed development can be seen in Figure 1.

The thermal treatment of hazardous and general waste (subcategory 8.1) and veterinary waste incineration (subcategory 8.2) are Listed Activities under the National Environmental Management Air Quality Act (NEMAQA), Act no. 39 of 2004.

1.1 Scope of Work

The purpose of this investigation is to determine baseline air quality conditions, identify sensitive receptors and quantify and assess the potential impact that the project may have on the receiving environment.

The following tasks, typical of an air quality impact assessment, are included in the scope of work:

- A review of surrounding activities in order to identify sources of emission and associated pollutants;
- A study of regulatory requirements and inhalation thresholds for identified key pollutants against which compliance need to be assessed and health risks screened;
- A study of the environment in the vicinity of the proposed development; including:
  - The identification of potential air quality sensitive receptors (AQSRs); and
  - The analysis of all available ambient air quality information/data to determine pre-development ambient pollutant levels and dustfall rates.
- The compilation of a comprehensive emissions inventory:
- Atmospheric dispersion modelling to simulate ambient air pollutant concentrations.
- A screening assessment to determine:
  - Compliance of simulated criteria pollutant concentrations with ambient air quality standards and screening criteria.
- The compilation of a comprehensive air quality specialist report detailing the study approach, limitations, assumption, results and recommendations.

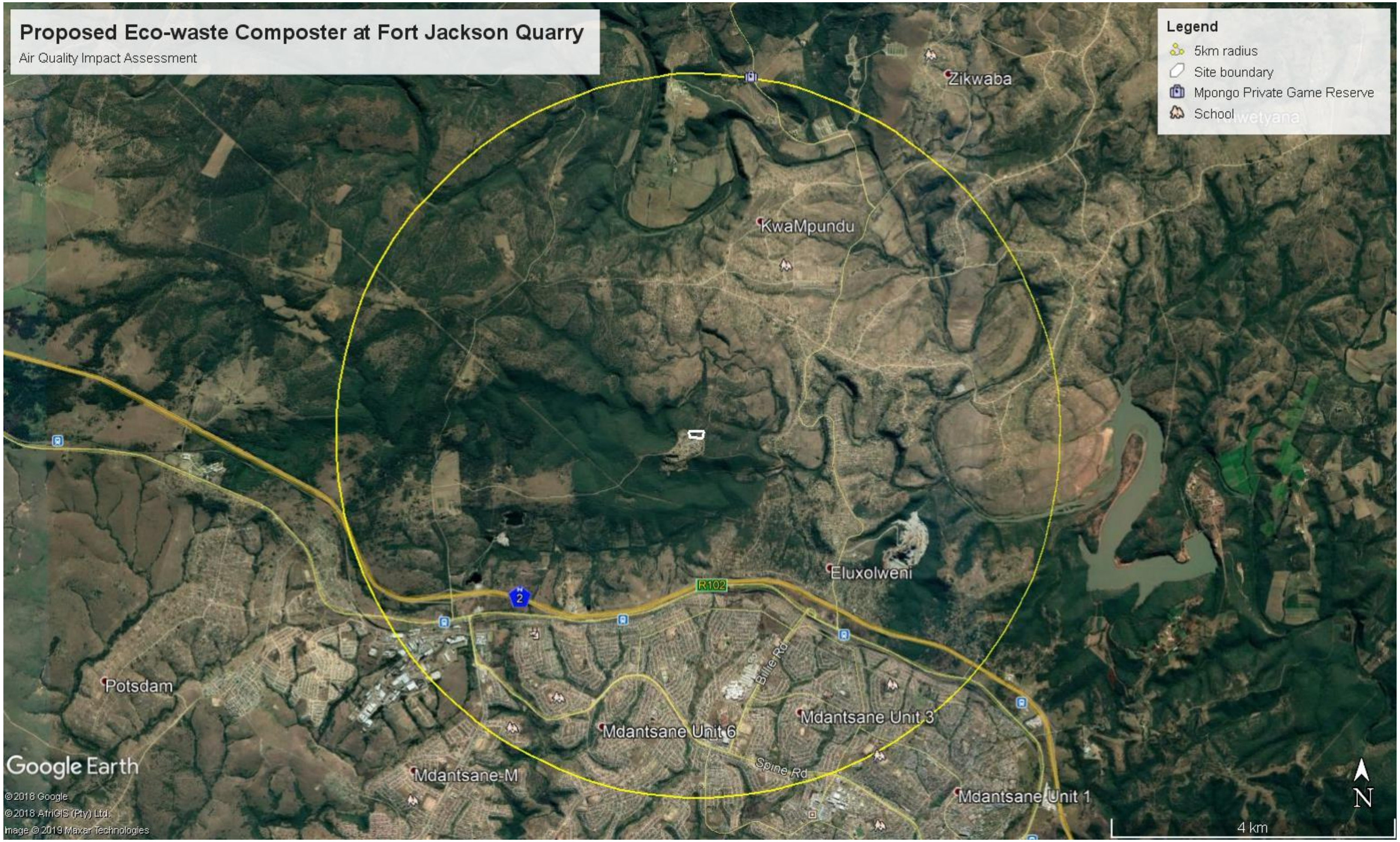

Figure 1: Locality map showing the proposed development

1.2 Description of Project Activities from an Air Quality Perspective

The main focus of the air quality impact assessment is the impact of the incinerator on the receiving environment.

Air quality impacts will be associated with the construction phase of the proposed development; however this will be of a short duration.

Construction will typically include land clearing of the construction footprint, general construction activities (i.e. bulk earthworks and infrastructure development for buildings and on-site roads etc.), bulldozing, loading and grading activities. These operations will likely result in fugitive[1] particulate matter (PM) emissions.

Particulate emissions often vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions. A large portion of the emissions results from equipment traffic over temporary roads at the construction site (US EPA, 1995).

This report therefore only focusses on the air quality impact from the operational phase.

1.3 Approach and Methodology

The approach and methodology followed in the completion of tasks included in the scope of work are discussed below:

1.3.1 Project Information and Activity Review

All project related information referred to in this study was provided by CES or the client.

1.3.2 The Identification of Regulatory Requirements and Screening Criteria

In the evaluation of ambient air quality impacts reference was made to:

- South African National Ambient Air Quality Standards (NAAQS) for criteria pollutants; and
- International Inhalation Assessment criteria for non-criteria pollutants.

1.3.3 Determining the Impact of the Project on the Receiving Environment

The establishment of a comprehensive emission inventory formed the basis for the assessment of the air quality impacts of the proposed incinerator on the receiving environment.

1.3.4 Compliance Assessment

Compliance was assessed by comparing simulated ambient criteria pollutant concentrations (PM_{10}, SO_2, NO_2, CO, Pb) and non-criteria pollutant concentrations (HCl, HF, Hg, Cd, NH_3, PCDD) to selected ambient air quality criteria.

[1] Fugitive emissions refer to emissions that are spatially distributed over a wide area and not confined to a specific discharge point as would be the case for process related emissions (IFC, 2007).

1.3.5 Impact Significance

The significance of impacts was determined in line with the requirements for impact assessment as outlined in the NEMA.

1.3.6 The Development of an Air Quality Management Plan

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

1.4 Assumptions, Exclusions and Uncertainties

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

- Constructional phase impacts of the proposed site were not quantified. These impacts are expected to be of short duration.
- Emissions for the operational phase were assumed to be equal to the minimum emissions standards (MES).
- A level 1 screening assessment was done as a level 1 assessment provides an estimate of the worst-case air quality impacts. Screening models are sufficient for this level. Level 1 assessments must be used for licence decisions for typically single sources.

1.5 Gaps in Knowledge

The following was identified as gaps in knowledge during the specialist study and should be noted:

- No on-site pre-development ambient pollutant concentration data was available for the proposed development site, only dust fallout.

2 Regulatory Requirements and Impact Assessment Criteria

Prior to assessing the impact of the project on human health and the environment, reference needs to be made to the environmental regulations governing the impact of such operations i.e. emission standards, ambient air quality standards and dust control regulations.

Emission standards are generally set for point sources and specify the amount of the pollutant acceptable in an emission stream and are often based on proven efficiencies of air pollution control equipment.

Air quality guidelines and standards are fundamental to effective air quality management, providing the link between the source of atmospheric emissions and the user of that air at the downstream receptor site. The ambient air quality standards and guideline values indicate safe daily exposure levels for the majority of the population, including the very young and the elderly, throughout an individual's lifetime. Air quality guidelines and standards are normally given for specific averaging or exposure periods. This section summarises legislation for criteria and non-criteria pollutants relevant to the study and dustfall impacts.

2.1 Emission Standards

The NEM:AQA (Act No. 39 of 2004 as amended) mandates the Minister of Environment to publish a list of activities which result in atmospheric emissions and consequently cause significant detrimental effects on the environment, human health and social welfare. All scheduled processes as previously stipulated under the Air Pollution Prevention Act (APPA) are included as listed activities with additional activities added to the list. The updated Listed Activities and Minimum National Emission Standards were published on the 22nd November 2013 in Government Gazette No. 37054 (Government Gazette, 2013). Amendments to these activities were published in 2015 (Government Gazette, 2015), 2018 (Government Gazette, 2018) and 2019 (Government Gazette, 2019).

Thermal treatment of general and hazardous waste is a Listed Activity under Section 21 of the Air Quality Act and requires an AEL to operate. The minimum emission limits as per the Listed Activity Sub-category 8.1 are provided in Table 1. The proposed incinerator as a new facility, will be required to comply with the new Plant MES as set out in Table 1.

Table 1: Subcategory 8.1 minimum emission standards for the thermal treatment of hazardous and general waste

Description:	Facilities where general and hazardous waste are treated by the application of heat.		
Application:	All installations treating 10 kg per day of waste.		
Substance or mixture of substances		**Plant Status**	**mg/Nm3 under normal conditions of 273 K and 101.3 kPa**
Common Name	**Chemical Symbol**		
Particulate matter	N/A	New	10
		Existing	25
Carbon monoxide	CO	New	50
		Existing	75
Sulfur dioxide	SO_2	New	50
		Existing	50
Oxides of nitrogen	NO_x expressed as NO_2	New	200
		Existing	200
Hydrogen chloride	HCl	New	10
		Existing	10
Hydrogen fluoride	HF	New	1

		Existing	1
Sum of lead, arsenic, antimony, chromium, cobalt, copper, manganese, nickel and vanadium.	Pb + As + Sb + Cr + Co + Cu + Mn + Ni + V	New	0.5
		Existing	0.5
Mercury	Hg	New	0.05
		Existing	0.05
Cadmium and thallium	Cd + Tl	New	0.05
		Existing	0.05
Total organic compounds	TOC	New	10
		Existing	10
Ammonia	NH_3	New	10
		Existing	10
Common Name	**Chemical Symbol**	**Plant Status**	**ng I-TEQ/Nm^3 under normal conditions of 10% O_2, 273 K and 101.3 kPa**
Dioxins and furans	PCDD/PCDF	New	0.1
		Existing	0.1

(a) The following special arrangements shall apply:

(i) For pyrolysis, reference oxygen content does not apply.

(ii) The facility shall be designed, equipped, built and operated in such a way so as to prevent the emission into air giving rise to significant ground-level air pollution (i.e. leading to the exceedance of an accepted ambient air quality threshold standard).

(iii) Monitoring equipment shall be installed and acceptable techniques used in order to accurately monitor the parameters, conditions and mass concentrations relevant to the co-processing of AFR and incineration of waste.

(iv) All continuous, on-line emission monitoring results must be reported as a daily average concentration expressed as mg/Nm^3, and at 'normalised' conditions of 10% O_2, 101.3 kPa, 273 K / 0 °C, dry gas.

(v) Discontinuous (periodic) emission monitoring results must be expressed as mg/Nm^3, or ng/Nm^3 I-TEQ for PCDD/PCDF, and at 'normalised' conditions of 10% 02, 101.3, kPa, 273 K / 0 °C, dry gas.

(vi) Exit gas temperatures must be maintained below 200 °C.

(vii) Pollution control devices (exhaust gas cooling and bag filter or ESP) must have a daily availability of 98% (i.e. maximum downtime of 2% or 30 minutes per running 24 hours). The cumulative annual downtime (total downtime over a one year period) may however not exceed 60 hours (0.685% per annum).

(viii) Continuous, on-line measurement of the following emissions and operating parameters is required:

- Particulate matter (total particulate);
- O_2;
- CO;
- NO_x;
- SO_2;
- HCl;
- HF;
- VOC/TOC;
- Emission exhaust volume (e.g. Nm^3/hr) and flow rate (e.g. m/s);
- Water vapour content of exhaust gas (humidity);
- Exhaust gas temperature;
- Internal process temperature/s;
- Pressure; and
- Availability of air pollution control equipment (including exit gas cooling).

(ix) Appropriate installation and functioning of automated, continuous monitoring equipment for emissions to air, which are subject to quality control and to an annual surveillance test. Independent accredited calibration must be undertaken by means of parallel measurements with the reference methods, at a frequency as per the requirements of the equipment, but as a minimum every 3 years.

(x) Periodic measurements of heavy metals and dioxin and furan emissions must be undertaken, using national (if available) or internationally acceptable methods, by independent/external, accredited specialists twice during the first 12 months of waste incineration / AFR co-processing, and annually thereafter.

(xi) Average emission values for heavy metals are to be measured over a minimum sample period of 60 minutes to obtain a representative sample, and a maximum of 8 hours, and the average values for dioxins and furans (expressed as I-TEQ) over a sample period of a minimum of 60 minutes and maximum of 8 hours.

(xii) Periodic measurements of heavy metals and dioxins and furans are to be carried out representatively to provide accurate and scientifically correct emission data and results, and sampling and analysis must be carried out by independent, accredited laboratories.

(xiii) To ensure valid monitoring results are obtained, no more than five half-hourly average values in any day, and no more than ten daily average values per year, may be discarded due to malfunction or maintenance of the continuous measurement system.

(xiv) All measurement results must be recorded, processed and presented in an appropriate manner in a Quarterly Emissions Monitoring Report in order to enable verification of compliance with permitted operating conditions and air emission standards. Quarterly Emission Monitoring Reports must include, amongst others:

- Daily average results of all continuous, on-line emission monitoring parameters, reported on line graphs that include individual, daily average data points, and indicating the relevant air emission limit if applicable;
- Results of all continuous, on-line operational monitoring parameters, reported on line graphs that correspond in scale with the emission monitoring results;
- Results of periodic emission measurements of heavy metals, and dioxins and furans;
- Confirmation of residence times and temperatures of specific wastes co-processed as determined by the specific feed points, plant dimensions and material and gas flow rates;
- Discussion on availability or air pollution control equipment, together with reasons for and management of downtime;
- All relevant results must be compared with baseline measurements taken prior to the co-processing of AFR or hazardous waste; and
- Detailed evaluation and discussion of any non-compliance during the reporting period.

(xv) Treatment of High Level POPs Containing Waste (as defined by the Stockholm and Basel Conventions) are to be preceded by an independently monitored Performance Verification Test to determine the Destruction Efficiency (DE) and Destruction and Removal Efficiency (DRE) of principal organic hazardous compounds (POHC) using a suitable verification compound (e.g. trichloroethane).

(xvi) A plan for conducting a Performance Verification Test must be submitted to the relevant Government Department/s at least 3 months prior to the commencement of such a test, and must include, amongst others, the following:

- Motivation for why the plant should be used for treatment of High Level POPs;
- A feasibility study showing that the plant is technically qualified;
- Planned date for commencement of the test and expected duration;
- Details on the waste to be co-processed during the test, including source, volume, composition etc.;
- Motivation for the particular choice of waste and its suitability in providing an accurate and representative indication of the plant's DE and DRE, and therefore suitability to treat High Level POPs Containing Waste;
- Extension of monitoring regime to include chlorobenzenes, HCB, PCBs, benzene, toluene, xylenes, PAHs, and NH_3;
- Monitoring and analysis to be conducted, the associated methodologies and independent parties responsible for monitoring.

(xvii) A detailed, independent report documenting and interpreting the results of the Performance Verification Test must be compiled. As a minimum, a DE/DRE of 99.9999% would be required, as well as compliance with Air Emission Standards.

(xviii) An Air Quality Improvement Plan for achieving emission limits over time must be developed if transitional arrangements apply to compliance with emission standards.

(xix) Compliance time frames for health care risk waste incineration will be as specified in paragraphs (8); (9); and (10) unless specific compliance time frames for health care risk waste incineration have been set under health care risk waste regulations, in which case, the specific compliance time frames for health care risk waste incineration set under health care risk waste regulations shall apply.

(xx) Continuous emission monitoring for Health Care Risk Incinerators shall be complied with by 31 March 2014.

(xxi) Combustion of solid, liquid and gaseous waste materials in installations primarily used for steam for steam raising or electricity generation must comply with the emission standards of this sub- category.

Veterinary waste incineration is a Listed Activity under Section 21 of the Air Quality Act and requires an AEL to operate. The minimum emission limits as per the Listed Activity Sub-category 8.2 are provided in Table 2. The proposed incinerator as a new facility, will be required to comply with the new Plant MES as set out in Table 2.

Table 2: Subcategory 8.2 minimum emission standards for crematoria and veterinary waste incineration

Description:	Crematoria of human remains, companion animals (pets) and the incineration of veterinary waste.
Application:	All installations.

Substance or mixture of substances		Plant Status	mg/Nm3 under normal conditions of 11% O_2, 273 K and 101.3 kPa
Common Name	Chemical Symbol		
Particulate matter	N/A	New	40
		Existing	250
Carbon monoxide	CO	New	75
		Existing	150
Oxides of nitrogen	NO_x expressed as NO_2	New	500
		Existing	1000
Mercury (Applicable to human cremation only)	Hg	New	0.05
		Existing	0.05

2.2 Ambient Air Quality Standards for Criteria Pollutants

Criteria pollutants are considered those pollutants most commonly found in the atmosphere, that have proven detrimental health effects when inhaled and are regulated by ambient air quality criteria. In the context of this project, these include PM (particulate matter), SO_2 (sulphur dioxide), NO_2 (nitrogen dioxide), CO (carbon monoxide) and lead (Pb).

The South African Bureau of Standards (SABS) assisted the Department of Environmental Affairs (DEA) in the development of ambient air quality standards. National Ambient Air Quality Standards (NAAQS) were determined based on international best practice for PM_{10}, $PM_{2.5}$, dustfall, SO_2, NO_2, ozone (O_3), CO, Pb and benzene (C_6H_6). The final revised NAAQSs were published in the Government Gazette on 24 of December 2009 (Government Gazette, 2009) and included a margin of tolerance (i.e. frequency of exceedance) and implementation timelines linked to it. NAAQS for $PM_{2.5}$ were published on 29 July 2012 (Government Gazette, 2012). The NAAQSs referred to in this study are listed in Table 3.

Table 3: Air quality standards for criteria pollutants (SA NAAQS)

Pollutant	Averaging Period	Concentration (µg/m³)	Frequency of Exceedance (FOE)	Compliance Date
$PM_{2.5}$	24 hour	40	4	1 January 2016 to 31 December 2029
	1 year	20	-	
	24 hour	25	4	1 January 2030
	1 year	15	-	
PM_{10}	24 hour	75	4	Immediate
	1 year	40	-	
SO_2	1 hour	350	88	Immediate
	24 hour	125	4	
	1 year	50	-	
NO_2	1 hour	200	88	Immediate
	1 year	40	-	
CO	8 hour	10 000	11	Immediate
	1 hour	30 000	88	
Lead (Pb)	1 year	0.5	-	Immediate

2.3 Assessment Criteria for Non-criteria Pollutants

Air quality criteria for non-criteria pollutants are published by various sources. Selected criteria for non-criteria pollutants are provided in Table 4.

Table 4: Selected non-carcinogenic screening criteria

Constituent	Inhalation Reference Concentrations (RfCs); Maximum Risk Levels (MRLs); Reference Exposure Limits (RELs)			
	Acute (µg/m³)	Source	Chronic (µg/m³)	Source
Ammonia	1 184	ATSDR	200	OEHHA
Arsenic	0.2	OEHHA	0.015	OEHHA
Cadmium	0.03	ATSDR	0.01	ATSDR
Hydrogen chloride	2100	OEHHA	9	OEHHA
Hydrogen fluoride	240	OEHHA	14	OEHHA
Mercury	0.6	OEHHA	0.3	IRIS

2.4 National Dust Control Regulations

The National Dust Control Regulations (NDCR) were published on the 1st of November 2013 (Goverment Gazette, 2013). The purpose of the regulation is to prescribe general measures for the control of dust in all areas including residential and non-residential areas. Acceptable dustfall rates according to the regulation are summarised in Table 5.

Table 5: Acceptable dustfall rates

Restriction areas	Dustfall rate (D) in mg/m²-day over a 30 day average	Permitted frequency of exceedance
Residential areas	D < 600	Two within a year, not sequential months.
Non-residential areas	600 < D < 1 200	Two within a year, not sequential months.

The regulation also specifies that the method to be used for measuring dustfall and the guideline for locating sampling points shall be ASTM D1739 (1970), or equivalent method approved by any internationally recognized body. It is important to note that dustfall is assessed for nuisance impact and not inhalation health impact. It should be noted that the requirements of the regulations only become applicable to a specific installation or site after a written notice has been given to the site/installation by the local Air Quality Officer.

2.5 Regulations Regarding Air Dispersion Modelling

Air dispersion modelling provides a cost-effective means for assessing the impact of air emission sources, the major focus of which is to determine compliance with the relevant ambient air quality standards. Regulations regarding air dispersion modelling were promulgated in Government Gazette No. 37804 vol. 589; 11 July 2014, (Government Gazette, 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 NEM:AQA;
(b) in the development of a priority area air quality management plan, as contemplated in section 19 of the NEM:AQA;
(c) in the development of an atmospheric impact report, as contemplated in section 30 of the NEM:AQA; and,
(d) in the development of a specialist air quality impact assessment study, as contemplated in Chapter 5 of the NEM:AQA.

The Regulation has 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 clear 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 1 assessment which is described as follows;

- Licence / approval decisions for typically single sources.
- Preliminary identification of air quality issues associated with proposed new sources or modifications to existing sources.
- Identification of the need for more detailed modelling using Level 2 or 3 assessment approaches (if exceedances of short-term objectives are predicted) and;
- Confirmation of refined model results that might appear unusually high or low.

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 Regulation prescribe the source data input to be used in the model. 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.

Chapter 4 of the Regulation prescribe meteorological data input from on-site 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.

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.

The modelling domain would normally be decided on the expected zone of influence; the extent being defined by simulated 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.

Chapter 5 provides general guidance on geophysical data, model domain and coordinates system requirements, whereas Chapter 6 elaborates more on these parameters as well as the inclusion of background air pollutant concentration data. Chapter 6 also provides guidance on the treatment of NO_2 formation from NOx emissions, chemical transformation of SO_2 into sulfates and deposition processes. Chapter 7 of the Regulation outlines how the plan of study and modelling assessment reports are to be presented to authorities.

3 DESCRIPTION OF THE RECEIVING ENVIRONMENT

3.1 Air Quality Sensitive Receptors

Air quality sensitive receptors (AQSRs) primarily refer to places where humans reside, schools and hospitals. Ambient air quality guidelines and standards, as discussed under section 2, have been developed to protect human health. Ambient air quality, in contrast to occupational exposure, pertains to areas outside of an industrial site boundary where the public has access to and according to the Air Quality Act, excludes areas regulated under the Occupational Health and Safety Act (Act No 85 of 1993).

The nearest residential area is Seya and Newlands located directly east of the site, KwaMpundu north of the site, and the more populated area of Mdantsane south of the site. The AQSRs are illustrated in Table 6 and Figure 2.

Table 6: AQSRs

Number	Schools (blue)	Hospitals/Clinics (red)
1	Ngwenyathi Public School	Cecilia Makiwane Hospital
2	Nxaruni Public School	Nkqubela Chest Hospital
3	Ntsonkota S School	NU9 Clinic
4	Sandisiwe Public School	Molantsane Hospital
5	Elitheni SP School	NU2 Nontyantyambo Health Centre
6	Khanyisa JP School	-
7	Sithembiso SS School	-
8	Mzoxolo SP School	-
9	Sinethemba High School	-
10	Dickson Dyani SP School	-
11	Dalukukhanya SP School	-
12	Fanti Gaqa SP School	-
13	Gcobani SP School	-
14	Luzuko SP School	-
15	Fikile Bengu SP School	-
16	Sakhile SP School	-

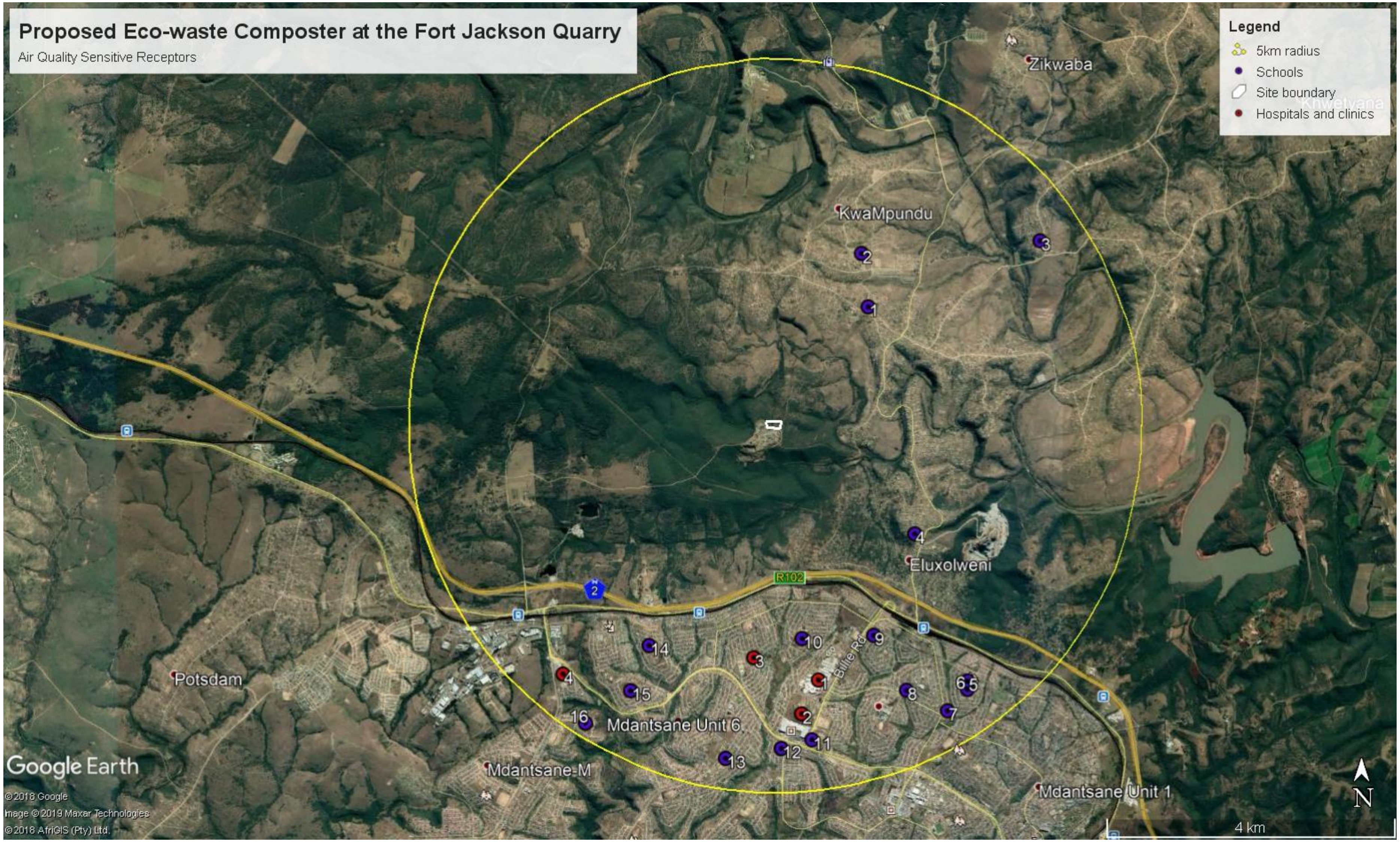

Figure 2: AQSRs surrounding the proposed development area

3.2 Site Visit

A site visit was not conducted by Airshed for the air quality impact assessment. Adequate project information was obtained from CES.

3.3 Ambient Air Quality within the region

3.3.1 Sources of Air Pollution within the Region

Mining activities, farming and residential land-uses occur in the vicinity of the proposed development area. These land-use activities contribute to baseline pollutant concentrations via vehicle tailpipe emissions, household fuel combustion, biomass burning and various fugitive dust sources. Long-range transport of particulates, emitted from remote tall stacks and from large-scale biomass burning in countries to the north of South Africa, has been found to contribute significantly to background fine particulate concentrations within the South African boundary (Andreae, et al., 1996; Garstang, et al., 1996; Piketh, et al., 1996).

Sources of atmospheric emissions include:

- Gaseous and particulate emissions from mining operations;
- Miscellaneous fugitive dust sources including vehicle entrainment on roads and windblown dust from open areas;
- Gaseous and particulate emissions from vehicles;
- Gaseous and particulate emissions from household fuel burning; and
- Gaseous and particulate emissions from biomass burning/veld fires (e.g. wild fires).

3.3.1.1 Mining Operations

The proposed site will be located at the Fort Jackson Quarry. Fugitive emissions sources from mining operations mainly comprise of land clearing operations (i.e. scraping, dozing and excavating), materials handling operations (i.e. tipping, off-loading and loading, conveyor transfer points), vehicle entrainment from haul roads and wind erosion from open areas.

3.3.1.2 Fugitive Dust from Paved and Unpaved Roads

Emissions from unpaved roads constitute a major source of emissions to the atmosphere in the South African context. When a vehicle travels on an unpaved road the force of the wheels on the road surface causes pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong turbulent air shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. Dust emissions from unpaved roads vary in relation to the vehicle traffic and the silt loading on the roads. Unpaved roads in the region are mainly haul roads.

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

3.3.1.3 Household Fuel Burning

Energy use within the residential sector is given as falling within three main categories, viz.: (i) traditional - consisting of wood, dung and bagasse, (ii) transitional - consisting of coal, paraffin and liquefied petroleum gas (LPG), and (iii) modern - consisting of electricity (increasingly this includes the use of renewable energy). The typical universal trend is given as being from (i) through (ii) to (iii). Pollutants include products of combustion (CO, NO_x, SO_2 and VOC), unburned HCs and particulate matter.

3.3.2 Measured Ambient Air Quality

Dust fallout data was obtained from Fort Jackson Quarry (**Error! Reference source not found.** and Figure 3). Sites 3 and 4 are non-complaint with the NDCR.

Figure 3: Location of dustfall locations at Fort Jackson Quarry

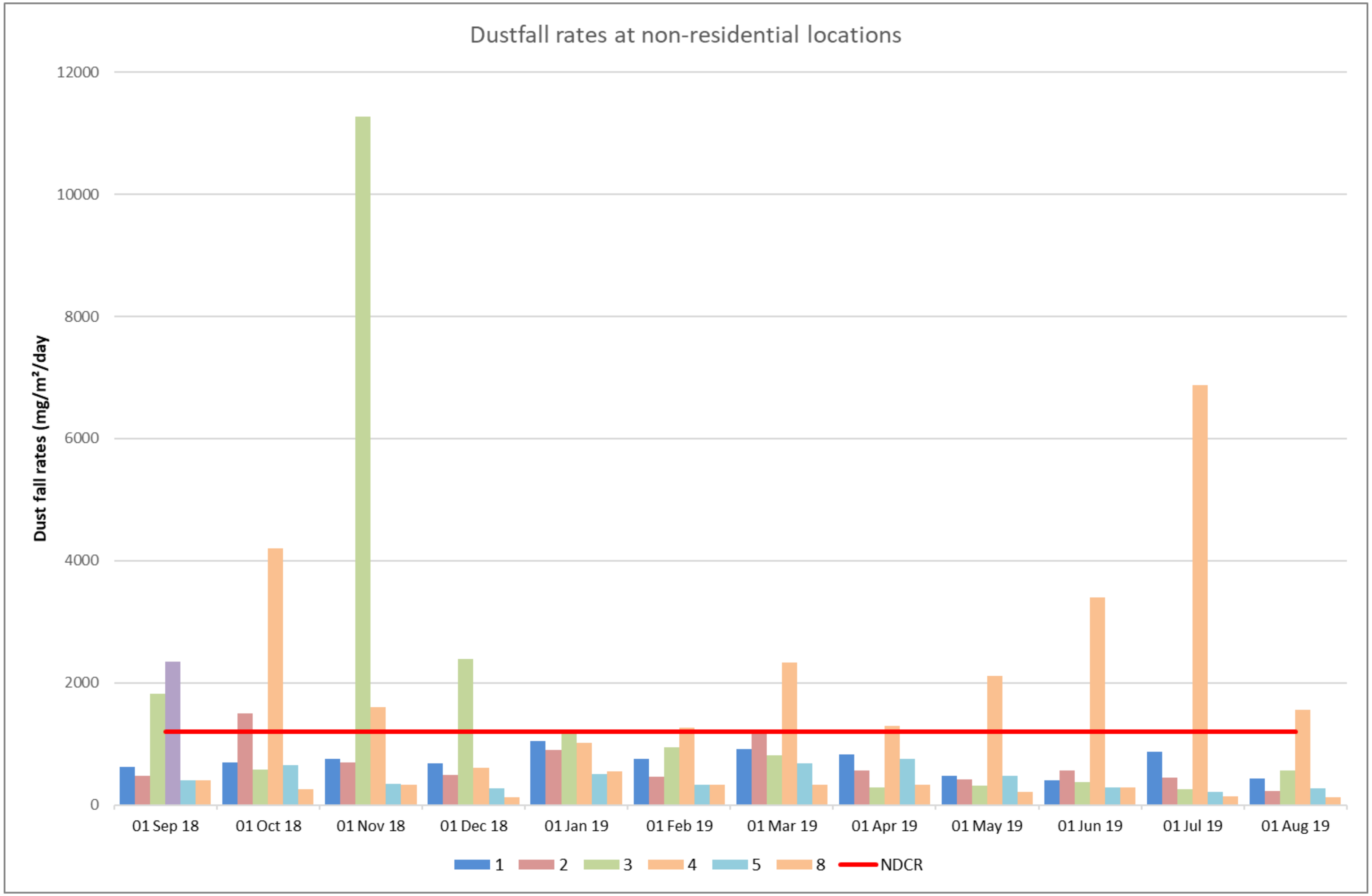

Figure 4: Dustfall at Fort Jackson Quarry

4 IMPACT ON THE RECEIVING ENVIRONMENT

4.1 Atmospheric Emissions

A discussion on the expected activities is provided in the sections below.

4.1.1 Construction Phase

Construction operations are potentially significant sources of dust emissions that may have a substantial temporary impact on local air quality. Construction air emissions would result from general site preparation for the developments. Construction activities that contribute to air pollution typically include: land clearing and demolition activities, excavation, material handling activities, wheel entrainment, operation of diesel or petrol engines etc. If not properly mitigated, construction sites could generate high levels of dust (typically from concrete, cement, wood, stone, silica) and this has the potential to travel for large distances.

Construction dust may be grouped into TSP with impacts generally close to the construction activities and are more responsible for soiling than health issues. Health impacts are more associated with the finer PM_{10} and $PM_{2.5}$ fractions, both of which are invisible to the naked eye. Research has shown that PM_{10} and even more significantly $PM_{2.5}$ penetrate deeply into the lungs and therefore has the potential to cause a wide range of health problems including respiratory illness, asthma, bronchitis and even cancer.

Combustion engines also emit emissions of CO, HC, NOx and CO_2. A potentially source of $PM_{2.5}$ on construction sites comes from the diesel engine exhausts of on- and off-road utility vehicles and heavy equipment as well as stationary combustion sources. These particles are known as DPM, and consist of soot (unburnt organic material), sulfates and silicates, all of which may readily combine with other compounds in the atmosphere, increasing the health risks of particle inhalation. Other noxious vapours may also originate from oils, glues, thinners, paints, treated woods, plastics, cleaners and other hazardous chemicals that may be used on construction sites.

A significant amount of the dust emissions result from construction vehicle traffic over temporary roads at construction sites. Dust emissions can also vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions.

Air quality impacts will be associated with the construction phase of the proposed development; however, this will be of a short duration and will not have an impact itself on the proposed development. Air quality sensitive receptors will only be in the proposed residential development once all construction is complete. A description of the construction phase, from an air quality impact perspective, is summarised below.

4.1.2 Operational Phase

The establishment of an emission inventory formed the basis for the assessment of the air quality impacts from the composter on the receiving environment. The facility generates process emissions.

Minimum emission standards (MES) are available for various pollutants (i.e. airborne particulates (PM_{10}), sulphur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), lead (Pb), ammonia (NH_3), hydrogen chloride (HCl), hydrogen fluoride (HF), arsenic (As), cadmium (Cd) and mercury (Hg) for the listed activity for waste incineration.

Source parameters and emission rates are included in Table 7 and Table 8. It will most likely be a batch process however, it has conservatively been assumed that the stack is operational 24 hours per day, 7 days per week.

The composter has two stacks of 0.255 m diameter each located adjacent to each other (Figure 5). When the plumes from multiple closely-spaced stacks or flues merge, the plume rise can be enhanced. Most models do not explicitly account for enhanced plume rise from this cause, and most regulatory agencies do not permit it to be accounted for in regulatory applications of modelling, with one exception. That exception is the case of a single stack with multiple flues, or multiple stacks very close together (less than about one stack diameter apart). In these cases, the multiple plumes may be treated as a single plume. To do this, a pseudo stack diameter is used in the calculations, such that the total volume flow rate of the stack gases is correctly represented. The flow per stack is added, and a resulting pseudo diameter is calculated to represent the single emission source (Ontario Ministry of Environment, 2003).

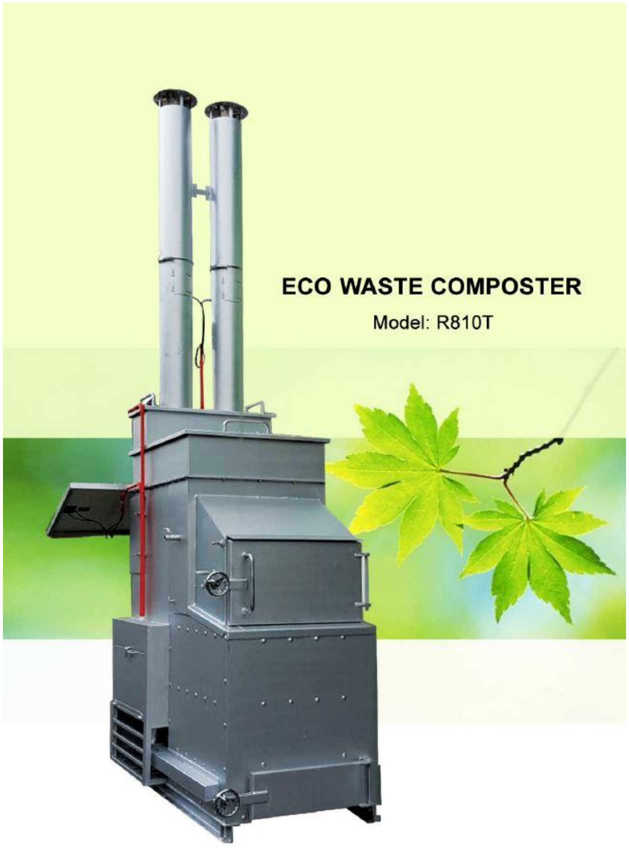

Figure 5: Eco-waste Composter

Table 7: Point Source Parameters

ID	Source Name	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Pseudo Diameter at Stack Tip / Vent Exit (m)	Actual Gas Exit Temperature (°C)	Actual Gas Volumetric Flow (m^3/hr)	Actual Gas Exit Velocity (m/s)
P1	Eco-waste Composter stack	-32.897	27.737	6.32	0.361	48.9	1 289	3.5

Table 8: Point Source Emissions

ID	Source Name	Pollutant name	MES (mg/Nm³)	Emission rate (g/s)
P1	Eco-waste Composter stack (handling hazardous or general waste)	PM	10	0.003
		SO_2	50	0.015
		NO_2	200	0.061
		CO	50	0.015
		HCl	10	0.003
		HF	1	0.0003
		Pb+As+Sb+Cr+Co+Cu+Mn+Ni+V	0.5	0.00015
		Hg	0.05	1.5E05
		Cd+Tl	0.05	1.5E05
		TOC	10	0.003
		NH_3	10	0.003
		dioxins	0.1 (ng/Nm³)	3.04E-11
	Eco-waste Composter stack (handling veterinary waste)	PM	40	0.012
		NO_2	500	0.15
		CO	75	0.023

Minimum emissions standards were used to estimate emissions from the eco-waste composter. The plant is not yet operational. Start-up and shut-down emissions are not expected to differ significantly to normal emissions. With it being a batch process, maintenance can be done while the facility is not operational.

Stack measurements at similar composters are shown in Table 9. Generally, measurements are within MES, with a few exceptions for PM, SO_2 and CO (highlighted).

Table 9: Stack emissions monitoring at similar units

Pollutant name	SA MES (mg/Nm³)	Oct 2015 Malaysia	Oct 2015 Malaysia	Nov 2015 Malaysia	Dec 2015 Malaysia	Mar 2016 Dubai	Sep 2016 Indonesia
PM	10	9.98	0.52	0.69			**32.42**
SO_2	50	0.005	1	1		**68**	**135**
NO_2	200	0.5	23	23		5.78	170
CO	50				0.2		**89**
HCl	10	0.11	0.012	0.016			0.05
HF	1		0.001	0.001			0.1
Pb+As+Sb+Cr+Co+Cu+Mn+Ni+V	0.5		0.32	0.43			0.016
Hg	0.05				0.02		0.001
Cd+Tl	0.05		0.02	0.02			0.005
TOC	10						1
NH_3	10						
dioxins	0.1 (ng/Nm³)		0.0014	0.0018		0.0168	

4.2 Atmospheric Dispersion Modelling

The assessment of the impact of the composter on the environment is discussed in this section.

The impact of the composter on the atmospheric environment was determined through the simulation of ambient pollutant concentrations.

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

South African Regulations Regarding Air Dispersion Modelling provides guidance on the use of a tiered approach in defining the levels of assessment required in a modelling application. This Code of Practice also recommends a number of dispersion models to be used in regulatory applications in South Africa. This requires a modeller to assess the application and identify which model would best provide the essential information to the regulatory authority with the detail and accuracy required in the application. Air quality assessments can vary in their level of detail and scope, which in turn is determined by the objectives of the modelling effort, technical factors and the level of risk associated with the project emissions.

A classical tiered approach in the selection of an air dispersion model is recommended, in which simpler screening models (Level 1) are first considered before moving to more advanced models if the situation requires (Level 2 or 3). The screening techniques must be used on relatively simple applications to provide conservative estimates of air quality impact using (pre-set) worst-case meteorological conditions. Otherwise, refined models must be applied where detailed treatment of physical and chemical atmospheric processes are required. The tiered approach minimises the cost and time required to do an assessment or licence application. It allows for flexibility in selecting a model that is most appropriate for a given application based on the assessment. Where a preliminary/conservative estimate is desired, acceptable screening techniques must be used, followed by the appropriate refined analysis.

The level of assessment must depend on the technical factors to be considered in the modelling exercise such as the geophysical, emissions and meteorological conditions. The assessment must also depend on the level of risk associated with the emissions and hence the level of detail and accuracy required from a model.

Given the small size of the industry and low levels of emissions, a Level 1 modelling approach was conducted.

4.2.1 Dispersion Model Selection

A level 1 assessment provides an estimate of the worst-case air quality impacts. As such, screening models are sufficient for this level. Level 1 assessment must be used for:

- License / approval decisions for typically single sources, as is the case for the proposed incinerator.
- Preliminary identification of air quality issues associated with proposed new sources or modifications to existing sources.
- Identification of the need for more detailed modelling using Level 2 or 3 assessment approaches (if exceedances of short-term objectives are predicted) and;
- Confirmation of refined model results that might appear unusually high or low.

As recommended by the Code of Practice, use was made of SCREEN3, a tool to calculate screening-level impact estimates for stationary sources in simple terrain or complex terrain.

SCREEN3 is a Gaussian plume model which provides maximum ground-level concentrations for point, area, flare, and volume sources. The model is a single source model and impacts from multiple SCREEN3 model runs can be summed to conservatively estimate the impact from several sources. SCREEN3 calculates 1-hour concentration estimates in simple terrain areas and 24-hour concentration estimates in complex terrain. These modelled estimates must be converted to the averaging period of each applicable national ambient air quality standard. The factor to convert from 1-hour to 1-year is 0.08.

SCREEN3 incorporates source related factors and meteorological factors to estimate pollutant concentration from continuous sources. The model assumed that the pollutant does not undergo any chemical reactions, and that no other removal processes (wet or dry deposition) act on the plume during its transportation. SCREEN3 examines a range of stability classes and wind speeds to identify the combination of wind speed and stability that results in the maximum ground level concentrations – the "worst case" meteorological conditions. Use was made of the stack tip downwash estimation following the Briggs equations.

Dispersion coefficients are estimated from the Pasquill-Gifford (rural) and McElroy-Pooler (urban) methods based on the Industrial Source Complex (ISC3) formulations. The dispersion coefficients are adjusted to account for the effects of buoyancy induced dispersion. For this assessment, use was made of the rural dispersion coefficients.

4.2.2 Meteorological Requirements

Use was made of (pre-set) worst-case meteorological conditions.

4.2.3 Source and Emission Data Requirements

The SCREEN model is able to model point, area, line and volume sources. The composter stack was modelled as a point source.

4.2.4 Modelling Domain

The dispersion of pollutants was simulated over a downwind distance of 5 000 m from the source at a resolution of 100 m for the proposed incinerator. SCREEN3 calculates ground-level (1.5 m above ground level) concentrations at each receptor point. The nearest sensitive receptor was included as a discrete receptor (860 m).

Both the simple and the complex terrain was selected. The complex terrain option is used for cases where the terrain elevations exceed the stack height. Complex terrain calculations were done for 200 and 400 m from the source.

4.2.5 Presentation of Results

Simulations were undertaken to determine highest hourly pollutant concentrations. Highest daily and annual average ground level concentrations were extrapolated through the application of factors specified in the Code of Practice. Averaging periods were selected to facilitate the comparison of predicted pollutant concentrations to relevant NAAQS and screening criteria.

Results are presented in tabular form as maximum ground level pollutant concentrations in comparison with assessment criteria.

4.3 Dispersion Simulation Results

Pollutants released by the proposed operations, likely to result in human health impacts include the following criteria pollutants: PM, SO_2, NO_2, CO and Pb.

Highest ground level pollutant concentrations (based on MES for subcategory 8.1) are summarised in Table 10. Ground level pollutant concentrations at the nearest sensitive receptor (based on MES for subcategory 8.1) are summarised in Table 11. Simulated worst-case concentrations are well within NAAQS both in the short and long term at the boundary as well as at the nearest AQSR.

Highest ground level pollutant concentrations (based on MES for subcategory 8.2) have the potential to exceed the hourly NAAQ limit value of 200 µg/m³ for NO_2, however this assumes all NO_x is NO_2, and is allowed 88 exceedances per year, so is likely to be within NAAQS (Table 12). It is also not likely that veterinary waste will be incinerated 24/7. Ground level pollutant concentrations at the nearest sensitive receptor (based on MES for subcategory 8.2) are summarised in Table 13 and are within NAAQS.

Pollutants released by the proposed operations, likely to result in human health impacts include the following non-criteria pollutants: HCl, HF, NH_3, Hg, As and Cd. Highest ground level pollutant concentrations are summarised in Table 14, and ground level pollutant concentrations at the nearest AQSR in Table 15. Simulated worst-case concentrations are well within the relevant reference health screening criteria (see section 2.3) both in the short and long term at the nearest sensitive receptor. Arsenic is simulated to exceed the screening criteria off-site, however this conservatively assumes that the MES applicable to the sum of Pb+As+Sb+Cr+Co+Cu+Mn+Ni+V is all arsenic.

Given the conservative nature of the impact assessment, it can be concluded that emissions from the facility will not result in exceedances of NAAQS or health screening criteria at the closest sensitive receptors.

Table 10: Maximum simulated ground level concentrations (100 m) and summary of compliance with NAAQS (8.1)

Pollutant	Concentration (µg/m³)	NAAQS (µg/m³)	Compliance
PM_{10} daily	1.68	75	√
PM_{10} annual	0.34	40	√
SO_2 hourly	20.5	350	√
SO_2 daily	8.2	125	√
SO_2 annual	1.64	50	√
NO_2 hourly	84	200	√
NO_2 annual	6.72	40	√
CO hourly	20.5	30 000	√
Lead annual	0.02	0.5	√

Table 11: Simulated ground level concentrations at nearest AQSR (860 m) and summary of compliance with NAAQS (8.1)

Pollutant	Concentration (µg/m³)	NAAQS (µg/m³)	Compliance
PM_{10} daily	0.39	75	√

Pollutant	Concentration (µg/m³)	NAAQS (µg/m³)	Compliance
PM_{10} annual	0.08	40	√
SO_2 hourly	4.88	350	√
SO_2 daily	1.95	125	√
SO_2 annual	0.39	50	√
NO_2 hourly	19.72	200	√
NO_2 annual	1.58	40	√
CO hourly	4.88	30 000	√
Lead annual	0.004	0.5	√

Table 12: Maximum simulated ground level concentrations (100 m) and summary of compliance with NAAQS (8.2)

Pollutant	Concentration (µg/m³)	NAAQS (µg/m³)	Compliance
PM_{10} daily	6.6	75	√
PM_{10} annual	1.3	40	√
NO_2 hourly	210	200	Most likely
NO_2 annual	17	40	√
CO hourly	32	30 000	√

Table 13: Simulated ground level concentrations at nearest AQSR (860 m) and summary of compliance with NAAQS (8.2)

Pollutant	Concentration (µg/m³)	NAAQS (µg/m³)	Compliance
PM_{10} daily	1.6	75	√
PM_{10} annual	0.3	40	√
NO_2 hourly	49	200	√
NO_2 annual	4	40	√
CO hourly	7	30 000	√

Table 14: Maximum simulated ground level concentrations (100 m) and summary of compliance with international guidelines

Pollutant	Highest Hourly Concentration (µg/m³)	Criteria (µg/m³)	Annual Average Concentration (µg/m³)	Criteria (µg/m³)	Within screening criteria
Ammonia	4.2	1 184 (ATSDR)	0.34	200 (OEHHA)	√
Arsenic	0.21 (b)	0.2 (OEHHA)	0.017 (b)	0.015 (OEHHA)	X
Cadmium	0.02 (a)	0.03 (ATSDR)	0.002 (a)	0.01 (ATSDR)	√
Hydrogen chloride	4.2	2 100 (OEHHA)	0.34	9 (OEHHA)	√
Hydrogen fluoride	0.41	240 (OEHHA)	0.03	14 (OEHHA)	√
Mercury	0.02	0.6 (OEHHA)	0.002	0.3 (IRIS)	√

(a) Based on emission limit for cadmium + thallium

(b) Based on emission limit for sum of lead, arsenic, antimony, chromium, cobalt, copper, manganese, nickel, vanadium. Arsenic (most stringent guidelines) used as representative pollutant.

Table 15: Simulated ground level concentrations at nearest AQSR (860 m) and summary of compliance with international guidelines

Pollutant	Highest Hourly Concentration (µg/m³)	Criteria (µg/m³)	Annual Average Concentration (µg/m³)	Criteria (µg/m³)	Within screening criteria
Ammonia	0.99	1 184 (ATSDR)	0.08	200 (OEHHA)	√
Arsenic	0.05 (b)	0.2 (OEHHA)	0.004 (b)	0.015 (OEHHA)	√
Cadmium	0.005 (a)	0.03 (ATSDR)	0.0004 (a)	0.01 (ATSDR)	√
Hydrogen chloride	0.99	2 100 (OEHHA)	0.08	9 (OEHHA)	√
Hydrogen fluoride	0.1	240 (OEHHA)	0.008	14 (OEHHA)	√
Mercury	0.005	0.6 (OEHHA)	0.0004	0.3 (IRIS)	√

(a) Based on emission limit for cadmium + thallium

(b) Based on emission limit for sum of lead, arsenic, antimony, chromium, cobalt, copper, manganese, nickel, vanadium. Arsenic (most stringent guidelines) used as representative pollutant.

4.4 Impact Significance Rating

EIA Regulations require that impacts be assessed in terms of the intensity, duration, severity and probability of impacts; as well as the degree to which these impacts can be managed or mitigated. A significance ranking methodology is provided in Appendix B.

The impact significance rating for potential impacts are presented in Table 16. All potential impacts were assigned impact rating scores equivalent to "**medium"** impact significance. It is probable that the facility will have an impact. The duration will last for the lifespan of the facility.

Table 16: Impact significance rating table

Source	IMPACT DESCRIPTION		RATING					
	Impact	Associated activities	Intensity factor	Duration	Severity factor	Severity rating	Probability rating	Significance rating
Impacts due to incinerator	Health impacts due to emissions	Incineration of waste	2	4	8	3	3	9 = Medium

5 CONCLUSIONS AND RECOMMENDATION

An air quality impact assessment was conducted for the impact of the incinerator on the receiving environment.

The main findings from the air quality impact assessment are:

- The proposed incinerator will need to comply with new plant MES. These emission limits were used in the dispersion modelling exercise as a conservative estimate of the incremental impact of the incinerator.
- No ambient criteria pollutant data is available close to site and therefore it was only possible to estimate the incremental impact.
- Dust fallout data at the quarry indicates non-compliance with NDCR. The proposed incinerator will however not have significant dust fallout.
- Simulated ambient criteria pollutant (PM_{10}, NO_2, SO_2, CO and Pb) concentrations were well below the NAAQS at all the nearby residential areas, schools and hospitals.
- Simulated non-criteria pollutants concentrations were all low and within relevant health screening criteria at all the nearby residential areas, schools and hospitals.
- The contribution from the proposed incinerator to cumulative ambient air quality is regarded very low based on the simulated ground-level concentrations.

The proposed incinerator triggers the Subcategory 8.1 and this has numerous special arrangements (see section 2.1). It is recommended that these are carefully reviewed and it is ensured that they are met. It is recommended that in-stack monitoring be scheduled soon after incinerator operations are initiated, assuming an AEL is granted, in order to ensure MES compliance. It could also trigger the Subcategory 8.2 if veterinary waste is incinerated.

In conclusion, it is the specialist opinion that the proposed incinerator may be authorised, however it is recommended that a stack monitoring campaign confirm that the pollutant concentrations are within the MES as assumed in the dispersion modelling exercise to determine air quality impact.

6 REFERENCES

Andreae, M. et al., 1996. Trace gas and aerosol emissions from savanna fires. In: *Biomass Burning and Global Change.* Cambridge: MIT Press.

CSIR Climate Studies, 2016. *Status Quo Assessment City of Johannesburg,* s.l.: s.n.

Garstang, M., Tyson, P., Swap, R. & Edwards, M., 1996. Horizontal and vertical transport of air over southern Africa.

Goverment Gazette, 2013. *National Dust Control Regulations.* s.l.:s.n.

Government Gazette, 2009. *National Ambient Air Quality Standards.* s.l.:s.n.

Government Gazette, 2012. *National Ambient Air Quality Standard for Particulate Matter with Aerodynamic Diameter less than 2.5 micron metres (PM2.5).* s.l.:s.n.

Government Gazette, 2013. *List of Activities which Result in Atmospheric Emissions which have or may have a Significant Detrimental Effect on the Environment, Including Health and Social Conditions, Economic Conditions, Ecological Conditions or Cultural Heritage.* Notice number 893 ed. s.l.:s.n.

Government Gazette, 2014. *Regulations Regarding Air Dispersion Modelling.* Regulation number 533 ed. s.l.:s.n.

Government Gazette, 2015. *Amendments to the List of Activities which Result in Atmospheric Emissions which have or may have a Significant Detrimental Effect on the Environment, Including Health and Social Conditions, Economic Conditions, Ecological Conditions or Cultural Heritage.* Notice number 551 ed. s.l.:s.n.

Government Gazette, 2018. *Amendments to the listed activities and associated minimum emission standards identified in terms of section 21 of the Act.* Notice number 1207 ed. s.l.:s.n.

Government Gazette, 2019. *Amendments to the listed activities and associated minimum emission standards identified in terms of section 21 of the Ac.* Notice number 687 ed. s.l.:s.n.

IFC, 2007. *General Environmental, Health and Safety Guidelines,* s.l.: s.n.

Ontario Ministry of Environment, 2003. *Proposed Guideline for Air Dispersion Modelling,* s.l.: s.n.

Piketh, S., Annegarn, H. & Kneen, M., 1996. Regional scale impacts of biomass burning emissions over southern Africa. In: *Biomass Burning and Global Change.* Cambridge: MIT Press.

US EPA, 1995. *AP 42, 5th Edition, Volume I, Chapter 13: Miscellaneous Sources, 13.2.3 Heavy Construction Operations.* [Online].

7 APPENDIX

7.1 Appendix A - Impact Assessment Methodology

The significance of Environmental Impacts was assessed in accordance with the following method:

Significance is the product of probability and severity. Probability describes the likelihood of the Impact actually occurring, and is rated as follows:

Improbable	Low possibility of impact to occur either because of design or historic experience	Rating = 2
Probable	Distinct possibility that impact will occur	Rating = 3
Highly probable	Most likely that impact will occur	Rating = 4
Definite	Impact will occur, in the case of adverse impacts regardless of any prevention measures	Rating = 5

The ***severity factor*** is calculated from the factors given to "intensity" and "duration". Intensity and duration factors are awarded to each impact, as described below.

The ***Intensity factor*** is awarded to each impact according to the following method:

Low intensity	natural and manmade functions not affected	Factor 1
Medium intensity	environment affected but natural and manmade functions and processes continue	Factor 2
High intensity	environment affected to the extent that natural or manmade functions are altered to the extent that it will temporarily or permanently cease or become dysfunctional	Factor 4

Duration is assessed and a factor awarded in accordance with the following:

Short term	<1 to 5 years	Factor 2
Medium term	5 to 15 years	Factor 3
Long term	impact will only cease after the operational life of the activity, either because of natural process or by human intervention	Factor 4
Permanent	mitigation, either by natural process or by human intervention, will not occur in such a way or in such a time span that the impact can be considered transient	Factor 4

The ***Severity Rating*** is obtained from calculating a severity factor, and comparing the severity factor to the rating in the table below. For example:

The Severity factor = Intensity factor X Duration factor
= 2 x 3
= 6

A ***Severity factors*** of six (6) equals a Severity Rating of Medium severity (Rating 3) as per table below:

Calculated values 2 to 4	Low Severity	Rating 2
Calculated values 5 to 8	Medium Severity	Rating 3
Calculated values 9 to 12	High Severity	Rating 4

Calculated values 13 to 16	Very High severity	Rating 5

A Significance Rating is calculated by Multiplying the Severity Rating with the Probability Rating.

The ***Significance Rating*** should influence the development project as described below:

Significance Rating 4 to 6	Low significance	Positive impact and negative impacts of low significance should have no influence on the Proposed development Project.
Significance Rating >6 to 15	Medium significance	Positive Impact: Should weigh towards a decision to continue Negative Impact: Should be mitigated to a level where the impact would be of medium significance before project can be approved
Significance Rating 16 and more	High significance	Positive impact: Should weigh towards a decision to continue, should be enhanced in final design. Negative impact: Should weigh towards a decision to terminate proposal, or mitigation should be performed to reduce significance to at least medium significance rating

7.2 Appendix B – Curriculum Vitae of Author

CURRICULUM VITAE

Name	Gillian Petzer (née Möhle)
Date of Birth	1 December 1975
Nationality	South African
Employer	Airshed Planning Professionals (Pty) Ltd
Position	Principal Consultant and Project Manager
Profession	Chemical Engineer employed as an Air Quality Assessment Consultant
Years with Firm	15 years

MEMBERSHIP OF PROFESSIONAL SOCIETIES

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

EXPERIENCE

Gillian has fifteen years of experience in air quality impact assessment and management. She is an employee of Airshed Planning Professionals (Pty) Ltd and is involved in the compilation of emission inventories, air pollution mitigation and management, and air pollution impact work.

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

Air Quality Management

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

Mining Sector

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

Industrial Sector

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

Energy Sector

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

Waste Disposal and Treatment Sector

Rosslyn and Chloorkop Waste Disposal Sites, Organic waste disposal site

Transport and Logistics Sector

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

Ambient Air Quality and Noise Sampling

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

SOFTWARE PROFICIENCY

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

EDUCATION

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

COURSES COMPLETED AND CONFERENCES ATTENDED

- Conference: NACA (October 2003), Attended
- Conference: NACA (October 2005), Attended and presented a paper
- Conference: NACA (October 2007), Attended and presented a paper
- Conference: NACA (October 2008), Attended and presented a poster
- Conference: NACA (October 2009), Attended and presented a paper
- Conference: NACA (October 2012), Attended
- Conference: IUAPPA (October 2013), Attended
- Course: Climate change and carbon management. Presented by Environmental & Sustainability Solutions (July 2014)
- Conference NACA (October 2016), Attended

COURSES PRESENTED

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

COUNTRIES OF WORK EXPERIENCE

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

LANGUAGES

Language	Proficiency
English	Native language
Afrikaans	Full professional proficiency

REFERENCES

Name	Position	Contact Number
Dr. Gerrit Kornelius	Associate of Airshed Planning Professionals	+27 (82) 925 9569 gerrit@airshed.co.za
Dr Lucian Burger	Director at Airshed Planning Professionals	+27 (82) 491 0385 lucian@airshed.co.za

Dr. Hanlie Liebenberg Enslin	Managing Director at Airshed Planning Professionals	+27 (83) 416 1955 hanlie@airshed.co.za

CERTIFICATION

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

28/09/2017