Platinum Pride Proposed Crematorium

Atmospheric Impact Assessment

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1. Executive Summary

Ikamva Green Holdings, trading as Platinum Pride, are in the process of obtaining the necessary permissions to commission a crematorium at 55 Stella Road in Montague Gardens, Cape Town.

As part of the Environmental Impact Assessment (EIA) and Atmospheric Emissions Licence (AEL) applications, a Specialist Air Quality Impact Assessment and an Atmospheric Impact Report (AIR) are required. This report fulfils the requirements for both the Specialist Air Quality Impact Assessment and the AIR and has been conducted in accordance with the Regulations Prescribing the Format of the Atmospheric Impact Report[1], the Regulations Regarding Air Dispersion Modelling[2], and Appendix 6 of the EIA Regulations[3].

The forms that are contained in the Regulations Prescribing the Format of the Atmospheric Impact Report were completed and are contained in Sections 3 to 6 of this report. Section 7 of this report contains the information that is required by the Regulations Regarding Air Dispersion Modelling, and the results from the air dispersion model.

In Section 7, the proposed location of the site was examined. Baseline ambient air quality in the area was collected from ambient air quality monitoring stations. Baseline data from the monitoring stations that are closest to the site, and with the highest level of data availability, were chosen to be used further in the study.

The crematorium is envisioned to be commissioned in two phases: Phase 1, which includes the installation of 2 cremators, and Phase 2, which includes the installation of an additional 4 cremators. Each cremator has the capacity to cremate 24 cadavers in a 24-hour period. This means that the crematorium, after commissioning Phases 1 and 2, will have a maximum cremation capacity of 144 cadavers per day. An emissions inventory was compiled for the pollutants that are identified by the air quality Listed Activities legislation[4] to be of concern from crematoria. These pollutants are particulate matter (PM), carbon monoxide (CO), the oxides of nitrogen (NO_x), and mercury (Hg). As per comments received during the commenting period on the Draft Basic Assessment Report, benzene and lead emissions were also modelled and the emission rates for these pollutants were estimated using the EMEP/EEA emissions factors. The extremely conservative assumption of assuming all volatile organic compounds (VOCs) emitted from cremators are comprised completely of benzene was made. Level 2 air dispersion modelling was conducted for these pollutants using the AERMOD View programme.

The maximum ambient pollutant concentrations that were predicted by the AERMOD model were added to baseline air quality data, where available, to obtain cumulative predicted concentrations. These concentrations were compared to the National Ambient Air Quality Standards (NAAQS), and international guidelines where no NAAQS are available. This is a very conservative method in which to assess the air quality impact of the proposed facility, as it assumes that the maximum pollutant

[1] G.N.R. 747 of 2013
[2] G.N.R. 533 of 2014
[3] G.N.R. 982 of 2014
[4] G.N. 893 of 2013

concentrations are experienced every hour/day in the three year period, which would not be the case in reality.

Ambient PM_{10} (using baseline data from the Table View monitoring station), $PM_{2.5}$, CO, mercury and lead concentrations around the fence line of the site are predicted to remain in compliance with the NAAQS standards (and the international guideline for mercury) should the proposed crematorium be commissioned.

While the annual cumulative benzene concentration would have exceeded the NAAQS in 2019 should the crematorium have been commissioned, this was also the case in the baseline data before the contribution from the proposed crematorium was considered. Thus, the benzene concentration as a result of the proposed crematorium does not change the overall compliance status.

Maximum ambient hourly NO_2 concentrations around the fence line are predicted to exceed the hourly NAAQS standard. However, the concentration rapidly decreases with distance from the site, and no NAAQS exceedances are predicted in any of the surrounding residential areas. It must also be noted that the cumulative air quality impact of the facility is estimated by assuming that the maximum hourly concentration will be experienced every hour of every day in the three year period, which would not be the case in reality. The ambient annual NO_2 concentration at the fence line is predicted to comply with the annual NAAQS for NO_2.

When PM_{10} data from the Edgemead monitoring station is used as a baseline, the daily PM_{10} concentrations are predicted to exceed the NAAQS standard at the facility's fence line. Again, it should be noted that the cumulative air quality impact of the facility is estimated by assuming that the maximum daily concentration will be experienced every day in the three year period, which would not be the case in reality.

Although the engineering specifications of the cremators indicate that the stacks are to be 12 metres high, the AERMOD model was run using various stack heights of up to 20 metres. The optimum height was determined to be 16 metres, which resulted in no NAAQS exceedances at the fence line for PM_{10} or NO_2, unless these exceedances existed in the baseline data (i.e. daily PM_{10} in 2021 using the Edgemead baseline data). It is recommended that higher stack heights be considered by the proponent in order to minimise the effect of the proposed crematorium on ambient air quality.

2. Introduction

Ikamva Green Holdings, trading as Platinum Pride, are in the process of obtaining the necessary permissions to commission a crematorium at 55 Stella Road in Montague Gardens, Cape Town.

The crematorium is envisioned to be commissioned in two phases: Phase 1, which includes the installation of 2 cremators, and Phase 2, which includes the installation of an additional 4 cremators. Each cremator has the capacity to cremate 24 cadavers in a 24-hour period. This means that the crematorium, after the commissioning of Phases 1 and 2, will have a maximum cremation capacity of 144 cadavers per day.

As part of the Environmental Impact Assessment (EIA) and Atmospheric Emissions Licence (AEL) applications, a Specialist Air Quality Impact Assessment, and an Atmospheric Impact Report (AIR) are required. This report fulfils the requirements for both the Specialist Air Quality Impact Assessment and the AIR and has been conducted in accordance with the Regulations Prescribing the Format of the Atmospheric. Impact Report (G.N.R. 747 of 2013), the Regulations Regarding Air Dispersion Modelling (G.N.R. 533 of 2014) and Appendix 6 of the EIA Regulations (G.N.R. 982 of 2014).

3. Enterprise Information

3.1. Enterprise Details

Enterprise Name	Ikamva Green Holdings
Trading As	Platinum Pride
Company/Close Corporation/Trust Registration Number (Registration Numbers if Joint Venture)	Registration in Progress
Registered Address	Teubes Family Wines 791 Vredendal
Postal Address	Teubes Family Wines 791 Vredendal
Telephone Number (General)	027 213 2377
Fax Number (General)	N/A
Industry Type/Nature of Trade	Crematorium
Land Use Zoning as per Town Planning Scheme	General Industrial 1
Land Use Rights if outside Town Planning Scheme	N/A

Responsible Person	Sybrand Teubes
Emission Control Officer	Sybrand Teubes
Telephone Number	027 213 2377
Cell Phone Number	084 601 2458
Fax Number	N/A
Email Address	sybrand.teubes@platinumpride.co.za
After Hours Contact Details	084 601 2458

3.2. Location and extent of plant

Physical Address of the Plant	55 Stella Road Montague Gardens
Description of Site (Where No Street Address)	N/A
Coordinates of Approximate Centre of Operations	-33.85127, 18.52201
Extent (km^2)	0.002509
Elevation Above Mean Sea Level (m)	10
Province	Western Cape
Metropolitan/District Municipality	City of Cape Town Metropolitan Municipality
Local Municipality	NA
Designated Priority Area (if applicable)	NA

Description of surrounding land use (within a 5 km radius)

The proposed crematorium is to be located at 55 Stella Road in Montague Gardens, Cape Town. Within a 5 km radius of the site, numerous suburbs are zoned for various land uses.

In the immediate area surrounding the site is the Montague Gardens industrial area.

Approximately 2 km NNE of the site is the industrial area of Killarney Gardens. Approximately 3 km NNE of the site is the Dunoon informal settlement. Approximately 2.3 km NE of the site are the Richwood and Burgundy Estate residential areas.

Approximately 1 km E of the site is the Bothasig residential area. Approximately 3 km E of the site is the Durbanville Hills agricultural area.

Approximately 2.6 km SE of the site is the Edgemead residential area. The residential area of Summer Greens is located approximately 2.9 km SSE of the site, with the residential area of Acacia Park located 4 km to the SSE.

Century City's commercial and residential area is located approximately 5 km SSW of the site, with the informal settlement of Joe Slovo Park approximately 2.2 km SW of the site, and the residential areas of Sandrift and Tijgerhof 3.5 km to the SW.

The general boundary of the Milnerton residential area is located approximately 300 metres to the W of the site, but it has been confirmed with the City of Cape Town by the Environmental Assessment Practitioner that no habitable dwellings exist within 500 metres.

The residential suburbs of Flamingo Vlei, Table View and Parklands are located approximately 1.5 km, 3 km and 5 km, respectively, NW of the site.

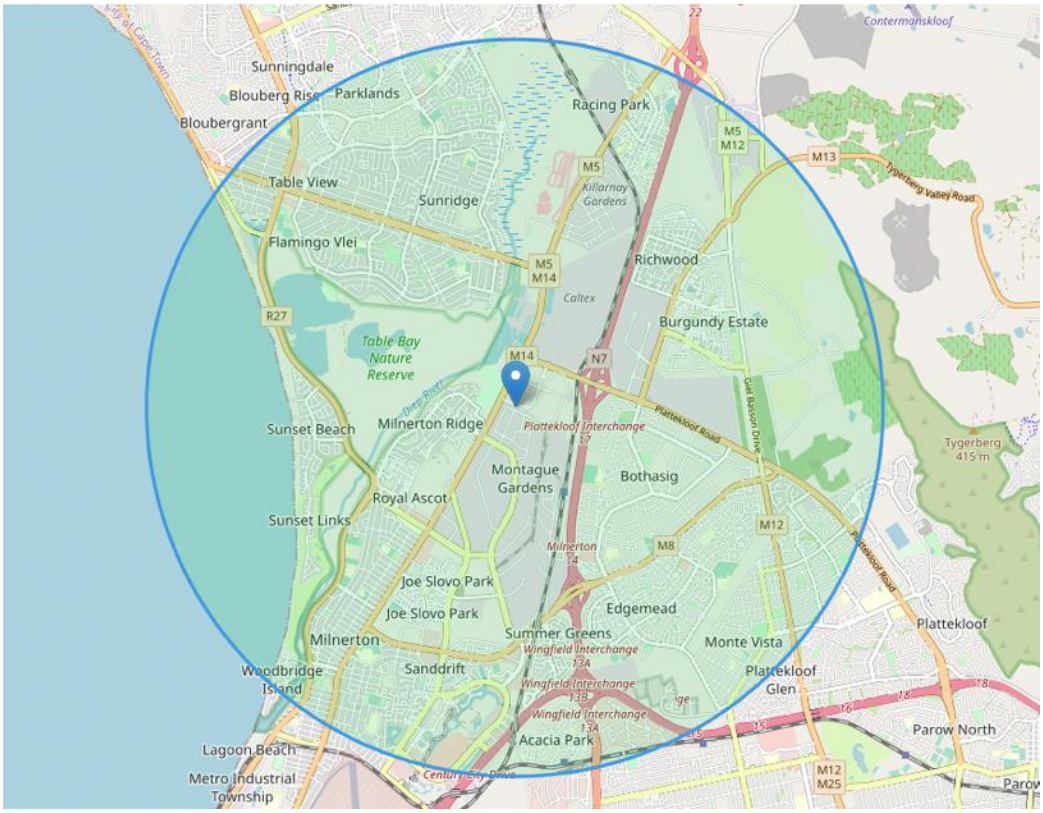


Figure 1: Map indicating the surrounding land use within a 5 km radius

3.3. Atmospheric Emissions Licence and Other Authorisations

Licence Type	Licence Number
Various licence and permission applications are currently in progress.	NA

4. Nature of Process

4.1. Listed activities

Existing/ Proposed	Category	Sub-category	Name of the Listed Activity	Description of the Listed Activity
Proposed	8	8.2	Crematoria and Veterinary Waste Incineration	Cremation of human remains, companion animals (pets) and the incineration of veterinary waste

4.2. Process description

The establishment of a crematorium at the site is to take place in two phases:

- Phase 1 will consist of the installation of two cremators that operate 24 hours per day. Each cremator has a maximum cremation capacity of 24 cadavers per day. Thus, in total, the site will have the capacity to cremate 48 cadavers per day.
- Phase 2 will consist of the installation of an additional four cremators, also operating 24 hours per day. After the completion of phase 2, the site will have the capacity to cremate 144 cadavers per day.

4.3. Unit process

Existing/ Proposed	Unit Process	Unit Process Function	Batch or Continuous Process
Proposed	Cremation	Cremation of human cadavers	Batch

5. Technical Information

5.1. Raw materials used

Raw Material Type	Design Consumption Rate (Quantity)	Units (Quantity/Period)
Human cadavers	144	cadavers/day

5.2. Production rates

Production Name	Maximum Production Capacity Permitted (Quantity)	Design Production Capacity (Quantity)	Actual Production Capacity (Quantity)	Units (Quantity/Period)
N/A	N/A	N/A	N/A	N/A

By-Product Name	Maximum Production Capacity Permitted (Quantity)	Design Production Capacity (Quantity)	Actual Production Capacity (Quantity)	Units (Quantity/Period)
N/A	N/A	N/A	N/A	N/A

5.3. Materials used in energy sources

Materials for Energy	Sulphur Content of the Material (%)	Ash Content of Material (%)	Maximum Permitted Consumption Rate (Quantity)	Design Consumption Rate (Quantity)	Actual Consumption Rate (Quantity)	Units (Quantity/ Period)
LPG	0	0	4 000	3 312	3 312	kg/day

5.4. Appliances and Abatement Equipment Control Technology

Appliance Name	Appliance Type/Description	Appliance Function/Purposes
N/A	N/A	N/A

6. Atmospheric Emissions

6.1. Point source parameters

Point Source Number	Point Source 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 Temp (°C)	Actual Gas Volumetric Flow (m^3/hr)	Actual Gas Exit Velocity (m/s)	Type of emission (continuous/batch)
EU0001	Cremator 1	-33.851222 (estimated)	18.522037 (estimated)	12 (provided)	6 (estimated)	0.35 (provided)	600 (provided)	3 500 (provided)	10.1 (provided)	Batch
EU0002	Cremator 2	-33.851199 (estimated)	18.521955 (estimated)	12 (provided)	6 (estimated)	0.35 (provided)	600 (provided)	3 500 (provided)	10.1 (provided)	Batch
EU0003	Cremator 3	-33.851177 (estimated)	18.521881 (estimated)	12 (provided)	6 (estimated)	0.35 (provided)	600 (provided)	3 500 (provided)	10.1 (provided)	Batch
EU0004	Cremator 4	-33.851151 (estimated)	18.52181 (estimated)	12 (provided)	6 (estimated)	0.35 (provided)	600 (provided)	3 500 (provided)	10.1 (provided)	Batch
EU0005	Cremator 5	-33.85113 (estimated)	18.521743 (estimated)	12 (provided)	6 (estimated)	0.35 (provided)	600 (provided)	3 500 (provided)	10.1 (provided)	Batch
EU0006	Cremator 6	-33.851107 (estimated)	18.521673 (estimated)	12 (provided)	6 (estimated)	0.35 (provided)	600 (provided)	3 500 (provided)	10.1 (provided)	Batch

6.2. Point source maximum emissions rates (normal operating conditions)

Point Source Number	Point Source Name	Pollutant Name	Average emission rate		Duration of emissions
			(mg/Nm³)	Averaging period	
EU0001	Cremator	Particulate matter	40	Hourly	Batch
		Carbon monoxide	75		
		Oxides of nitrogen	500		
		Mercury	0.05		

6.3. Point source maximum emissions rates (start-up, shut-down, upset and maintenance conditions)

No significant variation in the emissions profile is anticipated with start-up, shut-down, upset and maintenance conditions.

6.4. Fugitive emissions (area and/ or line sources)

RG/EU Code	Area and/or Line Source Description	Description of Specific Measures	Timeframe for Achieving Required Control Efficiency	Method of Monitoring Measures Effectiveness	Contingency Measures
N/A	N/A	N/A	N/A	N/A	N/A

6.5. Emergency Incidents

Not applicable.

7. Impact of Enterprise on the Receiving Environment – Air Dispersion Model

7.1. Facility Information

7.1.1. Project Location

Proposed Project Area

Figure 2 shows the portion of land on which the proposed crematorium is to be located. The adjacent buildings were modelled and were estimated to have a height of 6 metres. The position of the six stacks was estimated.

Figure 2: Satellite Map Showing the Site

Area Maps

A satellite map showing the 10 km surrounding the site is in Figure 3 below. Topographical features like mountains and the ocean are visible.

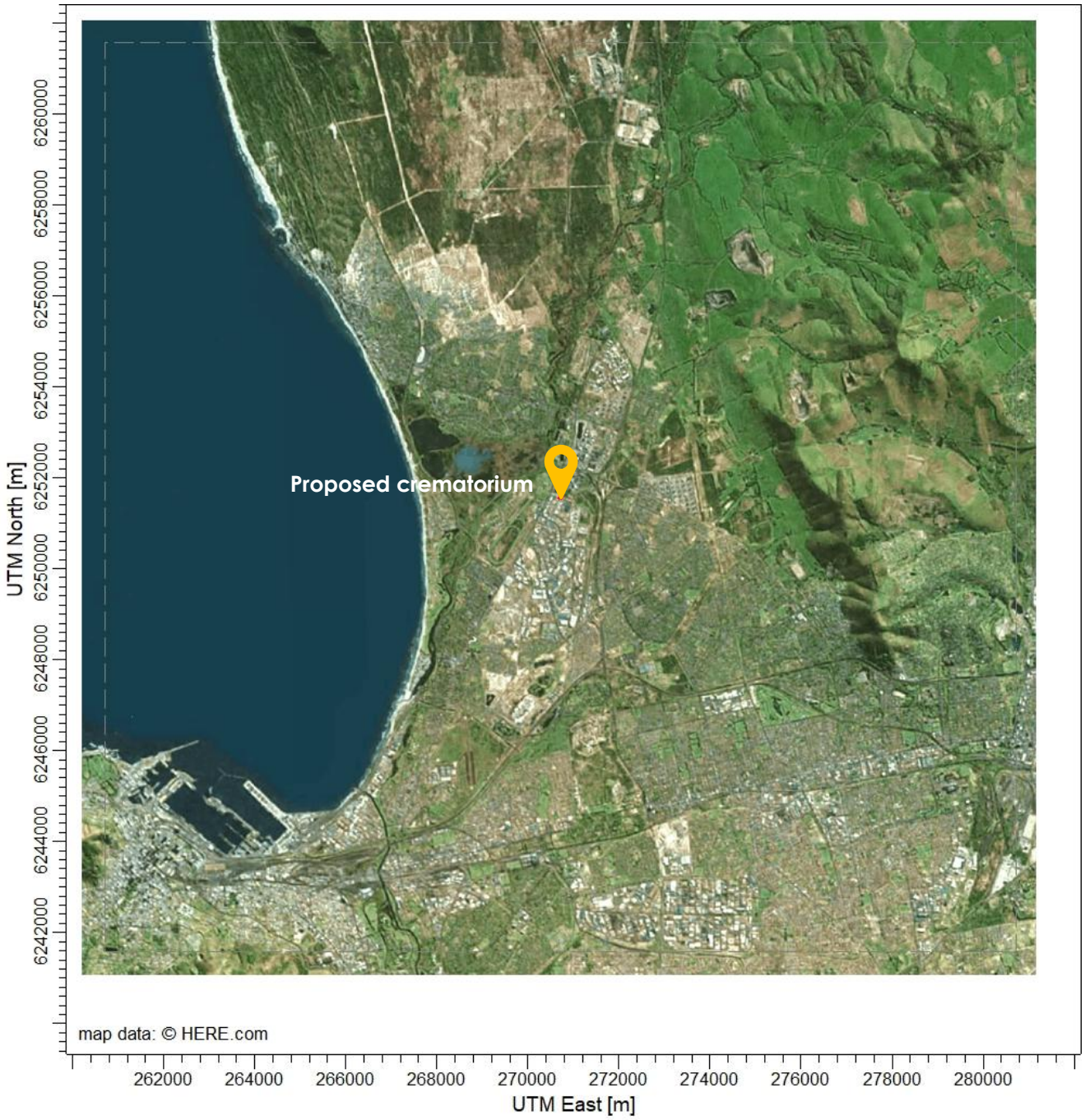


Figure 3: Satellite Map Showing the Area 10 km from the Proposed Crematorium

A street map of the 10 km surrounding the site is shown in Figure 4. Roads and railroads are indicated.

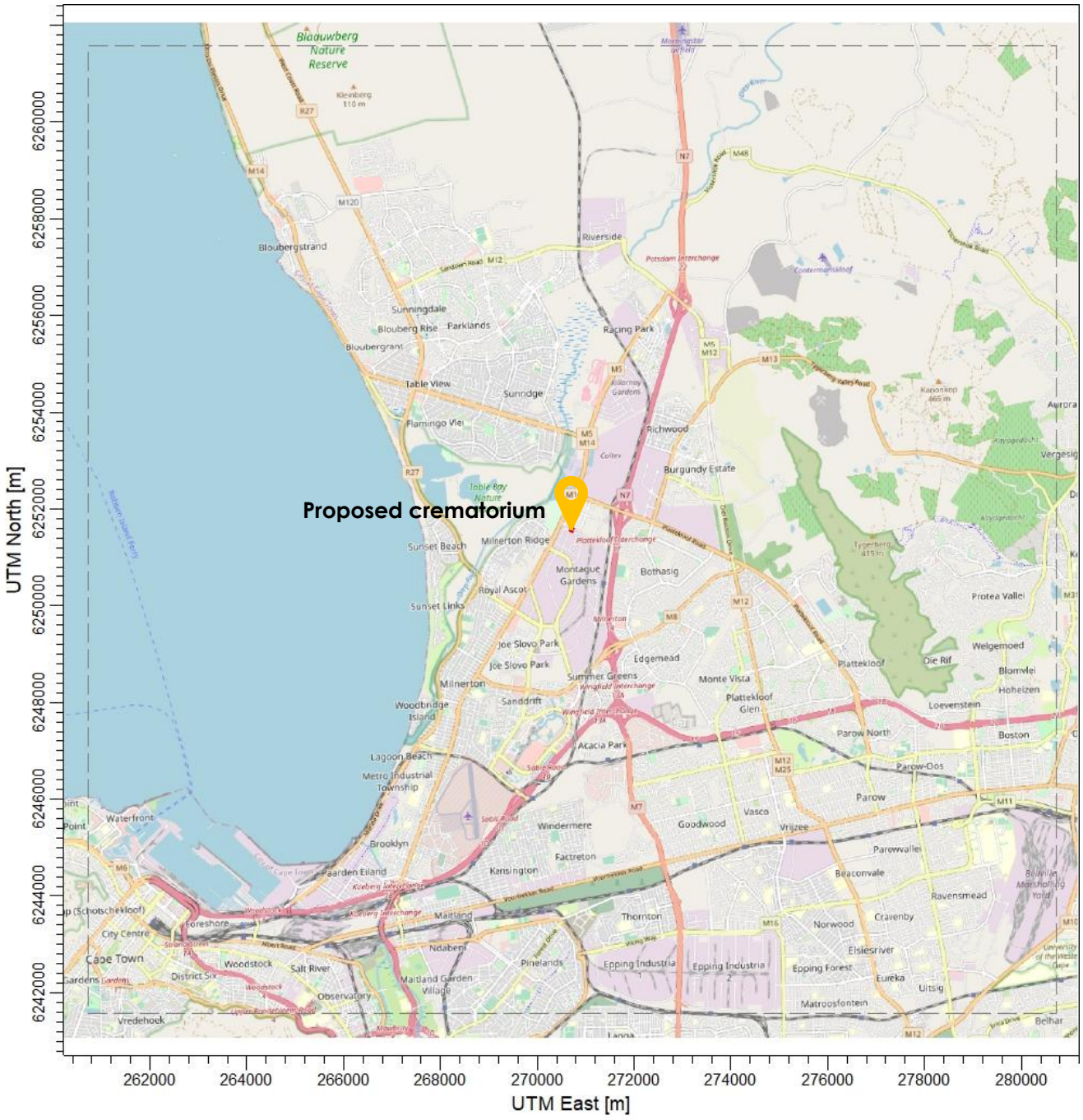


Figure 4: Satellite Map Showing the Area 10 km from the Proposed Crematorium

Hospitals (indicated by red markers) and clinics/health care centres (indicated by green markers) are shown in Figure 5.

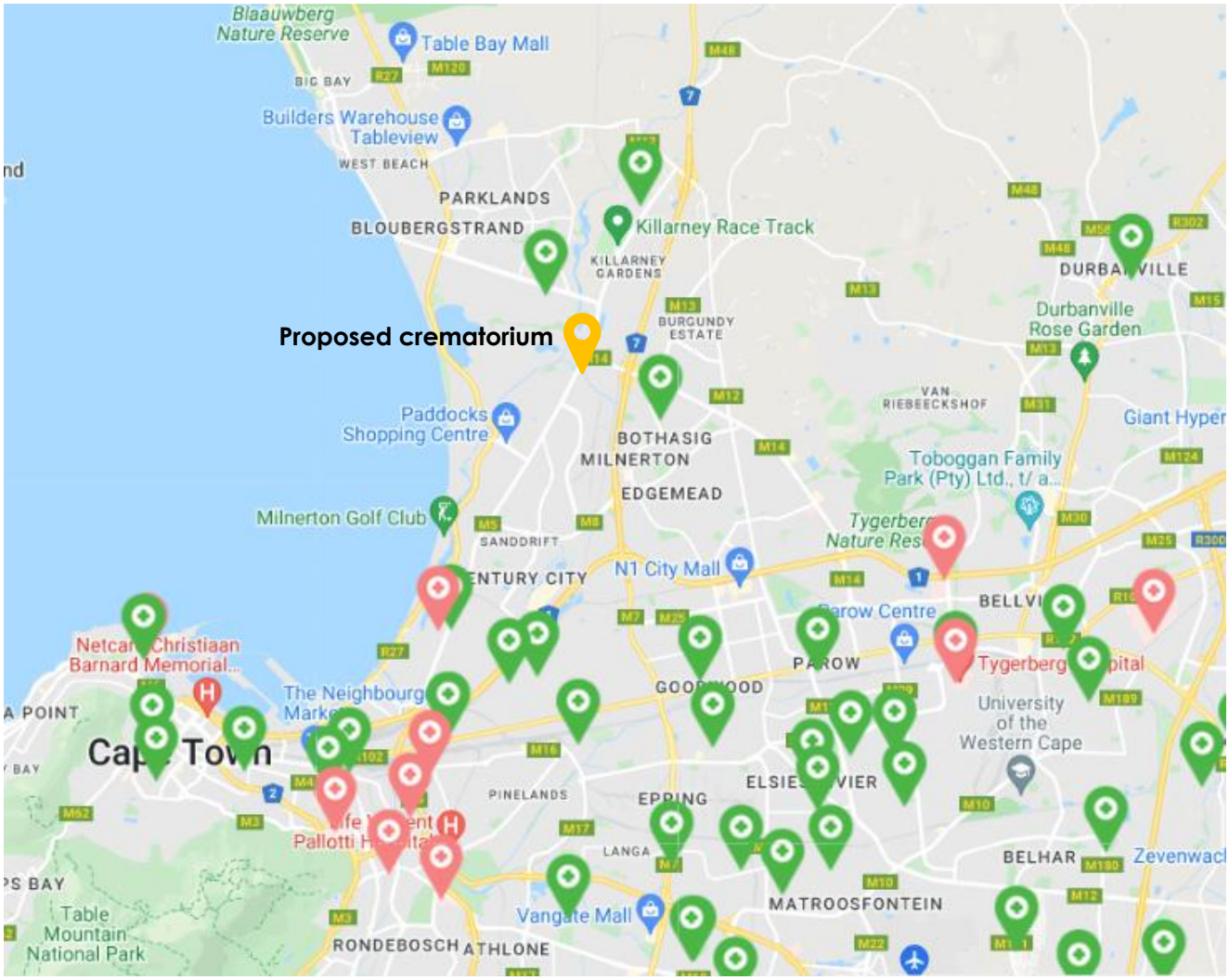


Figure 5: Street Map Showing Hospitals, Clinics and Health Care Centres in the Area 10 km from the Proposed Crematorium[5]

140 schools were identified in the 10 km surrounding the site, and these were too numerous to mark on the map. Schools surround the site in every direction, but none are located in the industrial area of Montague Gardens in which the crematorium is to be located. The closest schools are those in the residential areas surrounding Montague Gardens. The closest points to the proposed crematorium on the boundaries of the surrounding residential areas have been identified as discrete sensitive receptors in the air dispersion model. A list of the schools that were identified are shown in Table 1.

[5] https://www.westerncape.gov.za/static/health-facilities/

Table 1: Schools Surrounding the Proposed Crematorium

School	Distance
CBC St Johns	4.8 km N
Curro Academy Sandown	5 km N
Shelanti Private School	5.3 km N
Oakview Academy	2.7 km NE
Silverleaf Primary School	3.8 km NE
Sophakama Primary School	3.8 km NE
Dunoon Primary School	3.8 km NE
Du Noon Educare	4. km NE
Inkwenkwezi Secondary School	4.7 km NE
Vissershok Primary School	9.4 km NE
Wolraad Woltemade Primary School	1.4 km E
ACVV De Grendel Creche	1.7 km E
Cayden's School	2.0 km E
Tafelberg School	2.1 km E
Piccolo Montessori School	2.2 km E
The Learning Tree Educare	2.6 km E
Curro Burgundy Primary School	2.7 km E
Riverside College and Independent School	2.8 km E
Maureen's Daycare	3.2 km E
Sugar n Spice Playschool	3.6 km E
Chicadees Aftercare	3.7 km E
Protea Valley Educare	8.3 km E
Creative Minds Learning Studio	8.4 km E
Kideo Kids	8.5 km E
Welgemoed Preprimary School	8.5 km E
Protea Valley Montessori School	8.7 km E
One 2Play	8.8 km E
Laerskool Welgemoed	9.2 km E
Die Ark Speelskool	9.9 km E
Bosmansdam High School	1.4 km SE
Bothasig Preprimary School	1.9 km SE
Bosmansdam Primary School	2.0 km SE
Edgemead Primary School	3.0 km SE
Edgemead Pre-Primary School	3.2 km SE
The Village Educare and Pre-Primary School	3.2 km SE
Edgemead High School	3.6 km SE
Joe Simon Pre-Primary School	4.2 km SE
Mountain View Academy	4.4 km SE
Oakland Academy School	4.4 km SE
Monte Vista Primary School	4.5 km SE
Buzzi Bees Pre-Primary School	4.7 km SE
Panorama Primary School	5.1 km SE
Panorama Preprimary School	5.1 km SE
Kings School Goodwood	5.7 km SE
Parow North Primary School	6.7 km SE
Hoerskool President High School	7.2 km SE
Parow Primary School	7.8 km SE

School	Distance
Parow Preparatory School	7.8 km SE
Valhalla Primary School	7.9 km SE
Parow-Wes Primary School	8.0 km SE
Parow East Primary School	8.8 km SE
Elswood Secondary School	8.8 km SE
Riebeck Straat Primary School	9.0 km SE
Leonsdale Primary School	9.1 km SE
Elswood Primary School	9.2 km SE
The Settlers High School	9.4 km SE
Boston Primary School	9.8 km SE
Vredelust Primary School	9.9 km SE
Parow Valley Primary School	9.9 km SE
Webner Street Primary School	10 km SE
Ruyterwacht Preparatory School	8.4 km S
Koos Sadie Primary School	7.0 km S
Thornton Primary School	8.1 km S
Mosesh Primary School	10 km S
Emmanuel Christian Academy	7.0 km S
Goodwood Park Primary School	6.1 km S
Klein Tygerdal Preprimary	5.9 km S
Goodwood Park Bewaarskool	5.4 km S
Akasiapark Primary School	4.4 km S
Kings and Queens Pre-Primary and Primary School	3.3 km S
Curro Century City High School	3.5 km S
Curro Castle Century City	3.5 km S
Curro Century City Primary School	3.5 km S
GROW with Tiny Queens and Kings Educare Centre	3.5 km S
WD Hendricks Primary	5.8 km S
Sunderland Primary School	6.0 km S
Windermere High School	6.2 km S
Wingfield Primary School	6.4 km S
Kensington High School	6.5 km S
James Academy	6.7 km S
St John's RC Primary School	6.7 km S
Kenmere Primary School	6.9 km S
Windermere Primary School	7.2 km S
Factreton Primary	6. 9 km S
HJ Kroneberg Primary School	7.4 km S
Greens'cool	8 km S
Oude Molen Technical High School	8.3 km S
Pinelands North Primary School	8.5 km S
La Gratitude Pre-Primary School	9.1 km S
Pinehurst Primary School	9.1 km S
Pinelands High School	9.5 km S
Qunatum Leap Education	9.2 km S
First Steps Daycare	9.4 km S
Smart Start Daycare	9.3 km S

School	Distance
Meerendal Pre-primary School	9.9 km S
Cannons Creek Independent School	9.9 km S
Ready Steady Grow Montessori	9.0 km S
Purzelbaum German Playgroup	8.9 km S
Red Roots Pre-Primary	8.6 km S
Elda Mahlentle Primary School	1.3 km SW
Seal College	2.2 km SW
Mother Goose Playschool Milnerton	2.3 km SW
Seamount Primary School	2.6 km SW
Marconi Beam Primary School	2.9 km SW
Milnerton High School	3.1 km SW
Milnerton Primary School	3.3 km SW
Milnerton Pre Primary School	4.5 km SW
Tygerhof Primary School	4.7 km SW
Woodbridge Primary School	5.1 km SW
Happy Little Educare	5.8 km SW
Holy Cross Brooklyn	6.4 km SW
Eve's Shoe Educare	6.4 km SW
Childcare at Home	6.5 km SW
TOTs Nursery	6.6 km SW
Buren High School	6.9 km SW
Ysterplaat Junior Primary School	7.1 km SW
Watersprite Nursery School	7.2 km SW
Focus College	7.2 km SW
Hidayatul Islam Primary School	7.4 km SW
Ysterplaat Primary School	7.5 km SW
Holy Cross Convent	8.1 km SW
Maitland Secondary School	8.4 km SW
Usasazo Secondary School	8.5 km SW
Koeberg Primary School	8.6 km SW
Garden Village Primary School	9.7 km SW
Liberte School	0.9 km W
Alpha Montessori	2.5 km W
Table View Primary School	2.1 km NW
Sunridge Circle Primary School	2.6 km NW
Parklands College Junior Preparatory and Christopher Robin Pre-Primary	3.9 km NW
Parklands College Senior Preparatory	4.0 km NW
Bloubergrant Primary School	5 km NW
Blouberg International School	5.3 km NW
Bloberg Ridge Primary School	5.7 km NW
Sunningdale Private School	5.7 km NW
West Coast Christian School	6.1 km NW
Parklands College Secondary Faculty	6.2 km NW
Elkanah House High School	6.4 km NW
Generations School Sunningdale	6.6 km NW
Sunningdale Primary School	7 km NW
Rallim Preparatory School	8.0 km NW

Considering that the proposed crematorium is to be located in a large industrial area, the site is surrounded by numerous contributors to air pollution, including Astron Energy, Permoseal, BP, Engen, Cape Precious Metals, Gayatri Paper and Novus Printing works. The contribution of these sources to air pollution is taken into account when the cumulative impact of the proposed crematorium on air quality is assessed. This is because the baseline data that is used in this assessment already reflects the effect of the existing contributors to air pollution in the area.

On-site meteorological data was obtained from the WRF-MMIF model and thus no meteorological stations have been indicated on the map.

A regional map of the area 50 km from the site is shown below, again with topographical features indicated.

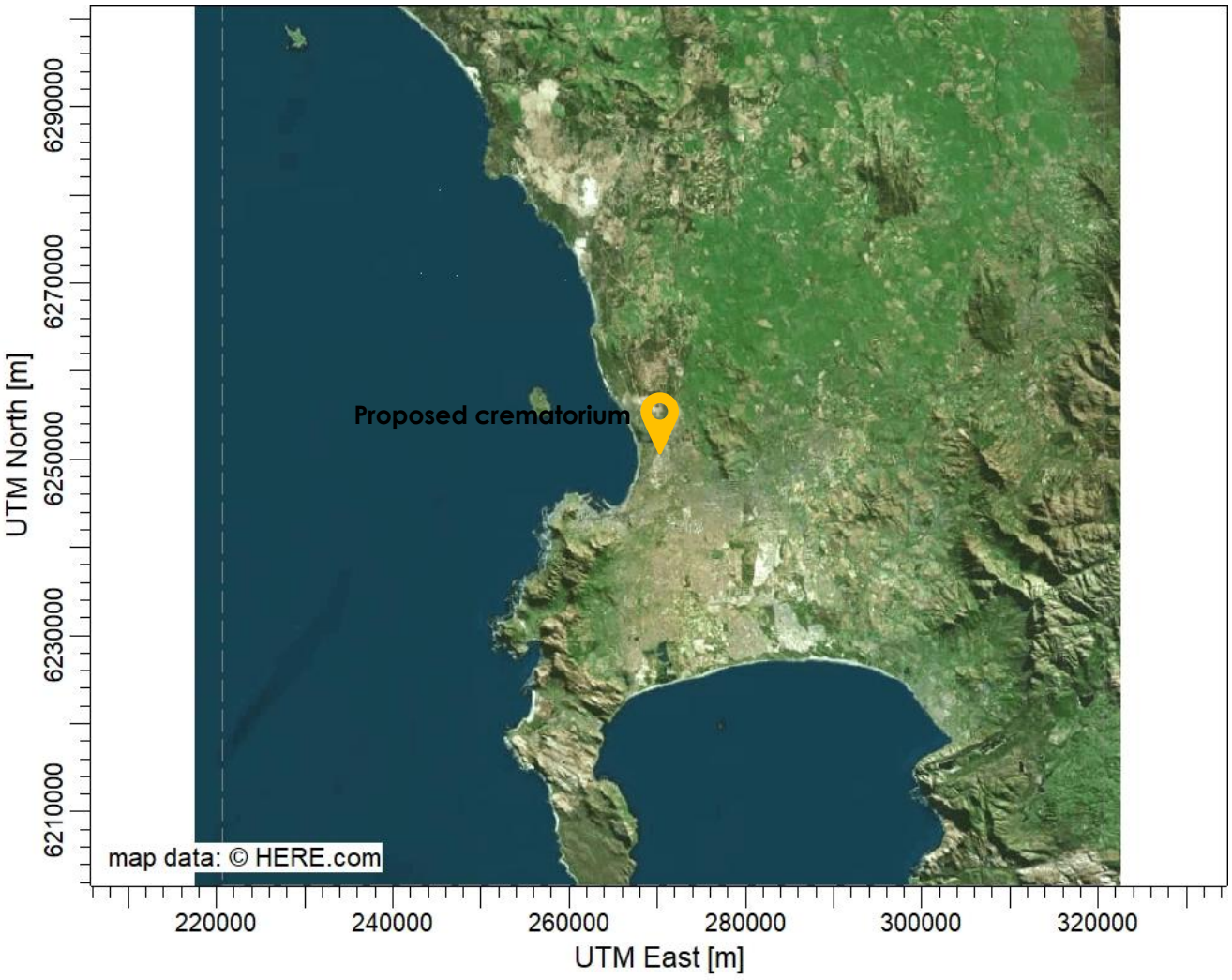


Figure 6: Map Showing the Area 50 km from the Proposed Crematorium

7.1.2. Geophysical and Elevation Data

Land use in the 3 km surrounding the site has less than 35% vegetation coverage, and thus the entire area was determined to be urban. Shuttle Radar Topography Mission (SRTM) 1 Version 3 (30-metre resolution) elevation data was obtained from WebGIS.

7.2. Emissions Characterisation

7.2.1. Emissions Characteristics

Emissions from the proposed crematorium are anticipated to be only from the six cremators themselves which have been identified as point sources. LPG is to be used as fuel for the cremators, and no fugitive emissions are anticipated from the LPG tanks.

The proposed crematorium will be classified as an air quality listed activity under Subcategory 8.2: *Crematoria and Veterinary Waste Incineration* of G.N. 893 of 2013, as amended. The pollutants that have been identified in G.N. 893 of 2013 from Subcategory 8.2 activities as potentially having a significant effect on the environment are particulate matter (PM), carbon monoxide (CO), the oxides of nitrogen (NO_x) and mercury (Hg). Emissions limits for these pollutants are shown in the excerpt from G.N. 893 below (Figure 7).

Subcategory 8.2: Crematoria and Veterinary Waste Incineration

Description:	Cremation 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 Kelvin 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

Figure 7: Emissions Limits for Crematoria

Additionally, comments received after the draft Basic Assessment Report, and version 2 of this Atmospheric Impact Report requested that numerous additional pollutants be investigated. Of these, benzene and lead were determined to be of particular interest due to the existence of National Ambient Air Quality Standards (NAAQS) for these pollutants.

7.2.2. Operating Scenarios

Normal operating conditions were simulated in the dispersion model. Start-up, standby and shutdown conditions were not simulated, as these are not expected to be significantly different to normal operating conditions.

7.2.3. Emissions Inventory and Source Parameters

As per Section 3.3 of the Code of Practice for Air Dispersion Modelling in Air Quality Management in South Africa, 2014 (referred to hereafter as the Code of Practice)[6], the minimum emissions standards

[6] Contained in the Regulations Regarding Air Dispersion Modelling (G.N.R. 533 of 2014)

(MESs) for Subcategory 8.2 were used as the basis for the emissions inventory for the proposed crematorium, where possible. These standards are given in concentration units of mg/Nm^3. However, for use in AERMOD, an emission rate in g/s is required. The flow rate of gas in the stack is needed to convert the concentration into an absolute emission rate. A gas flow rate of 3 500 m^3/h was provided by the applicant, along with an approximate stack temperature of 600 °C.

The minimum emissions standards and the provided flow rate were used to calculate the emissions rates of the legislated pollutants for Subcategory 8.2 from each cremator. A stack temperature of 600 °C was used, along with a stack pressure of 101.325 kPa (approximate ambient pressure at sea level), a moisture content of 2% (a conservative estimate from 27 sampling campaigns conducted by Yellow Tree on 14 cremators), and an oxygen concentration of 11%.

Table 2: Emissions Rates per Cremator

Pollutant	Concentration (mg/Nm^3)	Emission Rate (g/s)
PM	40	0.012
CO	75	0.022
NO_x	500	0.15
Mercury	0.05	0.000015

While there is only an MES for total PM, the National Ambient Air Quality Standards (NAAQS) are for PM_{10} (the fraction of PM that is smaller than 10 µm) and $PM_{2.5}$ (the fraction of PM that is smaller than 2.5 µm). Yellow Tree looked to the EEA/EMEP emissions factors for crematoria for further information regarding the split between PM_{10} and $PM_{2.5}$ in total PM (Figure 8).[7]

Table 3-1 Tier 1 emission factors for source category 5.C.1.b.v Cremation, cremation of human bodies

Tier 1 default emission factors					
	Code	Name			
NFR Source Category	5.C.1.b.v	Cremation			
Fuel	NA				
Not applicable	HCH, NH_3				
Not estimated	BC				
			95% confidence interval		
Pollutant	**Value**	**Unit**	**Lower**	**Upper**	**Reference**
NO_x	0.825	kg/body	0.0825	8.25	Santarsiero et al. (2005)
CO	0.140	kg/body	0.0140	1.40	Santarsiero et al. (2005)
NMVOC	0.013	kg/body	0.0013	0.13	CANA (1993)
SO_2	0.113	kg/body	0.0113	1.13	Santarsiero et al. (2005)
TSP	38.56	g/body	3.856	385.6	WebFIRE, 1992
PM_{10}	34.70	g/body	3.470	347.0	WebFIRE, 1992
$PM_{2.5}$	34.70	g/body	3.470	347.0	WebFIRE, 1992
Pb	30.03	mg/body	3.003	300.3	WebFIRE, 1992
Cd	5.03	mg/body	0.503	50.3	WebFIRE, 1992
Hg	1.49	g/body	0.149	14.9	WebFIRE, 1992

Figure 8: Excerpt from EEA/EMEP Chapter 5C1bv

[7] https://www.eea.europa.eu/publications/emep-eea-guidebook-2019/part-b-sectoral-guidance-chapters/5-waste/5-c-1-b-v/view

The ratios of TSP (total PM) to PM_{10} and $PM_{2.5}$ emissions factors were used to estimate PM_{10} and $PM_{2.5}$ emission rates.

Table 3: Emissions Rates Including PM_{10} and $PM_{2.5}$

Pollutant	Concentration (mg/Nm³)	Emission Rate (g/s)
PM	40	0.012
CO	75	0.022
NO_x	500	0.15
Mercury	0.05	0.000015
PM_{10}	-	0.011
$PM_{2.5}$	-	0.011

To verify the estimated emissions rates for PM_{10}, $PM_{2.5}$, CO, NO_x and Hg, the EEA/EMEP emissions factors were used, along with the maximum proposed cremation rate of eight cadavers in an eight-hour shift per cremator. Additionally, the EEA, EMEP emissions factors were used to estimate benzene and lead emissions. It was assumed that all non-methane volatile organic compounds (NMVOCs) were benzene. This is a very conservative assumption.

Table 4: Verification of Emission Rates Using Emissions Factors

Pollutant	Emissions Factor (g/cadaver)	Cadavers /shift	Emission (g)	Hours	Emission Rate (g/s)
PM	38.56	8	308.48	8	0.011
CO	140	8	1120	8	0.039
NO_x	825	8	6600	8	0.23
Hg	1.49	8	11.92	8	0.00041
PM_{10}	34.7	8	277.6	8	0.0096
$PM_{2.5}$	34.7	8	277.6	8	0.0096
NMVOCs (assumed to be benzene)	13	8	104.0	8	0.0036
Lead	0.03	8	0.24	8	0.0000083

It was reassuring to find that the emission rates that were estimated using both methods were similar, as shown below.

Table 5: Comparison Between MES Emissions Rates and Emissions Factors Emissions Rates

Pollutant	MES (g/s)	Emissions Factors (g/s)
PM	0.012	0.011
CO	0.022	0.039
NO_x	0.15	0.23
Hg	0.000015	0.00041
PM_{10}	0.011	0.0096
$PM_{2.5}$	0.011	0.0096

As required by the Code of Practice, the emission rates calculated using the MESs were used in this study, apart from NMVOCs (conservatively assumed to comprise solely of benzene) and lead for which no MESs exist.

7.3. Meteorological Data

On-site and upper air WRF-MMIF meteorological data, for a period of three full calendar years (2019, 2020 and 2021), was purchased from Lakes Environmental. The WRF model is recommended for use in the Code of Practice. The base station elevation is 54.86 metres. The data was processed using AERMET View Version 10.2.1. No missing hours or calm periods were noted.

7.4. Ambient Impact Analysis

7.4.1. National Ambient Air Quality Standards

South Africa's National Ambient Air Quality Standards (NAAQS) were promulgated in G.N. 1210 of 2009, with further standards for $PM_{2.5}$ promulgated in G.N. 486 of 2012. The following standards are applicable to PM_{10}, $PM_{2.5}$, CO and NO_2. There are no standards for mercury.

Averaging Period	Concentration	Frequency of Exceedence	Compliance Date
24 hours	120µg/m³	4	Immediate – 31 December 2014
24 hours	75 µg/m³	4	1 January 2015
1 year	50 µg/m³	0	Immediate – 31 December 2014
1 year	40 µg/m³	0	1 January 2015
The reference method for the determination of the particulate matter fraction of suspended particulate matter shall be EN 12341			

Figure 9: PM_{10} NAAQS

Averaging Period	Concentration	Frequency of Exceedence	Compliance Date
24 hours	65 µg/m³	4	Immediate - 31 December 2015
24 hours	40 µg/m³	4	1 January 2016 - 31 December 2029
24 hours	25 µg/m³	4	1 January 2030
1 year	25 µg/m³	0	Immediate - 31 December 2015
1 year	20 µg/m³	0	1 January 2016 - 31 December 2029
1 year	15 µg/m³	0	1 January 2030
The reference method for the determination of $PM_{2.5}$ fraction of suspended particulate matter shall be EN 14907			

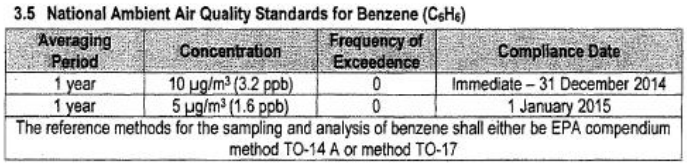
Figure 10: $PM_{2.5}$ NAAQS

Averaging Period	Concentration	Frequency of Exceedence	Compliance Date
1 hour	30 mg/m³ (26 ppm)	88	Immediate
8 hour (calculated on 1 hourly averages)	10 mg/m³ (8.7 ppm)	11	Immediate
The reference method for analysis of Carbon Monoxide shall be ISO 4224			

Figure 11: CO NAAQS

Averaging Period	Concentration	Frequency of Exceedence	Compliance Date
1 hour	200 µg/m³ (106 ppb)	88	Immediate
1 year	40 µg/m³ (21 ppb)	0	Immediate
The reference method for the analysis of nitrogen dioxide shall be ISO 7996			

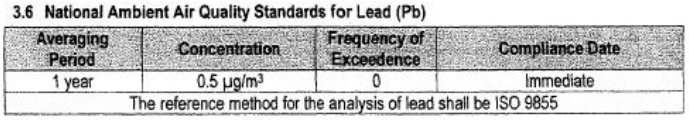
Figure 12: NO_2 NAAQS



3.5 National Ambient Air Quality Standards for Benzene (C_6H_6)

Averaging Period	Concentration	Frequency of Exceedence	Compliance Date
1 year	10 µg/m³ (3.2 ppb)	0	Immediate – 31 December 2014
1 year	5 µg/m³ (1.6 ppb)	0	1 January 2015
The reference methods for the sampling and analysis of benzene shall either be EPA compendium method TO-14 A or method TO-17			

Figure 13: Benzene NAAQS



3.6 National Ambient Air Quality Standards for Lead (Pb)

Averaging Period	Concentration	Frequency of Exceedence	Compliance Date
1 year	0.5 µg/m³	0	Immediate
The reference method for the analysis of lead shall be ISO 9855			

Figure 14: Lead NAAQS

For PM_{10} and $PM_{2.5}$, daily average and annual average standards are specified. Four exceedances of the daily average standard are permitted in each calendar year.

For CO, hourly and 8-hourly average standards are specified. 88 exceedances of the hourly standard are permitted, and 11 exceedances of the 8-hourly standard are permitted in each calendar year.

For NO_2, hourly and annual standards are specified, with 88 exceedances of the hourly standard permitted in each calendar year.

For benzene and lead, annual standards are specified.

7.4.2. International Guidelines

No NAAQS are applicable to mercury. Internationally used standards were sought for use as guidelines in this report, however, it appears that ambient mercury standards are not commonly implemented internationally. Only one World Health Organization (WHO) annual guideline of 1 µg/m³ was found, and this was estimated from the lowest-observed-adverse-effect levels (LOAELs). Thus, an annual guideline of 1 µg/m³ was used in this report.

Table 6: Mercury Ambient Guidelines

Averaging Period	International Standard	Source
Annual	1 µg/m³	WHO Regional Office for Europe, Copenhagen, Denmark, Air Quality Guidelines Chapter 6.9[8]

[8] https://www.euro.who.int/__data/assets/pdf_file/0004/123079/AQG2ndEd_6_9Mercury.PDF

7.4.3. Background Concentrations

Ambient air quality monitoring data from four ambient air quality monitoring stations were sourced from the South African Air Quality Information System (SAAQIS). Table 7 shows the monitoring stations from which data was sourced, as well as the distance between the station and the proposed crematorium site.

Table 7: Ambient Air Quality Monitoring Stations

Station	Distance and Direction from the Site	Parameters Monitored
Potsdam	1.5 km NNE	Benzene
Bothasig	2.0 km SW	NO_2
Table View	3.6 km NNW	PM_{10}, $PM_{2.5}$, NO_2
Edgemead (Acacia Power Station)	4.0 km SE	PM_{10}, NO_2
Goodwood	7.0 km SE	PM_{10}, CO, NO_2
Maitland	9.2 km SW	PM_{10}, $PM_{2.5}$, CO, NO_2
Foreshore	11.3 km SW	Benzene
Khayelitsha	21.9 SE	Benzene

No ambient mercury data or lead is available on SAAQIS, however, the Global Atmospheric Watch Station (GAWS) at Cape Point measures ambient mercury concentrations. Annual median data (specified to not be significantly different from average data) from the station between 2007 and 2017 was found in an academic paper and is shown in Figure 33[9].

[9] https://acp.copernicus.org/articles/20/7683/2020/

PM_{10}

The following graphs show the daily average PM_{10} concentrations from Table View, Edgemead, Goodwood, and Maitland (Figure 15, Figure 16, Figure 17, and Figure 18, respectively).

-

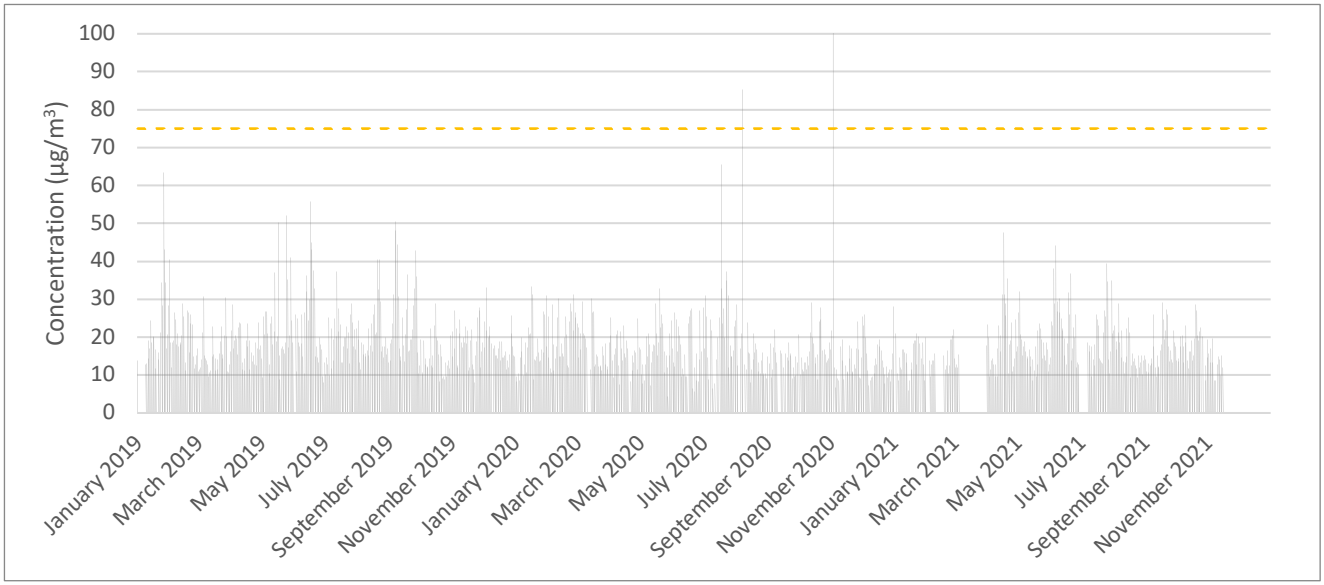


Figure 15: Daily Average PM_{10} Concentrations, Table View

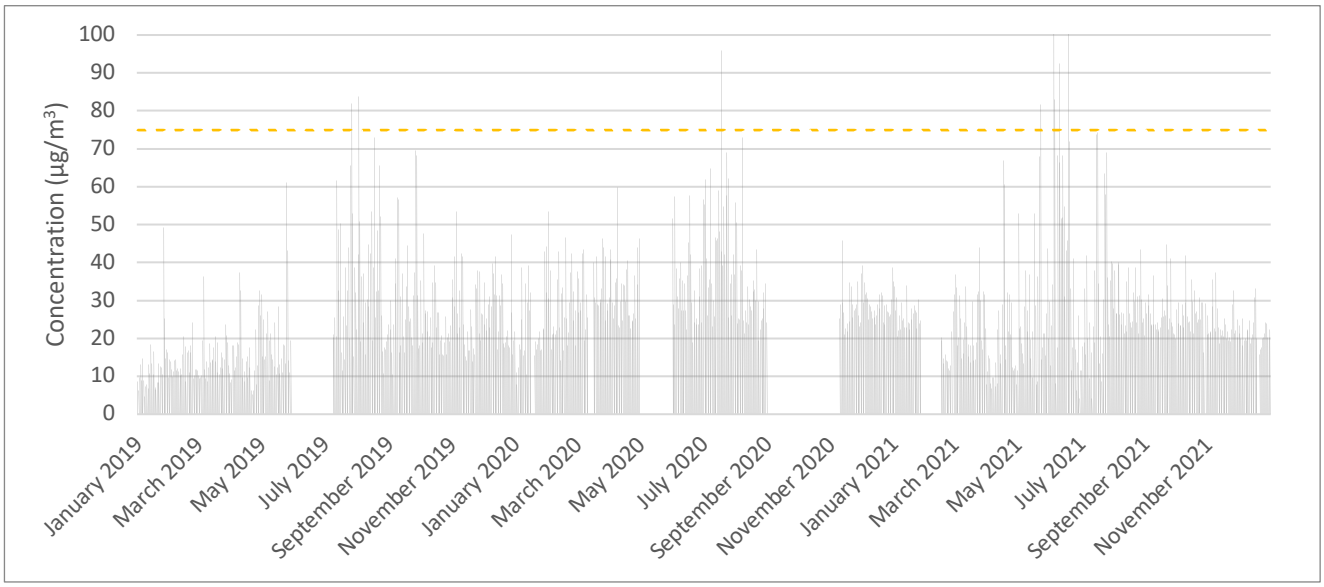


Figure 16: Daily Average PM_{10} Concentrations, Edgemead

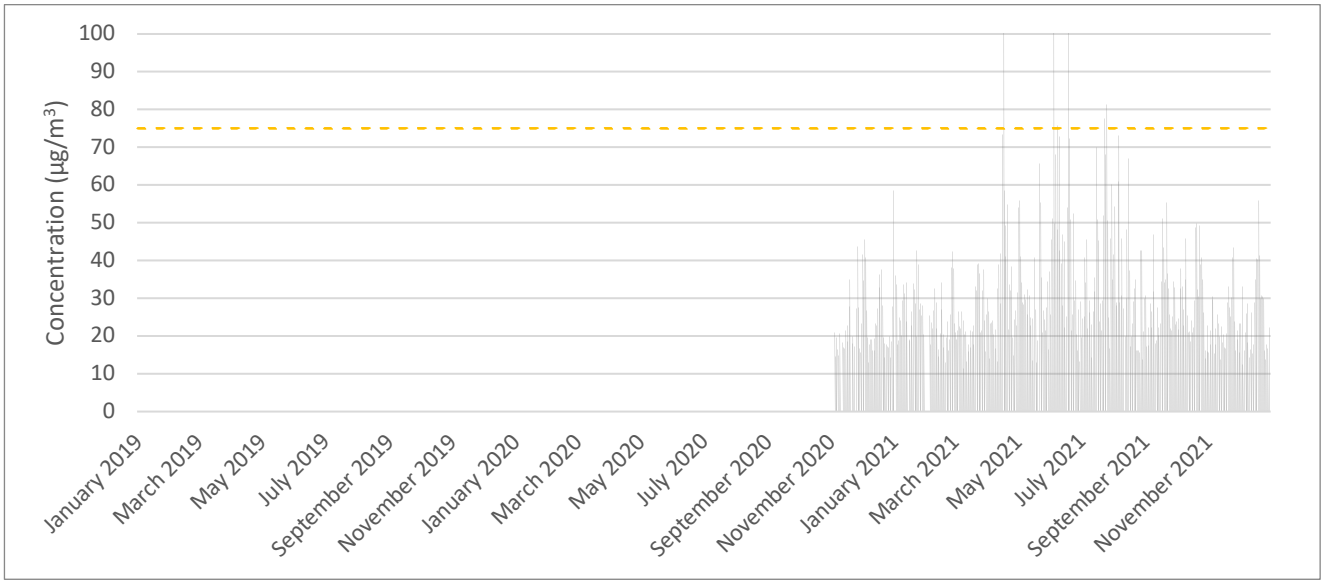


Figure 17: Daily Average PM_{10} Concentrations, Goodwood

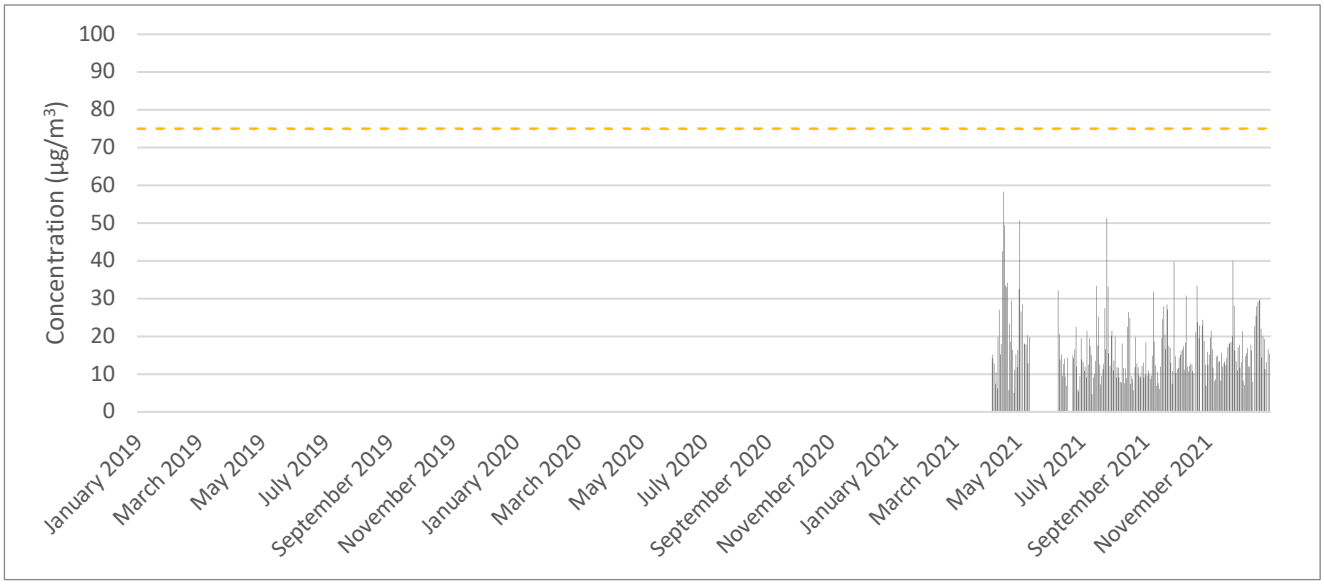


Figure 18: Daily Average PM_{10} Concentrations, Maitland

Table 8: Daily PM_{10} Ambient Air Quality Monitoring Data Summary

Number of exceedances per annum	2019	2020	2021	Limit
Table View[10]	0	2	0	4
Edgemead[11]	2	1	5	4
Goodwood[12]	-	0	6	4
Maitland[13]	-	-	0	4

Table 9: Annual PM_{10} Ambient Air Quality Monitoring Data Summary

Concentration (µg/m³)	2019	2020	2021	Limit
Table View	19.8	21.0	17.6	40
Edgemead	23.0	31.8	26.8	40
Goodwood	-	23.0	30.6	40
Maitland	-	-	16.7	40

Of the three stations, only Edgemead and Goodwood had exceedances of the daily average standard, both in 2021. The Table View station is closest to the site (3.6 km), followed by the Edgemead station (4.0 km). Both had relatively good data availability, and thus both have been used as baselines in this assessment. It should be noted that Edgemead showed more exceedances of the daily average standard than Table View, and showed higher annual averages.

[10] 87.6 % data availability over the three years
[11] 82.5 % data availability over the three years
[12] 37.2 % data availability over the three years
[13] 21.3 % data availability over the three years

$PM_{2.5}$

Whereas the previous graphs revealed the *PM_{10}* concentrations, the following graphs show the daily average *$PM_{2.5}$* concentrations from Table View and Maitland (Figure 19 and Figure 20, respectively).

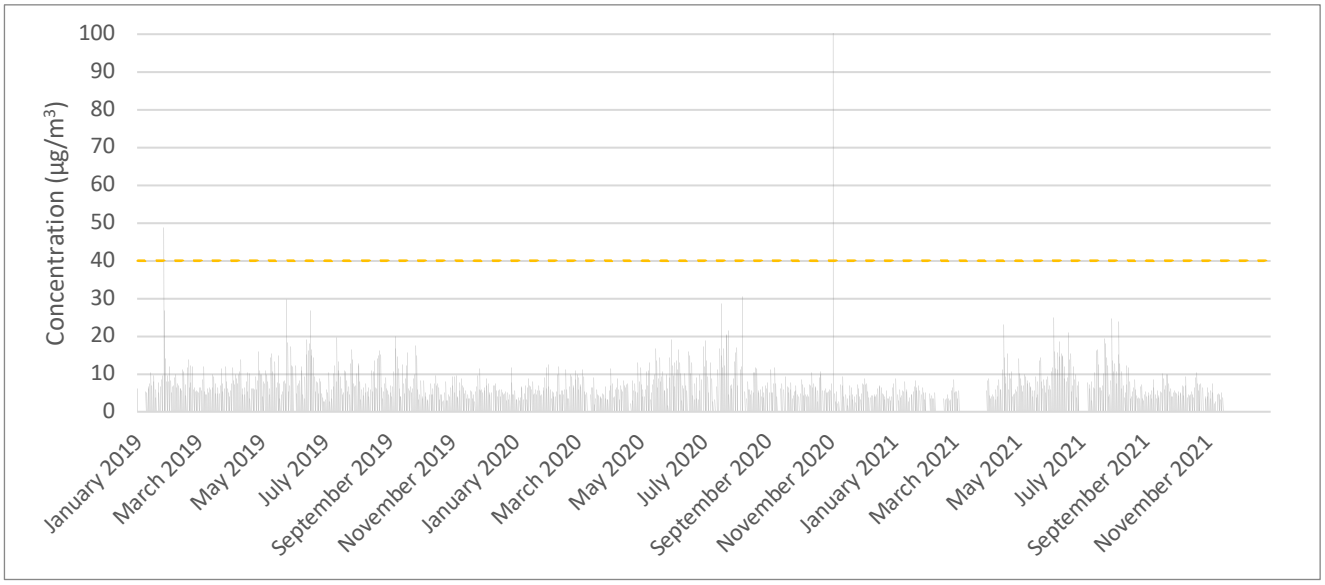


Figure 19: Daily Average $PM_{2.5}$ Concentrations, Table View

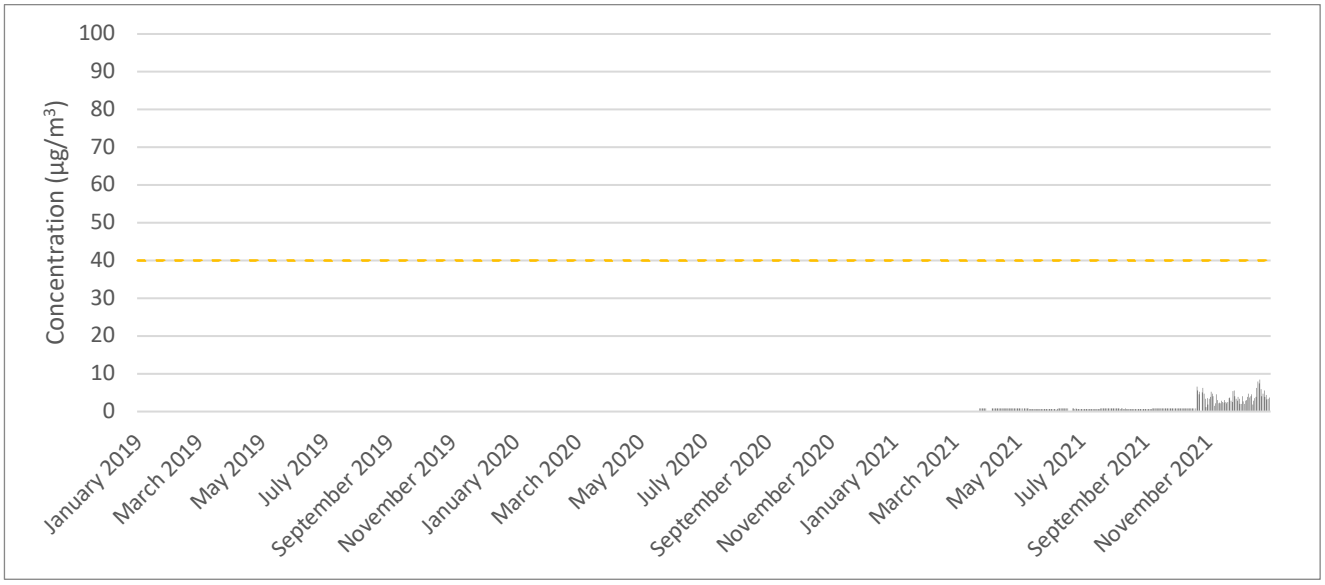


Figure 20: Daily Average $PM_{2.5}$ Concentrations, Maitland

Table 10: Daily $PM_{2.5}$ Ambient Air Quality Monitoring Data Summary

Number of exceedances per annum	2019	2020	2021	Limit
Table View[14]	1	1	0	4
Maitland[15]	-	-	0	4

Table 11: Annual $PM_{2.5}$ Ambient Air Quality Monitoring Data Summary

Concentration (µg/m³)	2019	2020	2021	Limit
Table View	7.9	8.6	7.3	20
Maitland	-	-	1.6	20

Both the Table View and Maitland stations complied with the NAAQS for $PM_{2.5}$. The Table View station is closest to the site and had the highest percentage of data availability, and thus the $PM_{2.5}$ data from Table View was used as the baseline for this assessment.

[14] 87.6 % data availability over the three years
[15] 21.3 % data availability over the three years

CO

The following graphs show the hourly average and 8-hourly average CO concentrations at the Goodwood and Maitland stations (Figure 21, Figure 22, Figure 23 and Figure 24, respectively). Very limited data was available from the Goodwood station, with extremely high concentrations measured over a short period in 2020. It appears unlikely that this data is accurate, especially considering that this magnitude of CO concentration is expected in chimney stacks and is significantly higher than would be expected in ambient air. From the Maitland station, consistent data was only available from April 2021.

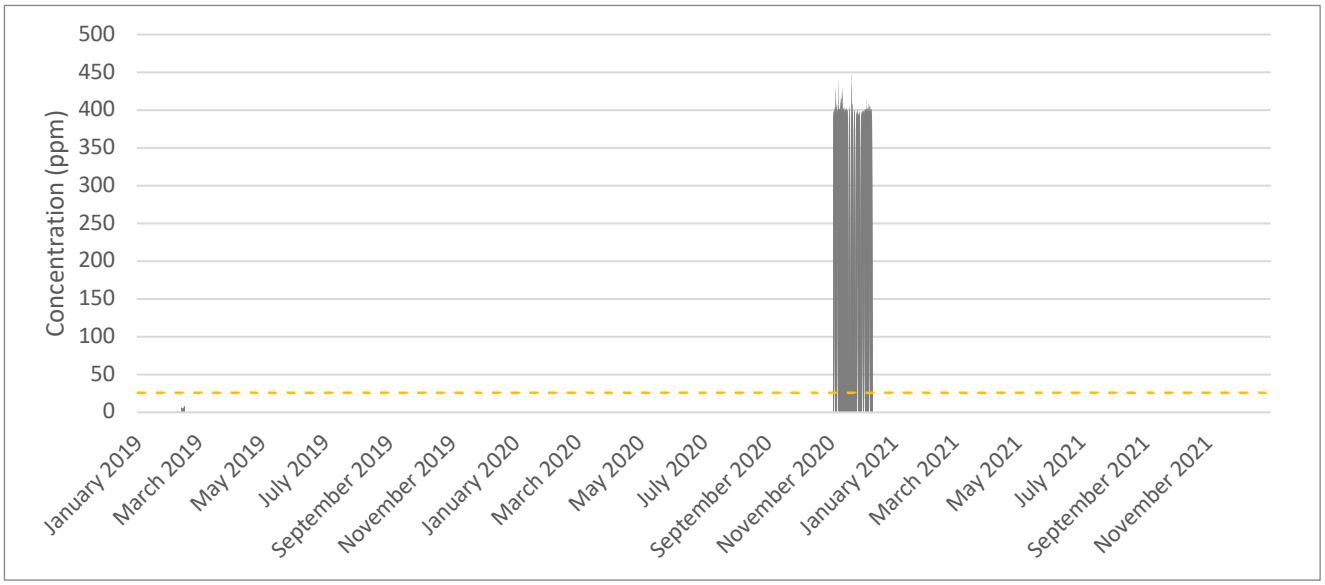


Figure 21: Hourly Average CO Concentrations, Goodwood

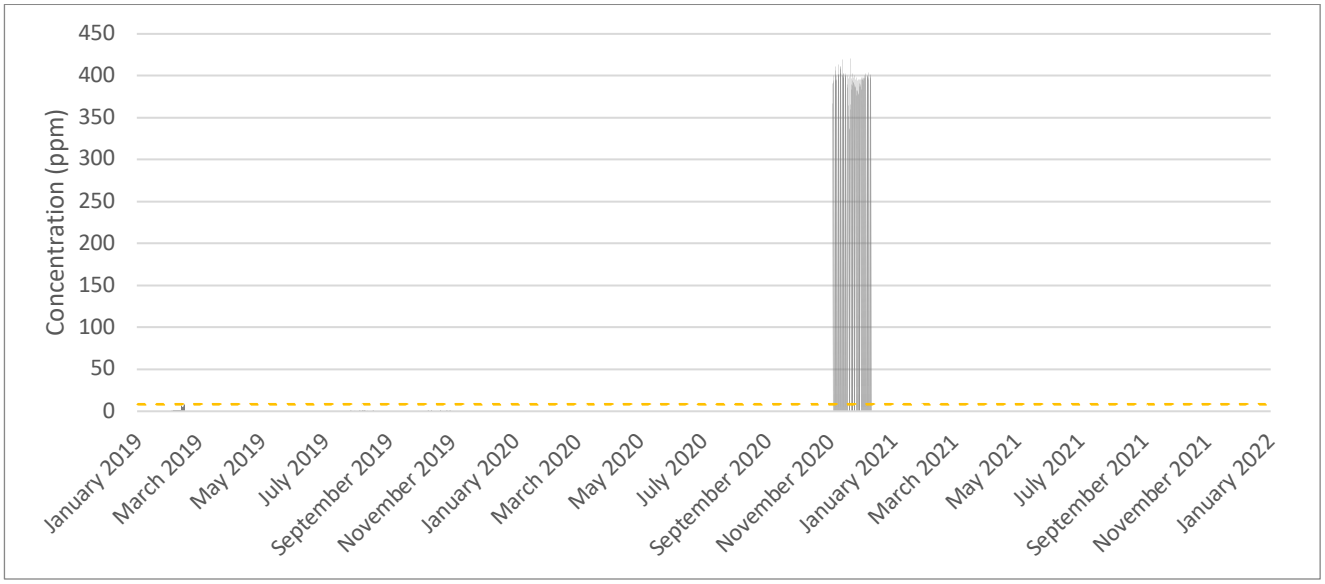


Figure 22: 8-Hourly Average CO Concentrations, Goodwood

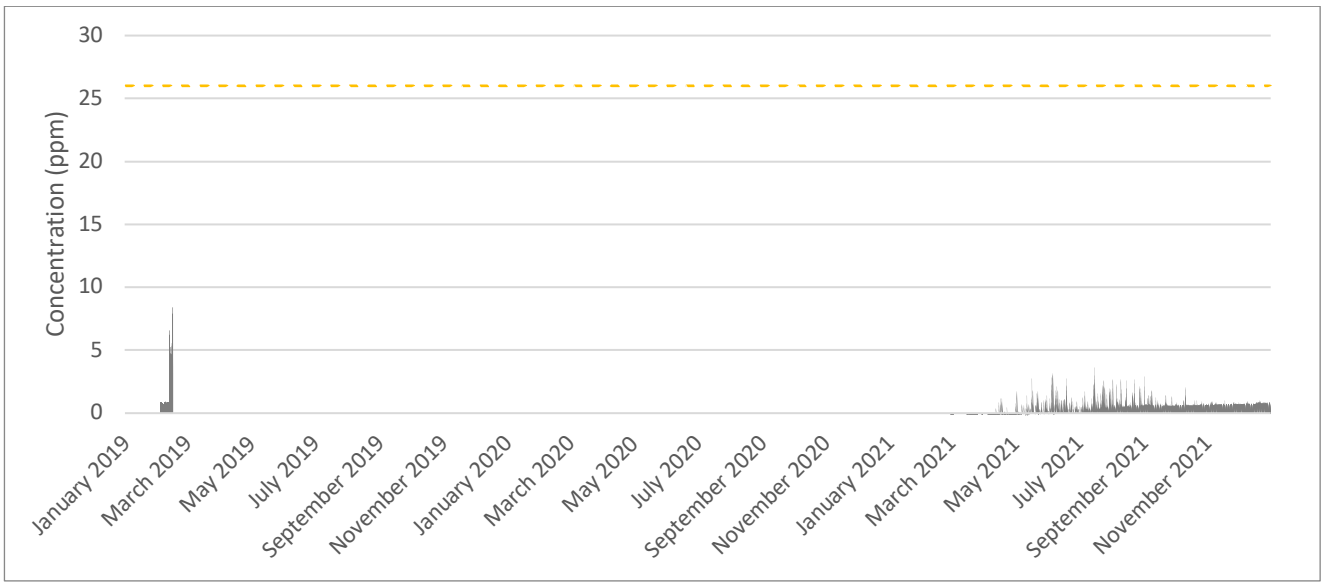


Figure 23: Hourly Average CO Concentrations, Maitland

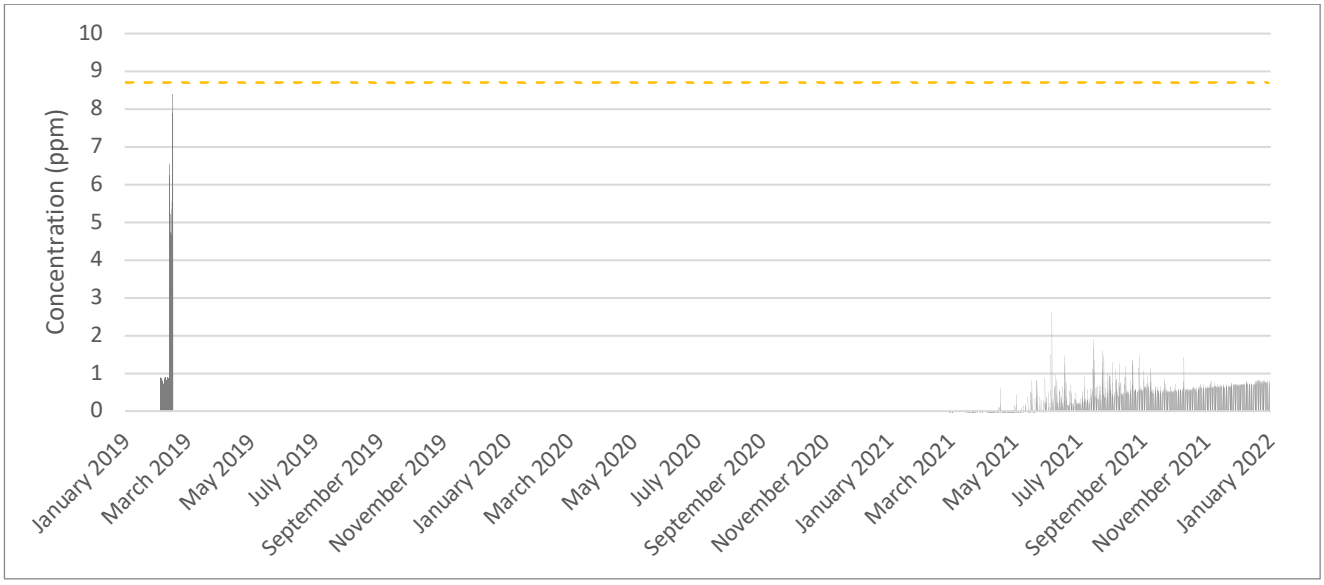


Figure 24: 8-Hourly Average CO Concentrations, Maitland

Table 12: Hourly CO Ambient Air Quality Monitoring Data Summary

Number of exceedances per annum	2019	2020	2021	Limit
Goodwood[16]	-	719	-	88
Maitland[17]	0	-	0	88

Table 13: 8-Hourly CO Ambient Air Quality Monitoring Data Summary

Number of exceedances per annum	2019	2020	2021	Limit
Goodwood[18]	-	112	-	11
Maitland[19]	0	-	0	11

As discussed, high CO concentrations were measured over a short period in 2020 at the Goodwood station. These exceeded the NAAQS, but it appears unlikely that this data is accurate. No exceedances were noted from the Maitland station, and the CO data from this station was used as the baseline for this assessment.

[16] 11.0 % data availability over the three years
[17] 21.3 % data availability over the three years
[18] 11.0 % data availability over the three years
[19] 21.3 % data availability over the three years

NO_2

The following graphs show the hourly average PM_{10} concentrations from Bothasig, Table View, Edgemead, Goodwood, and Maitland (Figure 25, Figure 26, Figure 27, Figure 28 and Figure 29, respectively). It must be noted that these are presented in parts per billion (ppb) which is 1 000 times smaller in magnitude than the measure of parts per million (ppm) which was used for CO concentration.

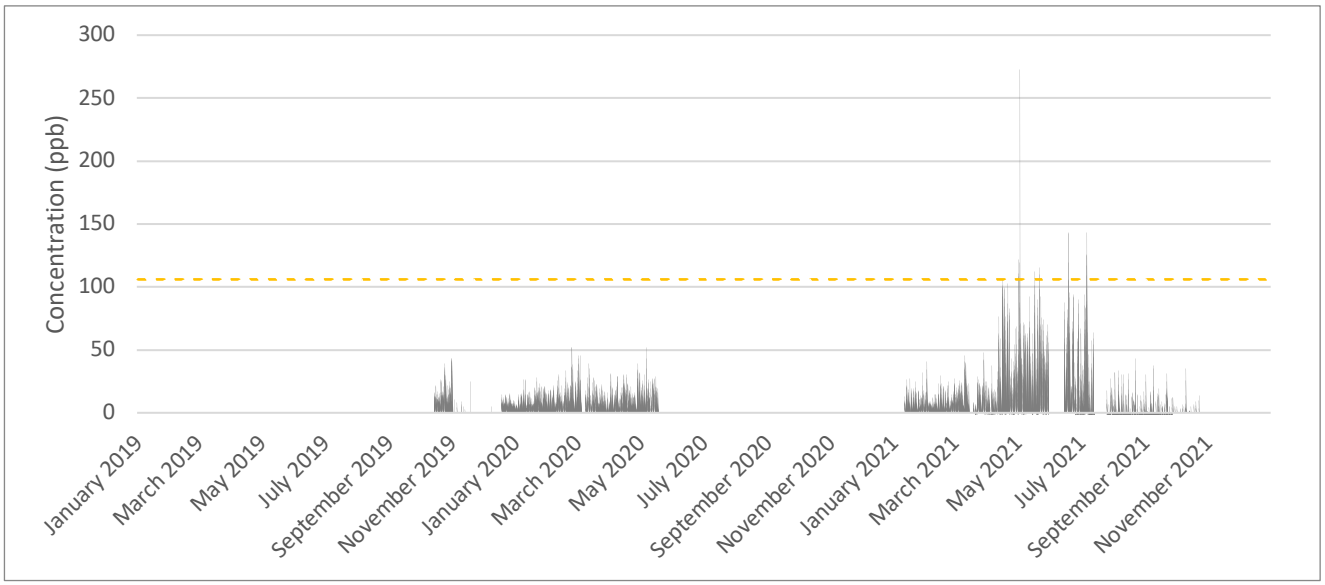


Figure 25: Hourly Average NO_2 Concentrations, Bothasig

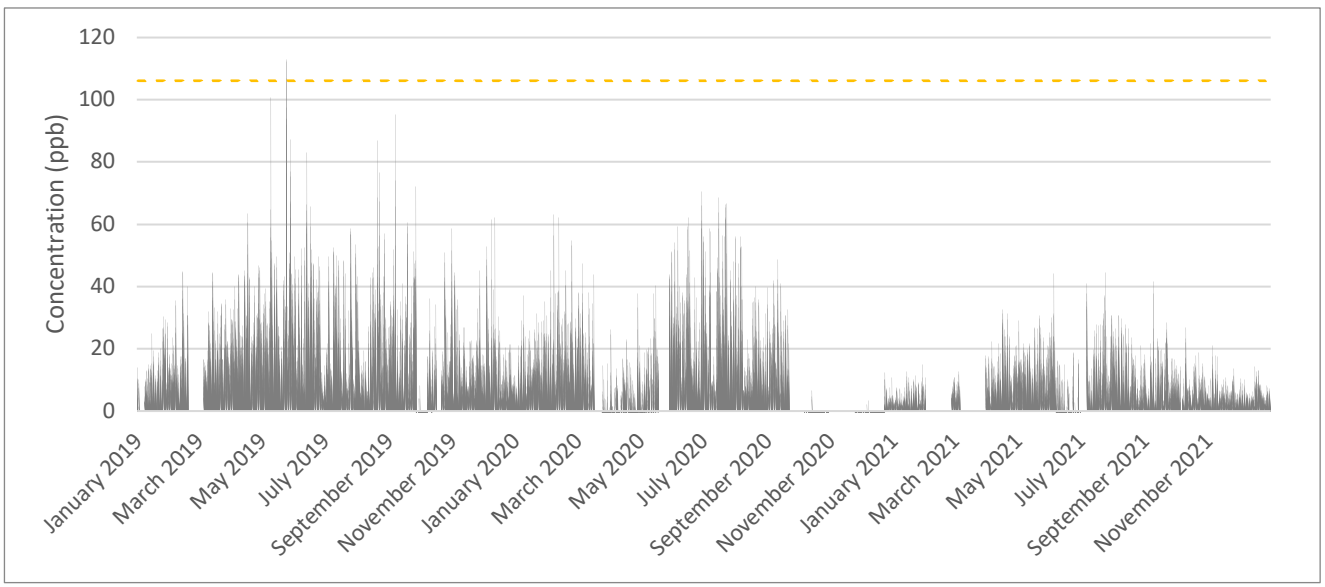


Figure 26: Hourly Average NO_2 Concentrations, Table View

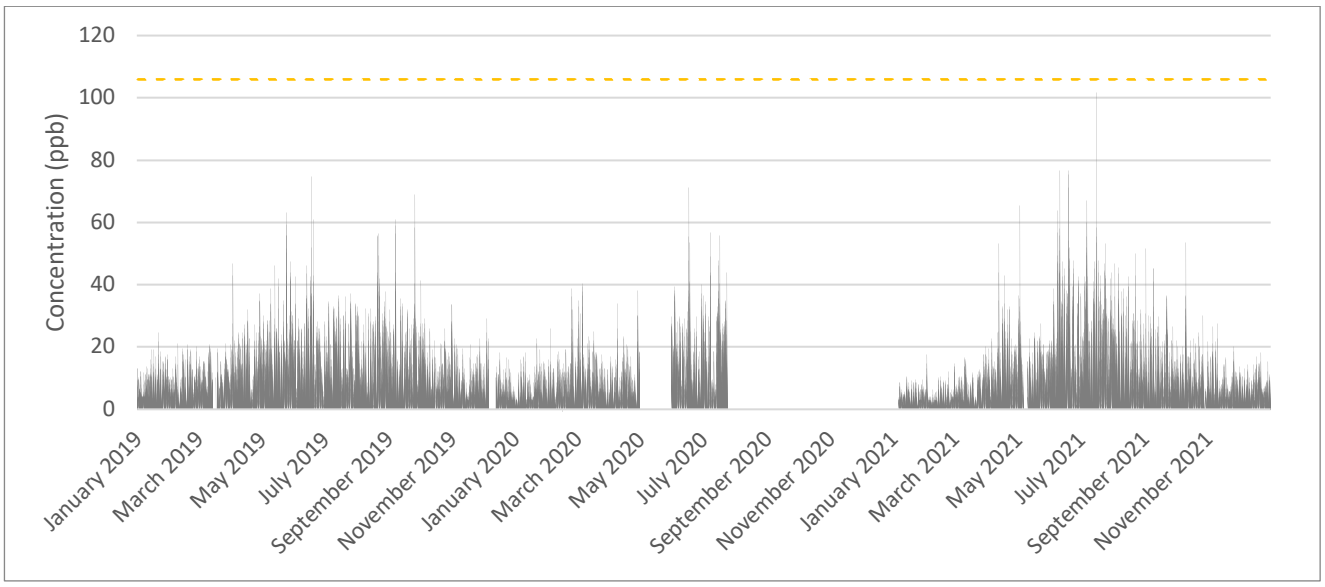


Figure 27: Hourly Average NO_2 Concentrations, Edgemead

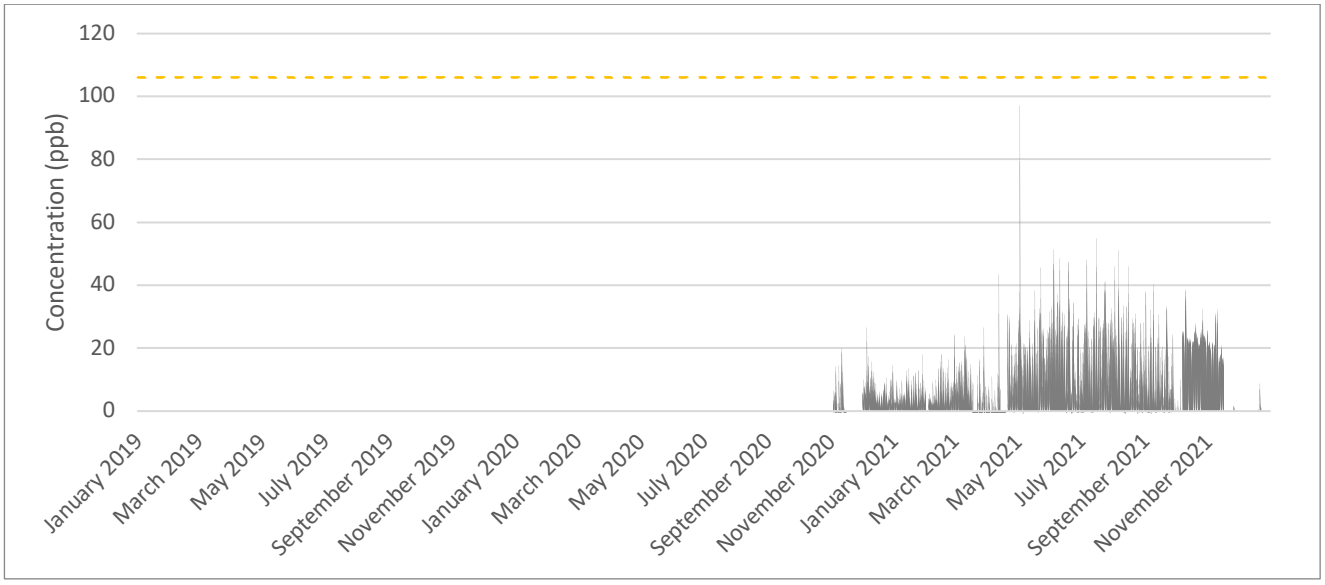


Figure 28: Hourly Average NO_2 Concentrations, Goodwood

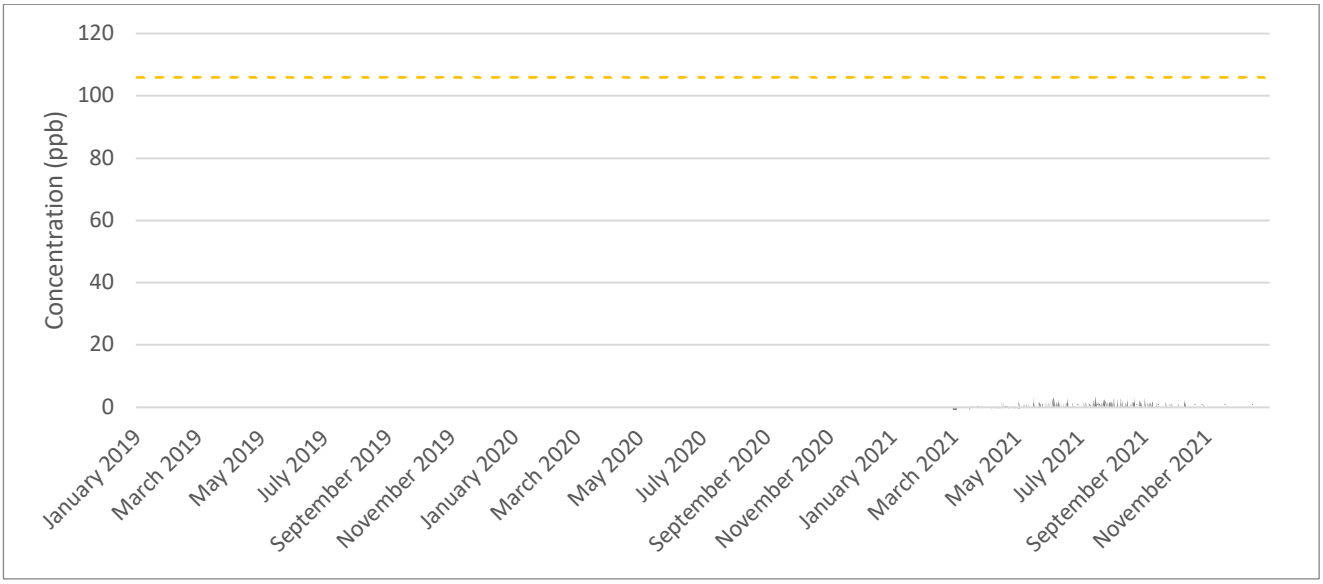


Figure 29: Hourly Average NO_2 Concentrations, Maitland

Table 14: Hourly NO_2 Ambient Air Quality Monitoring Data Summary

Number of exceedances per annum	2019	2020	2021	Limit
Bothasig[20]	0	0	17	88
Table View[21]	3	0	0	88
Edgemead[22]	0	0	0	88
Goodwood[23]	-	0	0	88
Maitland[24]	-	-	0	88

[20] 37.6 % data availability over the three years
[21] 82.4 % data availability over the three years
[22] 78.8 % data availability over the three years
[23] 30.3 % data availability over the three years
[24] 26.8 % data availability over the three years

Table 15: Annual NO_2 Ambient Air Quality Monitoring Data Summary

Concentration (ppb)	2019	2020	2021	Limit
Bothasig	8.8	6.8	9.5	21
Table View	12.9	12.1	5.7	21
Edgemead	9.5	8.4	8.7	21
Goodwood	-	3.5	8.9	21
Maitland	-	-	7.7	21

No NO_2 exceedances were noted at any of the stations. The Table View and Edgemead stations are not as close to the site as the Bothasig site, however, had the highest percentage of data availability, and were used as the baselines for this assessment.

Benzene

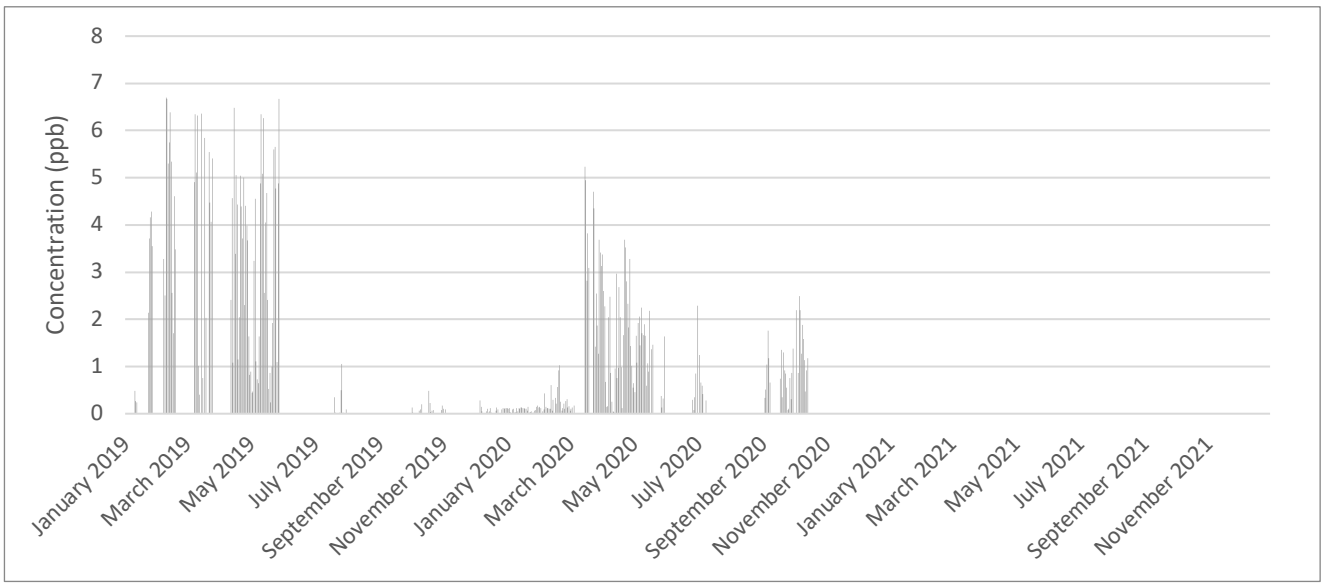


Figure 30: Daily Average Benzene Concentrations, Potsdam

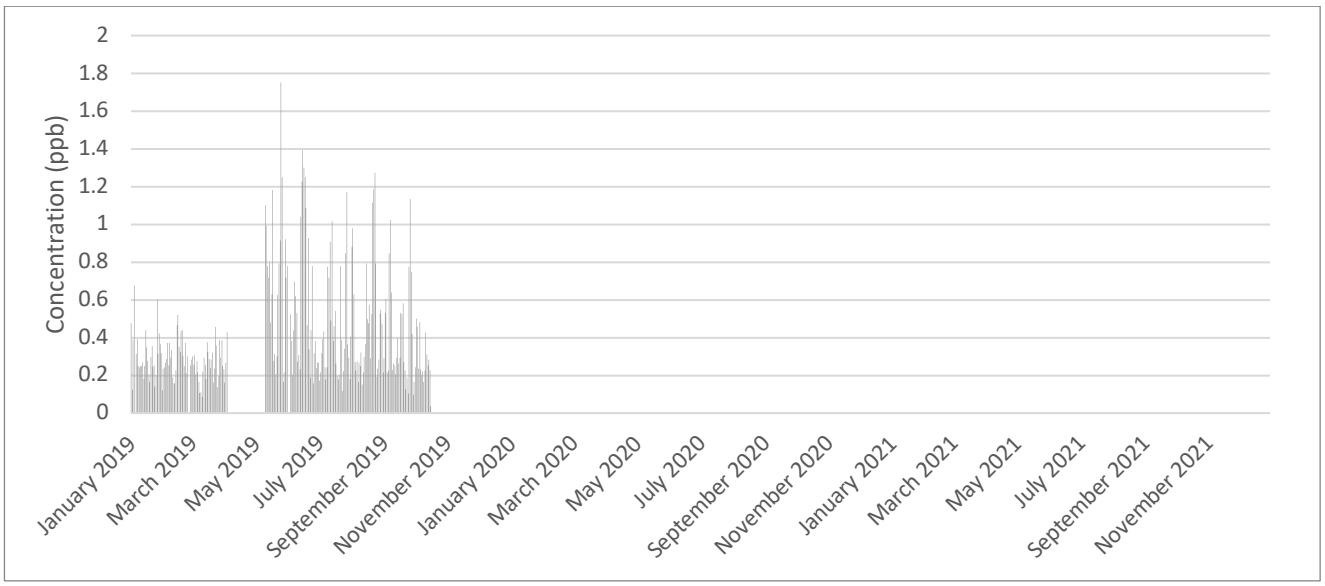


Figure 31: Daily Average Benzene Concentrations, Foreshore

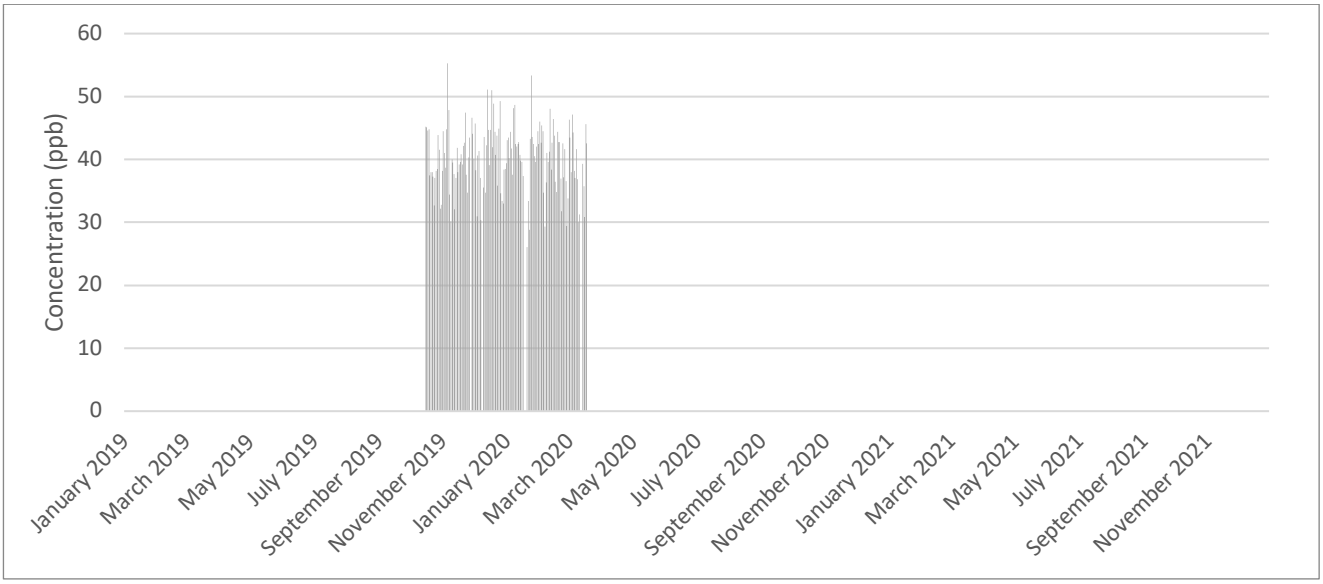


Figure 32: Daily Average Benzene Concentrations, Khayelitsha

Table 16: Annual Benzene Ambient Air Quality Monitoring Data Summary

Concentration (ppb)	2019	2020	2021	Limit
Potsdam[25]	2.0	0.9	-	1.6
Foreshore[26]	0.4	-	-	1.6
Khayelitsha[27]	40.3	40.2	-	1.6

Exceedances of the annual benzene standard were noted in 2019 at the Potsdam site (despite low data availability of 29.8 % over the 3 year period), and at the Khayelitsha site (also despite low data availability of 13.5 %). Data from the Potsdam site was used as the baseline for this study, as this site is the closest to the proposed crematorium and has the highest data availability of the three sites.

[25] 29.8 % data availability over the three years
[26] 23.0 % data availability over the three years
[27] 13.5 % data availability over the three years

Mercury

Annual median mercury concentrations measured at the Cape Point GAWS station are shown by the grey squares in the graph below (Figure 33). These ranged from approximately 0.9 ng/m3 and 1.1 ng/Nm^3 and were well below the WHO guideline of 1 µg/m3.

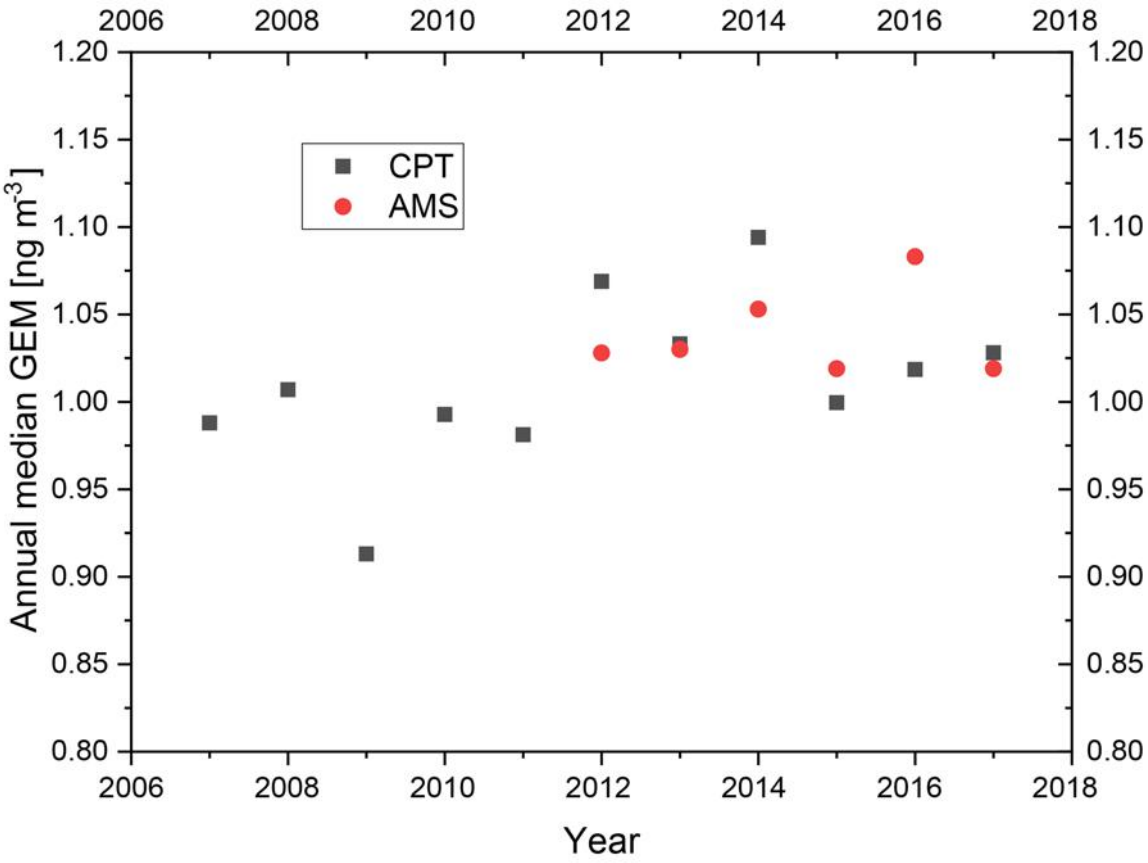


Figure 33: Median Mercury Concentrations, Cape Point[28]

[28] Slemr, F., Martin, L., Labuschagne, C., Mkololo, T., Angot, H., Magand, O., Dommergue, A., Garat, P., Ramonet, M., and Bieser, J.: Atmospheric mercury in the Southern Hemisphere – Part 1: Trend and inter-annual variations in atmospheric mercury at Cape Point, South Africa, in 2007–2017, and on Amsterdam Island in 2012–2017, Atmos. Chem. Phys., 20, 7683–7692, https://doi.org/10.5194/acp-20-7683-2020, 2020.

7.5. Modelling Procedure

7.5.1. Model Used

Based on Section 2.1.2 of the Code of Practice, a Level 2 assessment was used and the AERMOD model was chosen. The model was conducted using the AERMOD View Version 10.2.1 interface and AERMET View Version 10.2.1 pre-processor.

An elevated terrain height setting was chosen, as is the default setting for AERMOD. One land-use sector was used, and urban characteristics were selected (surface roughness of 1, Bowen ratio of 1.625 and Albedo of 0.2075).

7.5.2. Modelled Emissions

Table 17: Emissions Rates

Source	Source Location (UTM)	Pollutant	MES (mg/Nm³)	Emission Rate (g/s)
Cremator 1	X: 270739.96 Y: 6251577.46	PM	40	0.012
Cremator 2	X: 270732.32 Y: 6251579.83	CO	75	0.022
Cremator 3	X: 270725.42 Y: 6251582.09	NO_x	500	0.15
Cremator 4	X: 270718.78 Y: 6251584.85	Mercury	0.05	0.000015
Cremator 5	X: 270712.52 Y: 6251586.98	PM_{10}	-	0.011
Cremator 6	X: 270706.01 Y: 6251589.36	$PM_{2.5}$	-	0.011

7.5.3. Receptors

Three sets of receptors were used in this model:

1. A Cartesian plant boundary (indicated in red on the following map, Figure 34). Intermediate receptors were placed at 50 metre intervals along the boundary of the site. The plant boundary essentially acts as a set of receptors for the surrounding businesses and members of the public who do not work at the crematorium. The maximum concentrations at, and close to, the plant boundary were assessed.
2. Sensitive receptors at the closest point of six surrounding residential areas: Milnerton Ridge, Bothasig, Flamingo Vlei, Richwood, Dunoon and Phoenix (indicated with yellow markers on the following map, **Figure 34**),
3. A uniform cartesian grid with 50 metre spacing up to 500 metres from the crematorium (the ara of maximum impact), and 100-metre spacing beyond this (indicated by the grey grid and blue markers on the following map, Figure 34).

Figure 34: Map Showing Three Tiers of Receptors

7.6. Results

The following results were obtained from the air dispersion modelling. As per the Code of Practice, all short-term averages (24-hours or less) were presented as the 99th percentile concentration.

In the three-year period, there were 1 096 days. The 99th percentile value for the daily average values is thus the 11th highest value recorded (1 096 x 0.01 = 10.96).

For hourly concentrations, it was calculated that there were 1 096 x 24 = 26 304 hours in the 2019 – 2021 calendar years. The 99th percentile value is thus the 263rd highest value recorded (26 304 x 0.01 = 263).

For 8-hourly concentrations, there are three eight-hour periods in each day: 1 096 x 3 = 3 288. Thus, the 99th percentile value is the 33rd highest value (3 288 x 0.01 = 32.88).

No results inside the plant were assessed, as these are subject to occupational air quality standards and not the NAAQS. Fence line and surrounds, and sensitive receptor results were assessed and are presented in the following sections.

Additionally, the maximum concentrations that were predicted at the fence line and surrounds, and sensitive receptors, were added to the background concentrations for the relevant pollutant from the closest monitoring station with the best data availability to give cumulative concentrations, as per Section 6.2 of the Code of Practice. These cumulative concentrations were assessed against the NAAQS. For short-term averages, this is an extremely conservative way to assess the contribution of a facility to ambient air quality, as it assumes that the maximum concentration that was predicted is experienced every hour, every 8 hours, or every day in the period (depending on the averaging period being assessed). In reality, this would not occur.

7.6.1. PM_{10}

Table 18: PM_{10} Results

Ave. Period	Parameter	Max Fence Line and Surrounds	Milnerton Ridge Sensitive Receptor	Bothasig Sensitive Receptor	Flamingo Vlei Sensitive Receptor	Richwood Sensitive Receptor	Dunoon Sensitive Receptor	Phoenix Sensitive Receptor
Daily	**Conc. (µg/m³)**	**18.12408**	**0.26333**	**0.11884**	**0.12428**	**0.03783**	**0.03218**	**0.06409**
	Location	X: 270739.81 Y: 6251563.06	X: 270178.66 Y: 6251740.48	X: 271676.99 Y: 6251279.85	X: 270263.33 Y: 6252948.25	X: 272217.76 Y: 6253325.42	X: 272287.48 Y: 6254074.39	X: 269820.54 Y: 6249534.94
	Elevation	11.32	7.61	24.80	4.83	30.78	36.35	17.95
	Date	2019-07-03	2020-05-07	2021-07-28	2019-06-14	2021-04-21	2019-10-03	2019-08-24
Annual	**Conc. (µg/m³)**	**4.09635**	**0.04964**	**0.02201**	**0.03093**	**0.00555**	**0.00432**	**0.00865**
	Location	X: 270739.81 Y: 6251563.06	X: 270178.66 Y: 6251740.48	X: 271676.99 Y: 6251279.85	X: 270263.33 Y: 6252948.25	X: 272217.76 Y: 6253325.42	X: 272287.48 Y: 6254074.39	X: 269820.54 Y: 6249534.94
	Elevation	11.32	7.61	24.80	4.83	30.78	36.35	17.95
	Date	-	-	-	-	-	-	-

The data presented above indicates that the PM_{10} concentrations that are experienced by sensitive receptors are negligible. This is also clearly visible in Figure **35** and Figure 36 below, which show that the main impact of the proposed crematorium is immediately around the site.

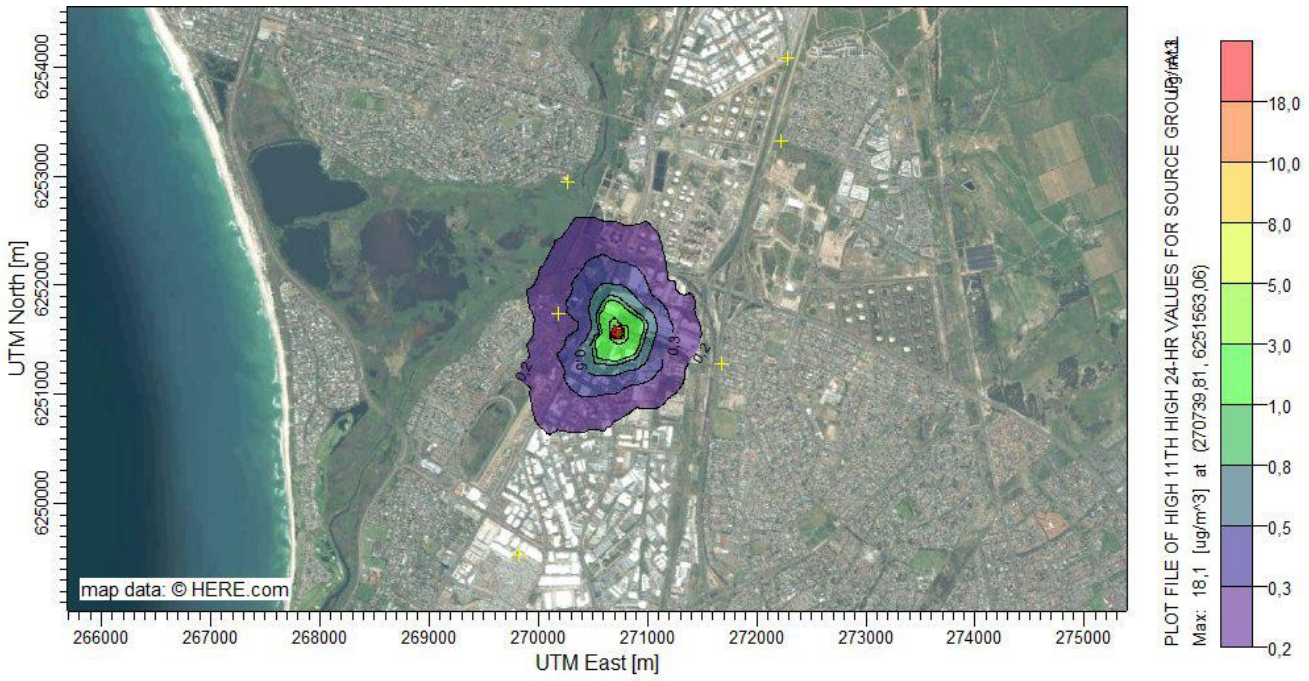


Figure 35: Isopleths of ***Daily*** PM_{10} Concentration Around the Proposed Crematorium

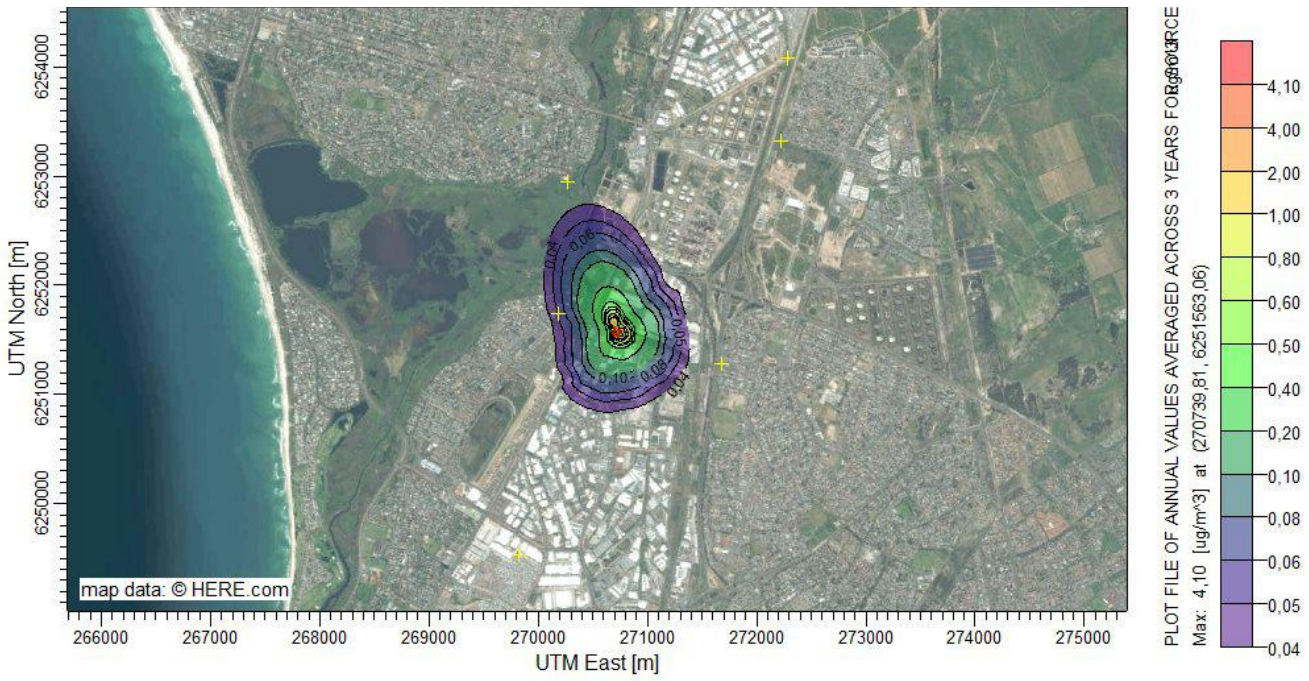


Figure 36: Isopleths of *Annual* PM_{10} Concentration Around the Proposed Crematorium

The impact of the proposed crematorium on compliance with the PM_{10} NAAQS is shown in Table 19 and Table 20 using the Table View monitoring station as a baseline, and Table 21 and Table 22 using the Edgemead monitoring station as a baseline.

Table 19: Cumulative Daily PM_{10} Results (Table View)

Number of exceedances per annum	2019	2020	2021	Limit
Baseline (Table View Monitoring Station)	0	2	0	4
Fence Line	1	3	0	4
Milnerton Ridge	0	2	0	4
Bothasig	0	2	0	4
Flamingo Vlei	0	2	0	4
Richwood	0	2	0	4
Dunoon	0	2	0	4
Phoenix	0	2	0	4

Table 20: Cumulative Annual PM_{10} Results (Table View)

Concentration (µg/m³)	2019	2020	2021	Limit
Baseline (Table View Monitoring Station)	19.8	21.0	17.6	40
Fence Line	23.9	25.1	21.7	40
Milnerton Ridge	19.8	21.0	17.7	40
Bothasig	19.8	21.0	17.6	40
Flamingo Vlei	19.8	21.0	17.6	40
Richwood	19.8	21.0	17.6	40
Dunoon	19.8	21.0	17.6	40
Phoenix	19.8	21.0	17.6	40

These tables show that the addition of the proposed crematorium is predicted to have no impact on the compliance with the NAAQS for PM_{10} in the area if the Table View station's ambient air quality data is used.

Table 21: Cumulative Daily PM_{10} Results (Edgemead)

Number of exceedances per annum	2019	2020	2021	Limit
Baseline (Edgemead Monitoring Station)	2	1	5	4
Fence Line	10	11	17	4
Milnerton Ridge	2	1	5	4
Bothasig	2	1	5	4
Flamingo Vlei	2	1	5	4
Richwood	2	1	5	4
Dunoon	2	1	5	4
Phoenix	2	1	5	4

Table 22: Cumulative Annual PM_{10} Results (Edgemead)

Concentration (µg/m³)	2019	2020	2021	Limit
Baseline (Edgemead Monitoring Station)	23.0	31.8	26.8	40
Fence Line	27.1	35.9	30.9	40
Milnerton Ridge	23.0	31.9	26.8	40
Bothasig	23.0	31.9	26.8	40
Flamingo Vlei	23.0	31.9	26.8	40
Richwood	23.0	31.8	26.8	40
Dunoon	23.0	31.8	26.8	40
Phoenix	23.0	31.8	26.8	40

When the Edgemead monitoring station is used as the baseline, the daily average PM_{10} concentrations exceed the NAAQS standard more than the allowed four times at the fence line of the facility. This is because the baseline PM_{10} concentrations at the Edgemead monitoring station were higher than at the Table View monitoring station. There are no annual NAAQS exceedances predicted. As has been noted, the cumulative daily results very conservatively assume that the maximum daily concentration is experienced every day of the three year period, which would not occur in reality.

Although the engineering specifications of the cremators indicate that the stacks are to be 12 metres high, the AERMOD model was run using various stack heights, up to a maximum of 20 metres. These resulted in lower maximum daily concentrations of PM_{10} at the fence line. The optimum height was determined to be 16 metres, which resulted in no NAAQS exceedances, unless these exceedances

existed in the baseline data (i.e. daily PM_{10} in 2021 using the Edgemead baseline data). These results are shown below.

Table 23: PM_{10} Results (16 Metre Stack)

Ave. Period	Parameter	Max Fence Line and Surrounds
Daily	**Conc. (µg/m³)**	**5.8629**
	Location	X: 270739.81 Y: 6251563.06
	Elevation	11.32
	Date	2019-07-18

Table 24: Cumulative Daily PM_{10} Results (16 Metre Stack, Edgemead)

Number of exceedances per annum	2019	2020	2021	Limit
Baseline (Edgemead Monitoring Station)	2	1	5	4
Fence Line	4	2	8	4

7.6.2. $PM_{2.5}$

Table 25: $PM_{2.5}$ Results

Ave. Period	Parameter	Max Fence Line and Surrounds	Milnerton Ridge Sensitive Receptor	Bothasig Sensitive Receptor	Flamingo Vlei Sensitive Receptor	Richwood Sensitive Receptor	Dunoon Sensitive Receptor	Phoenix Sensitive Receptor
Daily	**Conc. (µg/m³)**	**18.12408**	**0.26333**	**0.11884**	**0.12428**	**0.03783**	**0.03218**	**0.06409**
	Location	X: 270739.81 Y: 6251563.06	X: 270178.66 Y: 6251740.48	X: 271676.99 Y: 6251279.85	X: 270263.33 Y: 6252948.25	X: 272217.76 Y: 6253325.42	X: 272287.48 Y: 6254074.39	X: 269820.54 Y: 6249534.94
	Elevation	11.32	7.61	24.80	4.83	30.78	36.35	17.95
	Date	2019-07-03	2020-05-07	2021-07-28	2019-06-14	2021-04-21	2019-10-03	2019-08-24
Annual	**Conc. (µg/m³)**	**4.09635**	**0.04964**	**0.02201**	**0.03093**	**0.00555**	**0.00432**	**0.00865**
	Location	X: 270739.81 Y: 6251563.06	X: 270178.66 Y: 6251740.48	X: 271676.99 Y: 6251279.85	X: 270263.33 Y: 6252948.25	X: 272217.76 Y: 6253325.42	X: 272287.48 Y: 6254074.39	X: 269820.54 Y: 6249534.94
	Elevation	11.32	7.61	24.80	4.83	30.78	36.35	17.95
	Date	-	-	-	-	-	-	-

The results for ambient $PM_{2.5}$ concentrations are the same as the ambient PM_{10} concentrations. This is because the EMEP/EEA emissions factors indicate that the fraction of PM_{10} and $PM_{2.5}$ in TSP are the same. However, because the baseline concentrations for $PM_{2.5}$ are different to the baseline PM_{10} concentrations, the cumulative results differ.

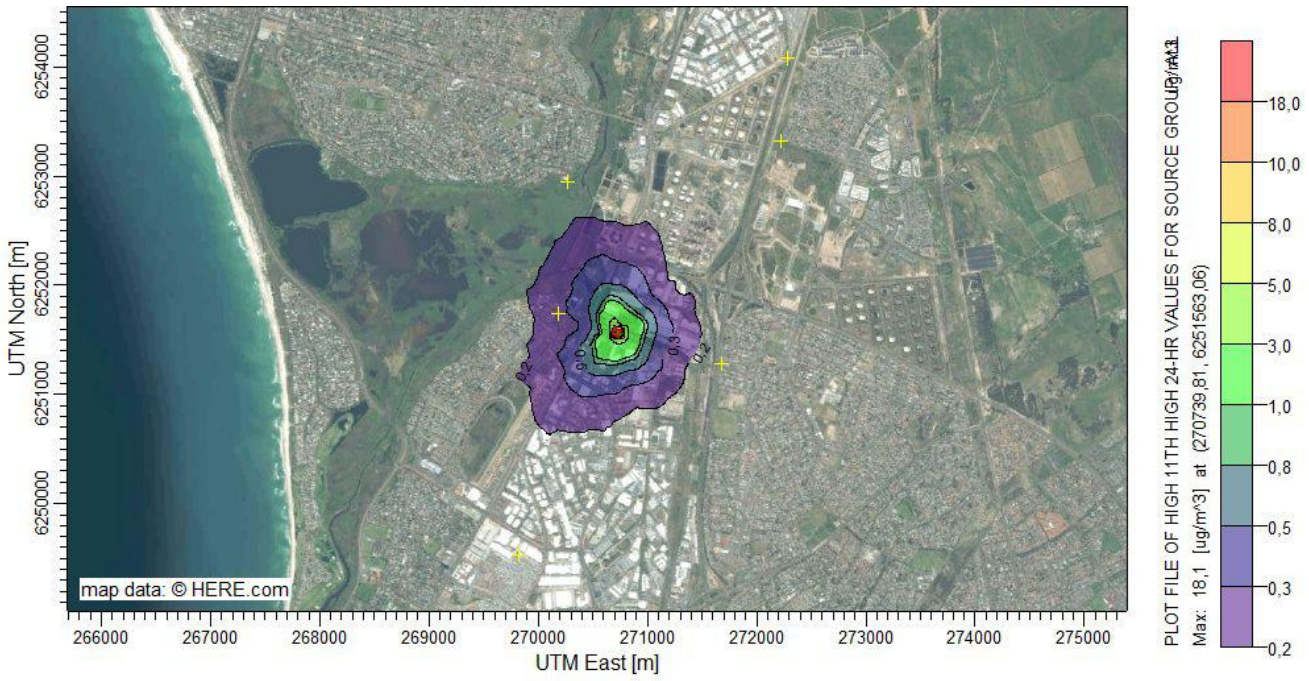


Figure 37: Isopleths of *Daily* $PM_{2.5}$ Concentration Around the Proposed Crematorium

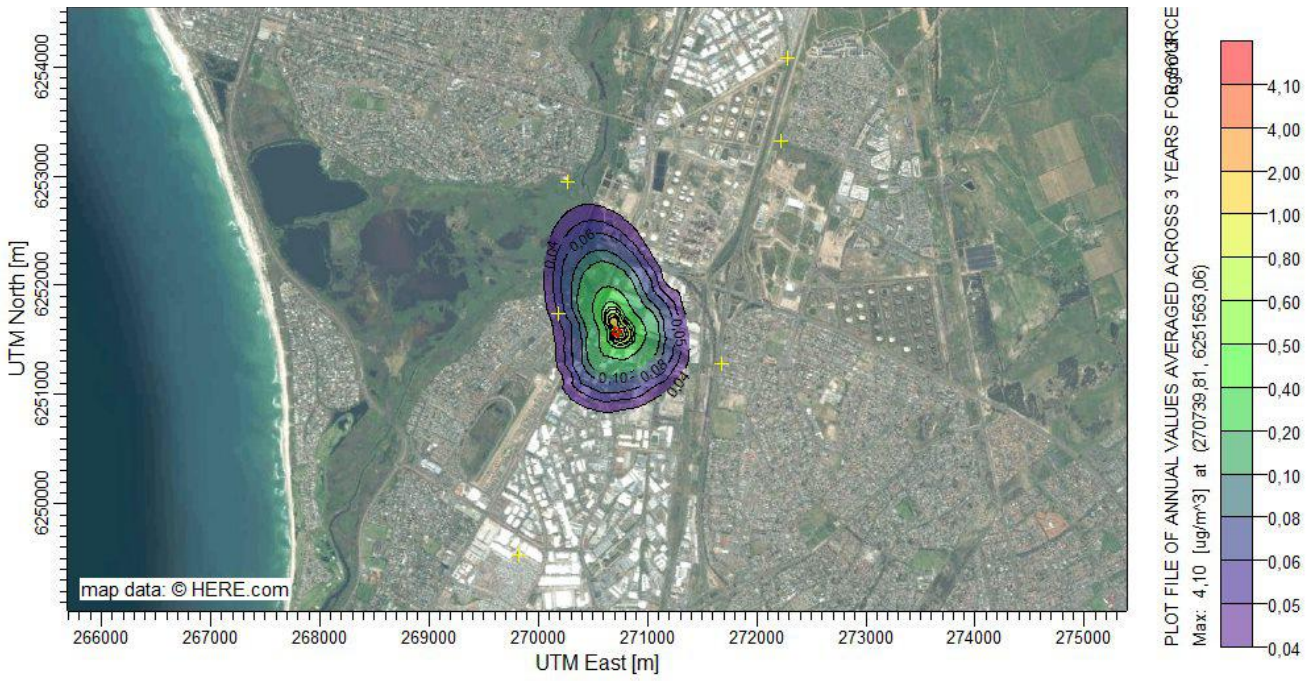


Figure 38: Isopleths of *Annual* $PM_{2.5}$ Concentration Around the Proposed Crematorium

Table 26: Cumulative Daily $PM_{2.5}$ Results

Number of exceedances per annum	2019	2020	2021	Limit
Baseline (Table View Monitoring Station)	1	1	0	4
Fence Line	4	3	4	4
Milnerton Ridge	1	1	0	4
Bothasig	1	1	0	4
Flamingo Vlei	1	1	0	4
Richwood	1	1	0	4
Dunoon	1	1	0	4
Phoenix	1	1	0	4

Table 27: Cumulative Annual $PM_{2.5}$ Results

Concentration (µg/m³)	2019	2020	2021	Limit
Baseline (Table View Monitoring Station)	7.9	8.6	7.3	20
Fence Line	12.0	12.7	11.4	20
Milnerton Ridge	7.9	8.6	7.4	20
Bothasig	7.9	8.6	7.3	20
Flamingo Vlei	7.9	8.6	7.3	20
Richwood	7.9	8.6	7.3	20
Dunoon	7.9	8.6	7.3	20
Phoenix	7.9	8.6	7.3	20

Continued compliance with the $PM_{2.5}$ NAAQS is predicted after the addition of the proposed crematorium.

7.6.3. Carbon Monoxide

Table 28: CO Results

Ave. Period	Parameter	Max Fence Line and Surrounds	Milnerton Ridge Sensitive Receptor	Bothasig Sensitive Receptor	Flamingo Vlei Sensitive Receptor	Richwood Sensitive Receptor	Dunoon Sensitive Receptor	Phoenix Sensitive Receptor
Hourly	**Conc. (ppm)**	0.05436	0.00117	0.00064	0.00054	0.00018	0.00015	0.00033
	Conc. (µg/m^3)	62.25430	1.34388	0.72931	0.61452	0.20896	0.16948	0.37716
	Location	X: 270697.50 Y: 6251558.43	X: 270178.66 Y: 6251740.48	X: 271676.99 Y: 6251279.85	X: 270263.33 Y: 6252948.25	X: 272217.76 Y: 6253325.42	X: 272287.48 Y: 6254074.39	X: 269820.54 Y: 6249534.94
	Elevation	10.00	7.61	24.80	4.83	30.78	36.35	17.95
	Date, Hour	2021-11-26, 18:00	2020-05-16, 02:00	2019-06-17, 18:00	2020-09-02, 04:00	2021-12-10, 21:00	2019-03-07, 01:00	2021-07-30, 01:00
8-Hourly	**Conc. (ppm)**	0.04082	0.00073	0.00040	0.00037	0.00012	0.00010	0.00024
	Conc. (µg/m^3)	46.75070	0.83173	0.46369	0.42499	0.13730	0.11403	0.27428
	Location	X: 270739.81 Y: 6251563.06	X: 270178.66 Y: 6251740.48	X: 271676.99 Y: 6251279.85	X: 270263.33 Y: 6252948.25	X: 272217.76 Y: 6253325.42	X: 272287.48 Y: 6254074.39	X: 269820.54 Y: 6249534.94
	Elevation	11.32	7.61	24.80	4.83	30.78	36.35	17.95
	Date	2020-06-21, 16:00	2020-08-08, 08:00	2019-10-07, 24:00	2021-04-15, 08:00	2021-12-29, 08:00	2020-10-16, 24:00	2019-04-29, 08:00

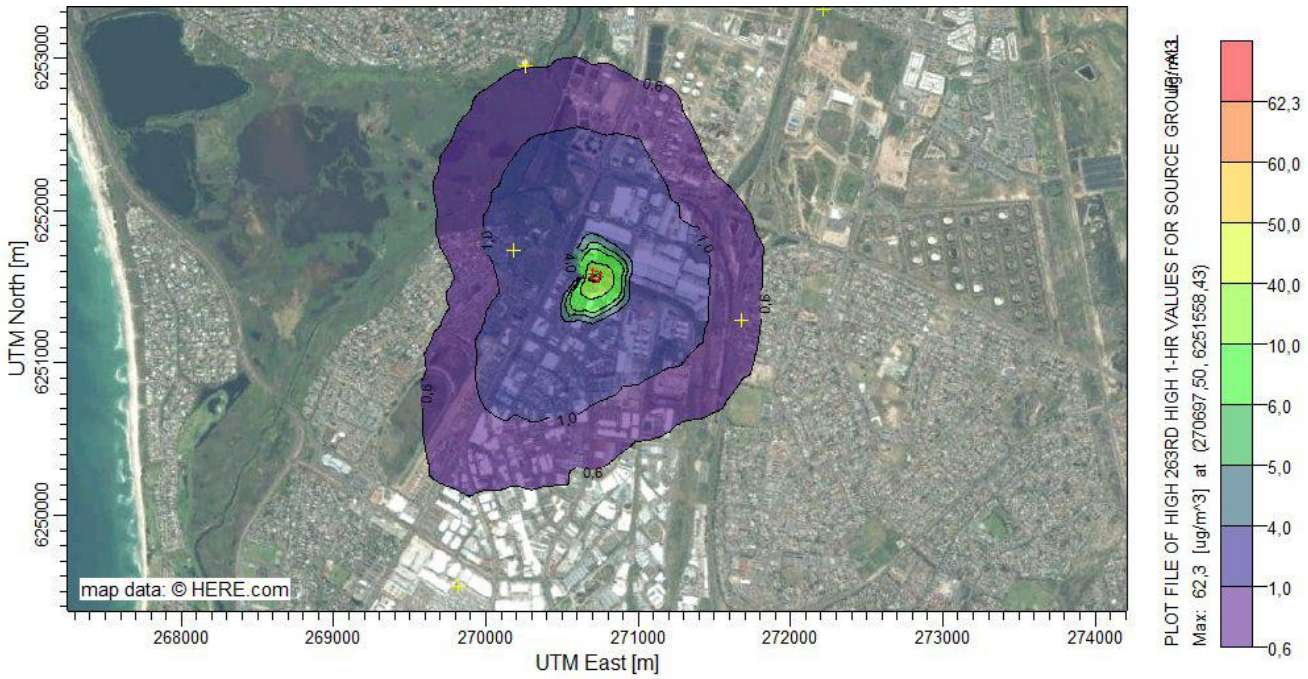


Figure 39: Isopleths of *Hourly* CO Concentration Around the Proposed Crematorium

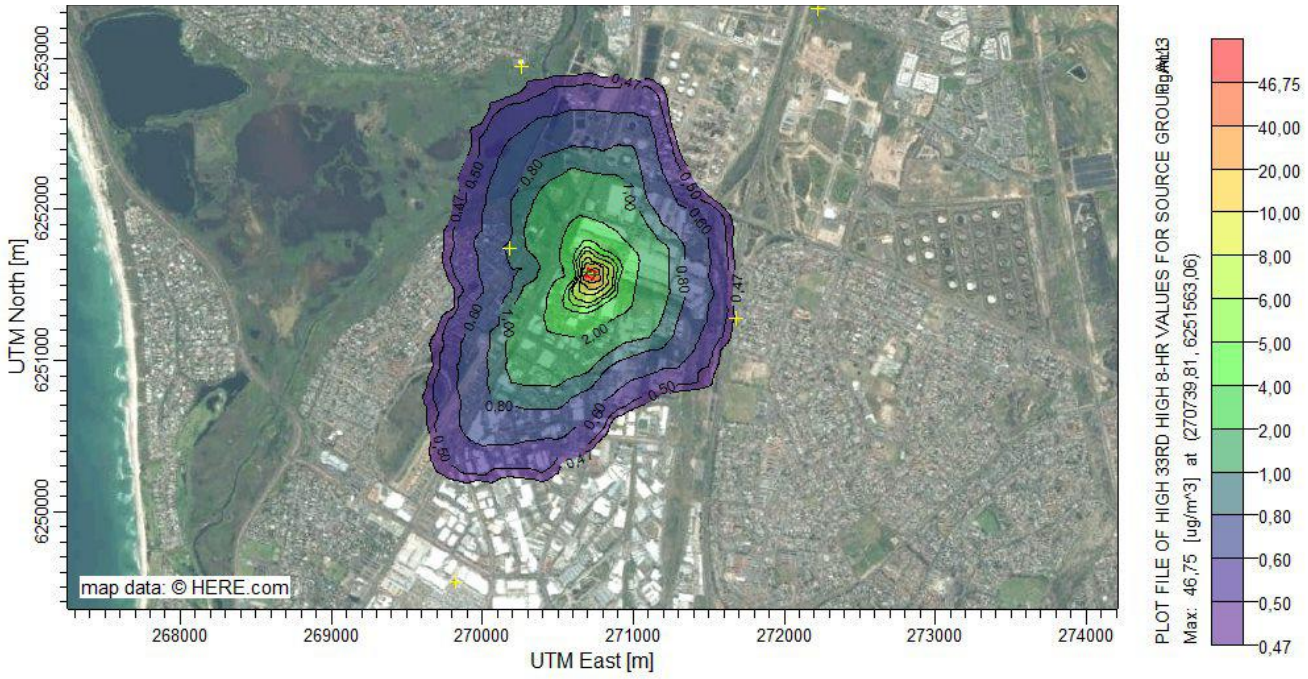


Figure 40: Isopleths of *8-Hourly* CO Concentration Around the Proposed Crematorium

Table 29: Cumulative Hourly CO Results

Number of exceedances per annum	2019	2020	2021	Limit
Baseline (Maitland Monitoring Station)	0	0	0	88
Fence Line	0	0	0	88
Milnerton Ridge	0	0	0	88
Bothasig	0	0	0	88
Flamingo Vlei	0	0	0	88
Richwood	0	0	0	88
Dunoon	0	0	0	88
Phoenix	0	0	0	88

Table 30: Cumulative 8-Hourly CO Results

Number of exceedances per annum	2019	2020	2021	Limit
Baseline (Maitland Monitoring Station)	0	0	0	11
Fence Line	0	0	0	11
Milnerton Ridge	0	0	0	11
Bothasig	0	0	0	11
Flamingo Vlei	0	0	0	11
Richwood	0	0	0	11
Dunoon	0	0	0	11
Phoenix	0	0	0	11

Continued compliance with the CO NAAQS is predicted after the addition of the proposed crematorium.

7.6.4. NO_2

NO_x is comprised of two chemicals: nitric oxide (NO) and nitrogen dioxide (NO_2). NO_x that is released from combustion installations is almost completely comprised of NO, with minimal NO_2 present. However, once released into the atmosphere, NO rapidly reacts with ozone to form NO_2. Dispersion models do not have sufficiently detailed descriptions of atmospheric chemistry to accurately account for NO's conversion to NO_2, and thus one of two assumptions must be made:

1. Total conversion method: It is assumed that all of the NO_x that is released from a point source converts into NO_2. If the maximum NO_2 concentrations are less than the NAAQS, then no further adjustments need to be made. If the NO_2 concentrations exceed the NAAQS, the ambient ratio method (ARM) should be used.

2. Ambient ratio method (ARM): It is assumed that the ratio of NO_2 to NO_x is 0.8.[29]

As per the Code of Practice, the total conversion method was used first, and compliance with the NAAQS was assessed.

Table 31: NO_2 Results (Total Conversion Method)

Ave. Period	Parameter	Max Fence Line and Surrounds	Milnerton Ridge Sensitive Receptor	Bothasig Sensitive Receptor	Flamingo Vlei Sensitive Receptor	Richwood Sensitive Receptor	Dunoon Sensitive Receptor	Phoenix Sensitive Receptor
Hourly	**Conc. (ppb)**	**193.37076**	**4.76203**	**2.58430**	**2.17753**	**0.74043**	**0.60056**	**1.33647**
	Conc. (µg/m³)	363.80592	8.95923	4.86207	4.09679	1.39304	1.12989	2.51442
	Location	X: 270688.13 Y: 6251555.34	X: 270178.66 Y: 6251740.48	X: 271676.99 Y: 6251279.85	X: 270263.33 Y: 6252948.25	X: 272217.76 Y: 6253325.42	X: 272287.48 Y: 6254074.39	X: 269820.54 Y: 6249534.94
	Elevation	10.00	7.61	24.80	4.83	30.78	36.35	17.95
	Date, Hour	2020-12-07, 07:00	2020-05-16, 02:00	2020-06-17, 18:00	2020-09-02, 04:00	2021-12-10, 21:00	2019-03-07, 01:00	2021-07-30, 01:00
Annual	**Conc. (ppb)**	**30.24871**	**0.36655**	**0.16254**	**0.22838**	**0.04101**	**0.03193**	**0.06384**
	Conc. (µg/m³)	56.90963	0.68962	0.3058	0.42967	0.07716	0.06007	0.12011
	Location	X: 270739.81 Y: 6251563.06	X: 270178.66 Y: 6251740.48	X: 271676.99 Y: 6251279.85	X: 270263.33 Y: 6252948.25	X: 272217.76 Y: 6253325.42	X: 272287.48 Y: 6254074.39	X: 269820.54 Y: 6249534.94
	Elevation	11.32	7.61	24.80	4.83	30.78	36.35	17.95
	Date	-	-	-	-	-	-	-

[29] Section 6.6.1. of the Code of Practice.

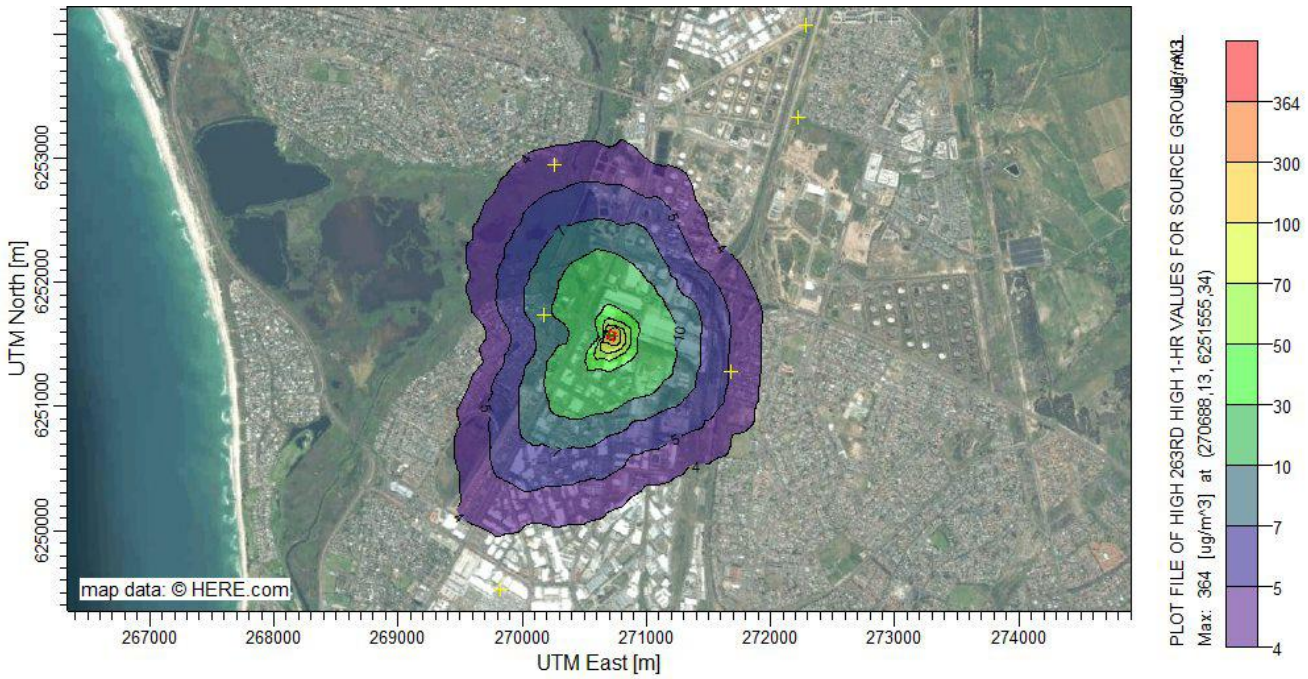


Figure 41: **Isopleths of *Hourly* NO_2 Concentration Around the Proposed Crematorium**

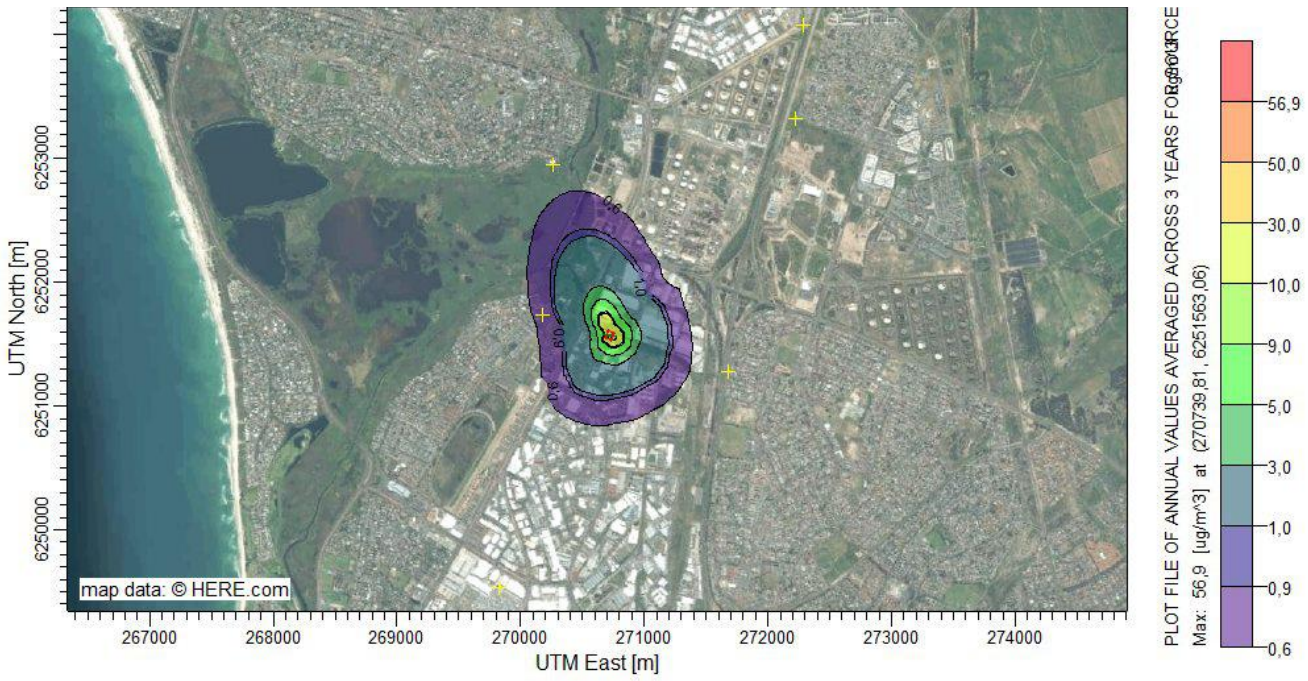


Figure 42: Isopleths of *Annual* NO_2 Concentration Around the Proposed Crematorium

Table 32: Cumulative Hourly NO_2 Results (Total Conversion, Table View)

Number of exceedances per annum	2019	2020	2021	Limit
Baseline (Table View Monitoring Station)	3	0	0	88
Fence Line	Exceeded			88
Milnerton Ridge	3	0	0	88
Bothasig	3	0	0	88
Flamingo Vlei	3	0	0	88
Richwood	3	0	0	88
Dunoon	3	0	0	88
Phoenix	3	0	0	88

Table 33: Cumulative Annual NO_2 Results (Total Conversion, Table View)

Concentration (µg/m³)	2019	2020	2021	Limit
Baseline (Table View Monitoring Station)	12.9	12.1	5.7	21
Fence Line	43.1	42.4	35.9	21
Milnerton Ridge	13.3	12.5	6.1	21
Bothasig	13.0	12.3	5.9	21
Flamingo Vlei	13.1	12.4	5.9	21
Richwood	12.9	12.2	5.7	21
Dunoon	12.9	12.2	5.7	21
Phoenix	12.9	12.2	5.8	21

Table 34: Cumulative Hourly NO_2 Results (Total Conversion, Edgemead)

Number of exceedances per annum	2019	2020	2021	Limit
Baseline (Edgemead Monitoring Station)	0	0	0	88
Fence Line	Exceeded			88
Milnerton Ridge	0	0	1	88
Bothasig	0	0	0	88
Flamingo Vlei	0	0	0	88
Richwood	0	0	0	88
Dunoon	0	0	0	88
Phoenix	0	0	0	88

Table 35: Cumulative Annual NO_2 Results (Total Conversion, Edgemead)

Concentration (µg/m³)	2019	2020	2021	Limit
Baseline (Edgemead Monitoring Station)	9.5	8.4	8.7	21
Fence Line	39.8	38.6	38.9	21
Milnerton Ridge	9.9	8.7	9.1	21
Bothasig	9.7	8.5	8.9	21
Flamingo Vlei	9.8	8.6	8.9	21
Richwood	9.6	8.4	8.7	21
Dunoon	9.6	8.4	8.7	21
Phoenix	9.6	8.4	8.8	21

Considering that the hourly and annual NAAQS standards of 106 ppb and 21 ppb respectively were exceeded, the model was run again using the ARM method, and the maximum concentrations at the fence line are shown in the following table. It must be noted that the NO_2 concentration rapidly declines and once it reaches sensitive receptors remains well below the NAAQS. Thus, the ARM method was not used to model the NO_2 concentration at the sensitive receptors.

Table 36: NO_2 Results (ARM)

Ave. Period	Parameter	Max Fence Line and Surrounds
Hourly	**Conc. (ppb)**	**154.69661**
	Conc. (µg/m³)	291.04474
	Location	X: 270688.13 Y: 6251555.34
	Elevation	10.00
	Date, Hour	2020-12-07, 07:00
Annual	**Conc. (ppb)**	**24.19897**
	Conc. (µg/m³)	45.52771
	Location	X: 270739.81 Y: 6251563.06
	Elevation	11.32
	Date	-

Again, the maximum hourly and annual fence line concentrations are predicted to exceed the NAAQS standards of 106 ppb and 21 ppb respectively.

Although the engineering specifications of the cremators indicate that the stacks are to be 12 metres high, the AERMOD model was run using various stack heights, up to a maximum of 20 metres. These resulted in lower maximum hourly concentrations of NO_2 at the fence line. The optimum height was determined to be 16 metres, which resulted in no NAAQS exceedances. These results are shown below.

Table 37: NO_2 Results (Using ARM and 16 Metre Stack)

Ave. Period	Parameter	Max Fence Line and Surrounds
Hourly	**Conc. (ppb)**	**55.20215**
	Conc. (µg/m³)	103.85681
	Location	X: 270688.13 Y: 6251555.34
	Elevation	10.00
	Date, Hour	2021-07-27, 04:00
Annual	**Conc. (ppb)**	**6.14729**
	Conc. (µg/m³)	11.56546
	Location	X: 270697.50 Y: 6251658.43
	Elevation	11.46
	Date	-

Table 38: Cumulative Hourly NO_2 Results (Table View, ARM and 16 Metre Stack)

Number of exceedances per annum	2019	2020	2021	Limit
Baseline (Table View Monitoring Station)	3	0	0	88
Fence Line	79	43	0	88

Table 39: Cumulative Annual NO_2 Results (Table View, ARM and 16 Metre Stack)

Concentration (µg/m³)	2019	2020	2021	Limit
Baseline (Table View Monitoring Station)	12.9	12.1	5.7	21
Fence Line	19.0	18.3	11.8	21

Table 40: Cumulative Hourly NO_2 Results (Edgemead, ARM and 16 Metre Stack)

Number of exceedances per annum	2019	2020	2021	Limit
Baseline (Edgemead Monitoring Station)	0	0	0	88
Fence Line	16	5	25	88

Table 41: Cumulative Annual NO_2 Results (Edgemead, ARM and 16 Metre Stack)

Concentration ($\mu g/m^3$)	2019	2020	2021	Limit
Baseline (Edgemead Monitoring Station)	9.5	8.4	8.7	21
Fence Line	15.7	14.5	14.8	21

7.6.5. Mercury

Table 42: Mercury Results

Ave. Period	Parameter	Max Fence Line and Surrounds	Milnerton Ridge Sensitive Receptor	Bothasig Sensitive Receptor	Flamingo Vlei Sensitive Receptor	Richwood Sensitive Receptor	Dunoon Sensitive Receptor	Phoenix Sensitive Receptor
Annual	Conc. (µg/m³)	0.00573	0.00007	0.00003	0.00004	0.00001	0.00001	0.00001
	Location	X: 270739.81 Y: 6251563.06	X: 270178.66 Y: 6251740.48	X: 271676.99 Y: 6251279.85	X: 270263.33 Y: 6252948.25	X: 272217.76 Y: 6253325.42	X: 272287.48 Y: 6254074.39	X: 269820.54 Y: 6249534.94
	Elevation	11.32	7.61	24.80	4.83	30.78	36.35	17.95
	Date	-	-	-	-	-	-	-

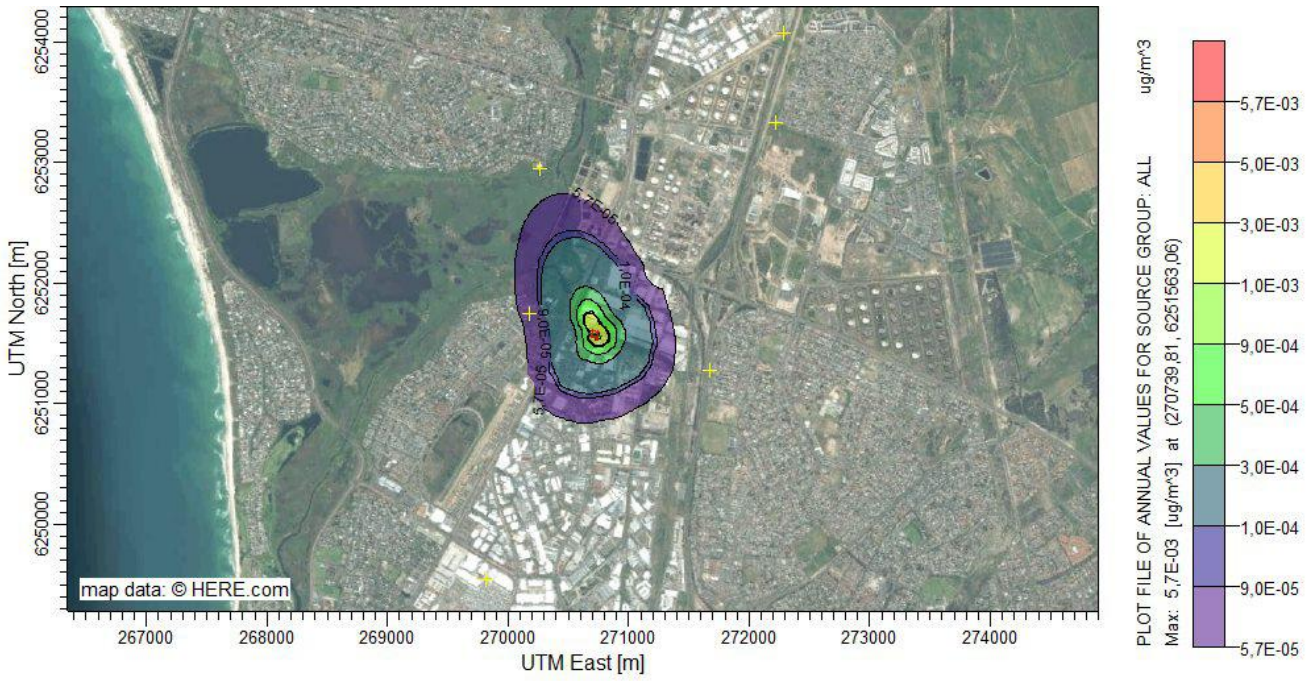


Figure 43: Isopleths of Annual Mercury Concentration Around the Proposed Crematorium

Table 43: Mercury Cumulative Ambient Air Quality (Cape Point)

Receptor	Annual Average International Guideline	Concentration (µg/m³)
Baseline	1 µg/m³	0.0011
Fence Line		0.0068
Milnerton Ridge		0.0012
Bothasig		0.0011
Flamingo Vlei		0.0011
Richwood		0.0011
Dunoon		0.0011
Phoenix		0.0011

Very low concentrations of mercury are predicted at the fence line and sensitive receptors. These are well below the international guideline that was used in this report.

7.6.6.Benzene

Table 44: Benzene Results

Ave. Period	Parameter	Max Fence Line and Surrounds	Milnerton Ridge Sensitive Receptor	Bothasig Sensitive Receptor	Flamingo Vlei Sensitive Receptor	Richwood Sensitive Receptor	Dunoon Sensitive Receptor	Phoenix Sensitive Receptor
Annual	Conc. (ppb)	0.43171	0.00523	0.00232	0.00326	0.00059	0.00046	0.00091
	Conc. (µg/m³)	1.37920	0.01671	0.00741	0.01041	0.00187	0.00146	0.00291
	Location	X: 270739.81 Y: 6251563.06	X: 270178.66 Y: 6251740.48	X: 271676.99 Y: 6251279.85	X: 270263.33 Y: 6252948.25	X: 272217.76 Y: 6253325.42	X: 272287.48 Y: 6254074.39	X: 269820.54 Y: 6249534.94
	Elevation	11.32	7.61	24.80	4.83	30.78	36.35	17.95
	Date	-	-	-	-	-	-	-

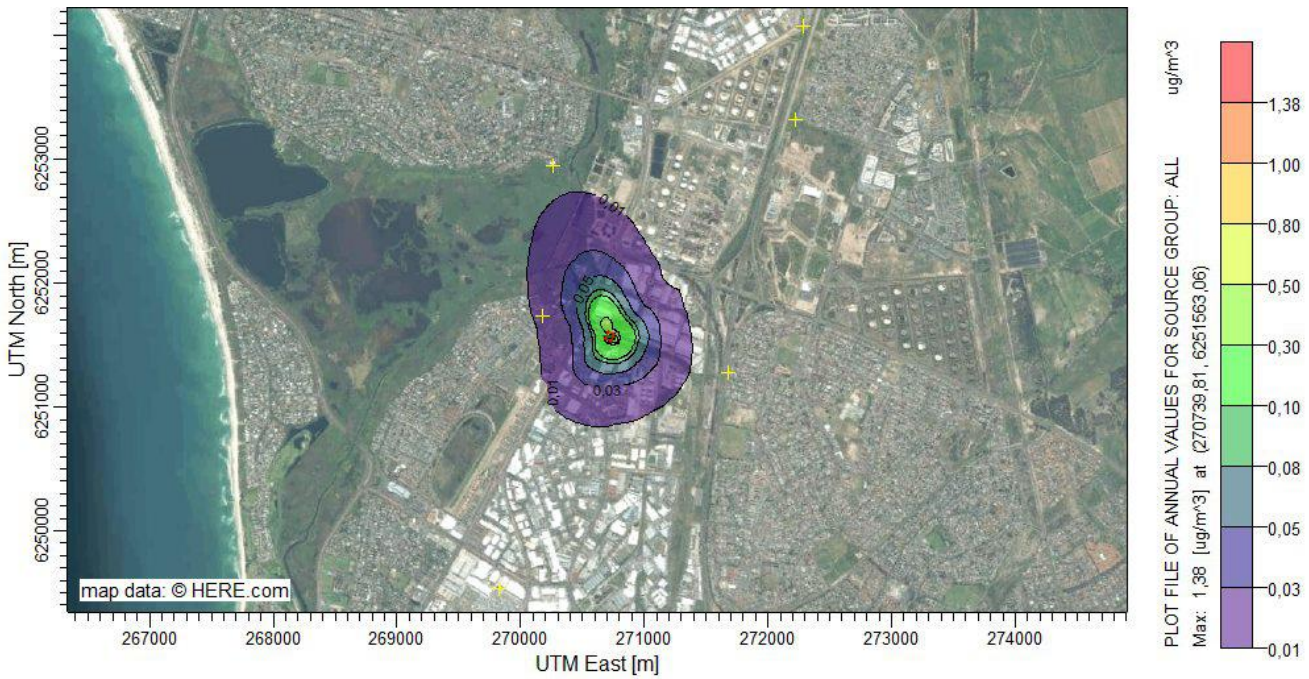


Figure 44: Isopleths of Annual Benzene Concentration Around the Proposed Crematorium

Table 45: Cumulative Annual Benzene Results

Concentration (ppb)	2019	2020	2021	Limit
Baseline (Potsdam)	2.0	0.9	-	1.6
Fence Line	2.5	1.4	-	1.6
Milnerton Ridge	2.0	0.9	-	1.6
Bothasig	2.0	0.9	-	1.6
Flamingo Vlei	2.0	0.9	-	1.6
Richwood	2.0	0.9	-	1.6
Dunoon	2.0	0.9	-	1.6
Phoenix	2.0	0.9	-	1.6

The annual baseline benzene concentration exceeded the NAAQS in 2019. Thus, after the predicted annual benzene concentration as a result of the proposed crematorium was added, the exceedance remained. In 2020, the annual baseline benzene concentration was below the NAAQS, and this remained the case when the annual benzene concentration as a result of the proposed crematorium was added. Thus, the proposed crematorium is not predicted to affect compliance with the benzene standard. Again, it must be remembered that it was very conservatively assumed that all VOCs that are released from the cremators are benzene. This would not be the case in reality.

7.6.1.Lead

Table 46: Lead Results

Ave. Period	Parameter	Max Fence Line and Surrounds	Milnerton Ridge Sensitive Receptor	Bothasig Sensitive Receptor	Flamingo Vlei Sensitive Receptor	Richwood Sensitive Receptor	Dunoon Sensitive Receptor	Phoenix Sensitive Receptor
Annual	Conc. (µg/m3)	0.003178	0.00004	0.00002	0.00002	0	0	0.00001
	Location	X: 270739.81 Y: 6251563.06	X: 270178.66 Y: 6251740.48	X: 271676.99 Y: 6251279.85	X: 270263.33 Y: 6252948.25	X: 272217.76 Y: 6253325.42	X: 272287.48 Y: 6254074.39	X: 269820.54 Y: 6249534.94
	Elevation	11.32	7.61	24.80	4.83	30.78	36.35	17.95
	Date	-	-	-	-	-	-	-

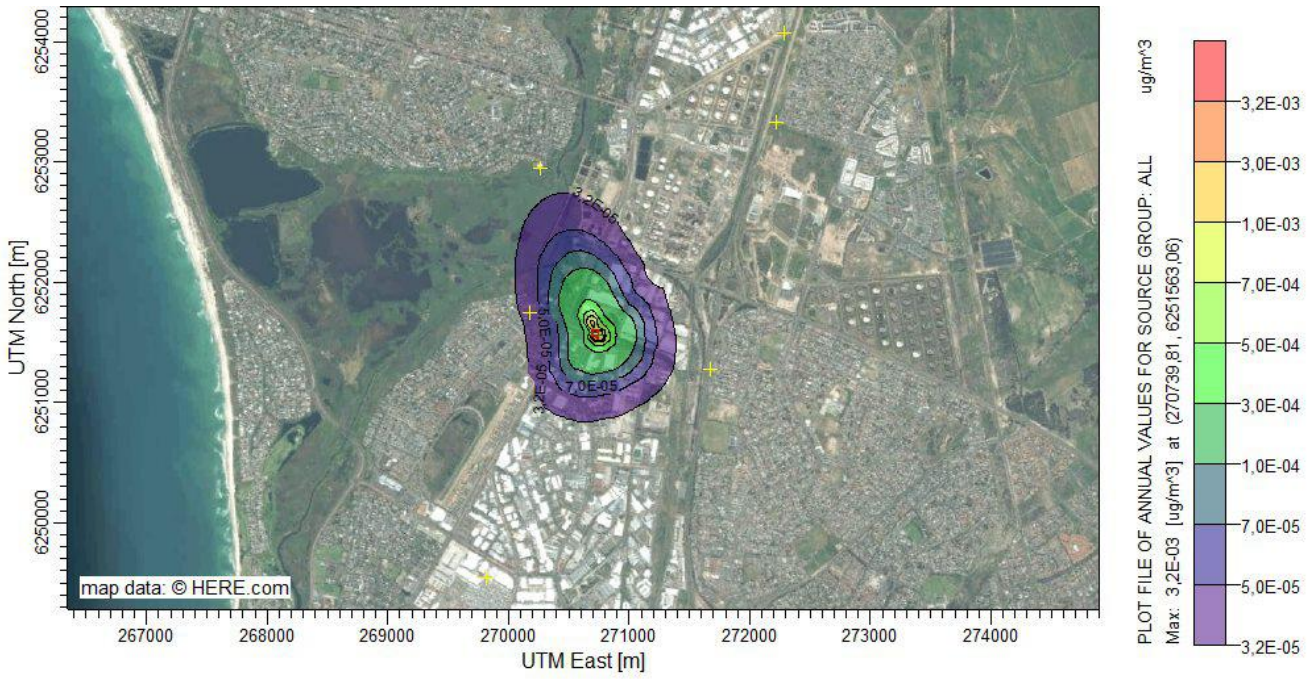


Figure 45: Isopleths of Annual Lead Concentration Around the Proposed Crematorium

The ambient annual lead concentration as a result of the proposed crematorium's operations is predicted to remain well below the NAAQS of 0.5 µg/m³ at the fence line and at all sensitive receptors. There is no baseline ambient air quality data available.

7.7. Air Dispersion Modelling Conclusions

Baseline ambient air quality in the area surrounding the proposed crematorium was collected from ambient air quality monitoring stations. Baseline data from the monitoring stations closest to the site, and with the highest level of data availability were chosen to be used further in the study.

An emissions inventory was compiled for the pollutants identified by G.N. 893 of 2013 to be of concern from crematoria: PM, CO, NO_x, and mercury. Level 2 air dispersion modelling was conducted for these pollutants using the AERMOD View programme.

The ambient pollutant concentrations that were predicted by the AERMOD model were added to baseline air quality data to obtain cumulative predicted concentrations. These concentrations were compared to the NAAQS standards and international guidelines where no NAAQS are available.

Ambient PM_{10} (using the Table View baseline data), $PM_{2.5}$, CO, mercury, and lead concentrations around the fence line of the site are predicted to remain in compliance with the NAAQS standards (and the international guideline for mercury) should the proposed crematorium be commissioned.

While the annual cumulative benzene concentration would have exceeded the NAAQS in 2019, this was also the case in the baseline data before the contribution from the proposed crematorium was considered. Thus, the benzene concentration as a result of the proposed crematorium does not change the overall compliance status.

Maximum ambient hourly NO_2 concentrations at the fence line are predicted to exceed the hourly NAAQS standard. However, the concentration rapidly decreases with distance from the site, and no NAAQS exceedances are predicted in any of the surrounding residential areas. It must also be noted that the cumulative air quality impact of the facility is estimated by assuming that the maximum hourly concentration will be experienced every hour of every day in the three year period, which would not be the case in reality. The ambient annual NO_2 concentration at the fence line is predicted to comply with the annual NAAQS for NO_2.

When PM_{10} data from the Edgemead monitoring station is used as a baseline, the daily PM_{10} concentrations are predicted to exceed the NAAQS standard at the facility's fence line. Again, it should be noted that the cumulative air quality impact of the facility is estimated by assuming that the maximum daily concentration will be experienced every day in the three year period, which would not be the case in reality.

Although the engineering specifications of the cremators indicate that the stacks are to be 12 metres high, the AERMOD model was run using stack heights of up to 20 metres. The optimum height was determined to be 16 metres, which resulted in no NAAQS exceedances at the fence line for PM_{10} or NO_2, unless these exceedances existed in the baseline data (i.e. daily PM_{10} in 2021 using the Edgemead baseline data). It is recommended that higher stack heights be considered by the proponent in order to minimise the effect of the proposed crematorium on ambient air quality.

8. Complaints

Not applicable.

9. Current or Planned Air Quality Management Interventions

Not applicable.

10. Compliance and Enforcement History

None.

Yellow Tree would like to thank Sharples Environmental Services and Platinum Pride for the opportunity to be of service. Yellow Tree's passion is to assist clients in quantifying their emissions accurately, to advise clients about engineering solutions to air emissions problems, and to help clients in making improvements in keeping with their environmental policies while constraining the costs of such solutions.

11. Appendix A: Report Details

Reporting Conducted by:	Yellow Tree Unit D14, Prime Park Mocke Road Diep River 7945
Report Compiled by:	Caitlin Morris, BSc (Chem Eng), LLM (Env Law) 083 566 2552 
Report Reviewed by:	Sean Charteris, BSc (Chem Eng) 
Report Compiled for:	Sharples Environmental Services

12. Appendix B: Air Dispersion Modelling Study Reporting Requirements[30]

Chapter 1: Facility and modellers' information		Submitted Yes/No	Comments, References
1.1	**Project identification information requirements**		
	• Applicant	Y	7
	• Physical address of facility	Y	8
	• Air Emissions License reference number (if applicable)	Y	9
	• Environmental authorization reference number (if applicable)	Y	NA
	• Modelling contractor(s), when applicable	Y	81
1.2	**Project background requirements**		
	• Purpose(s) and objectives of the air dispersion modelling under consideration.	Y	6
	• General descriptive narrative of the plant processes and proposed new source or modification.	Y	10
1.3	**Project location requirements**		
1.3.1	Detailed scaled layout plan of proposed project area including the following:		
	• UTM coordinates of facility Property lines, including fence	Y	15
	• Property lines, including fence lines	Y	15
	• Roads and railroads that pass through property line	Y	15
	• Location and dimensions of buildings and/or structures (on or off property) which could cause downwash ° Location ° Length ° Width ° Height	Y	15
	• Indication of shortest distance to property line from significant sources	Y	15
1.3.2	**Area map(s) that include the following:**		
	• Map of adjacent area (10 km radius from proposed source) indicating the following ° Latitude/Longitude on horizontal and vertical axis ° Nearby known pollution sources ° Schools and hospitals within 10km of facility boundary ° Topographic features ° Any proposed off-site or on-site meteorological monitoring stations ° Roads and railroads	Y	16
	• Regional map that includes the following ° UTM coordinates ° Modelled Facility ° Topography features within 50 km ° Known pollution sources within 50 km	Y	20

[30] Section 7.2.2 Code of Practice

	° Any proposed off-site meteorological monitoring stations		
1.4	**Geophysical data** • Discuss land use characterization procedures utilized to determine dispersion coefficients (urban or rural) • Discuss the elevation data (DEM) and its resolution	 Y Y	 21 21
1.5	**Elevation data (DEM) and resolution** • Discuss DEM data utilized	 Y	 21
Chapter 2. Emissions characterisation		**Submitted Yes/No**	**Comments, References**
2.1	**Emissions characteristics** • Include fugitive and secondary emissions when applicable • Emission unit descriptions and capacities (including proposed emission controls) • New structures or modifications to existing structures as a results of project	 Y Y NA	 22 22
2.2	**Operating scenarios for emission units** • Operating conditions simulated in the modelling study ° Normal ° Start-up ° Standby ° Shutdown	 Y	 22
2.3	**Proposed emissions and source parameter table(s)** • List all identifiable emissions • Include parameter table(s) for each operating scenario of each emission unit, which may include, but not be limited to the following: ° Operating scenario(s) ° Source location (UTM Coordinates) ° Point source parameters ° Area source parameters ° Volume source parameters ° Include proposed emissions (and supporting calculations) for all identifiable emissions	 Y Y	 45 45
Chapter 3: Meteorological data		**Submitted Yes/No**	**Comments, References**
3.1	**Surface data discussions must include:** • Off-site ° Source of data ° Description of station (location, tower height, etc.) ° Period of record ° Demonstrate temporal and spatial representativeness ° Seasonal wind-rose(s)	NA	

	° 3-year of representative off-site data ° Evaluate if off-site data complies with regulatory Code of Practice ° Program and version used to process data ° Method used to replace missing hours ° Method used to handle calm periods • On-site ° Description of station (location, tower height, etc.) ° Period of record ° Demonstrate spatial representativeness ° Minimum 1-year of representative on-site data ° Evaluate if off-site data complies with regulatory Code of Practice ° Program and version used to process data ° Method used to replace missing hours ° Method used to handle calm periods	Y	26
3.2	**Discuss upper air data utilised** • Discuss upper air data utilised from the most representative station. • Explain why it is most representative.	 Y Y	 26 26
	Chapter 4: Ambient impact analysis and ambient levels	**Submitted Yes/No**	**Comments, References**
4.1	**Standards Levels** • National Ambient Air Quality Standards	Y	27
4.2	**Background Concentrations** • Specify background values used including supporting documentation	 Y	 29
	Chapter 5: Modelling Procedures	**Submitted Yes/No**	**Comments, References**
5.1	**Model used in the study Assessment level proposed** • Assessment level proposed and justification • Dispersion model used. • Supporting models and input programs • Version of models and input programs	 Y Y Y Y	 45 45 45 45
5.2	**Specify modelled emissions** • Pollutants • Scenarios and emissions that were modelled • Conversion factor utilized for converting NOx to NO2	 Y Y Y	 45 45 59
5.3	**Specify setting utilised within the model(s), which may include:** • Recommended settings utilized within model • Terrain settings (simple flat/simple elevated/complex) • Land characteristics (Bowen ratio, surface albedo, surface roughness)	 Y Y Y	 45 45 45

	• Specify number of sectors used and why (if applicable)	Y	45
	• Specify assumptions (if applicable)	NA	
	• Include discussion on non-regulatory settings utilized and reasons why	NA	
5.4	**Describe the receptors grids utilized within the analysis**		
	• Property line resolution	Y	45
	• Fine grid resolution	Y	45
	• Medium grid resolution(s)	Y	45
	• Course grid resolution	Y	45
	• Hotspots and sensitive location resolutions and sizes	Y	45
	• Figures that show locations of receptors relative to modelled facility and terrain features.	Y	46
Chapter 6: Ambient impact results documentation		**Submitted Yes/No**	**Comments, References**
6	At a minimum, the Ambient Air Quality Standards results are to be documented as follows:		
6.1	**Table(s) of modelling results including**		
	1. Pollutant	Y	47-71
	2. Averaging time	Y	47-71
	3. Operating scenario	Y	47-71
	4. Maximum modelled concentration	Y	47-71
	5. Receptor location of maximum impact (coordinates)	Y	47-71
	6. Receptor elevation	Y	47-71
	7. Date of maximum impact	Y	47-71
	8. Grid resolution at maximum impact	Y	47-71
	9. Name of output e-file(s) where data was taken from.		47-71
6.2	**Figure(s) showing source impact area including**		47-71
	1. UTM coordinates on horizontal and vertical axis	Y	47-71
	2. Modelled facility	Y	47-71
	• Boundary		47-71
	• Buildings		47-71
	• Emission points		47-71
	3. Topography features	Y	47-71
	4. Isopleths of impact concentrations	Y	47-71
	5. Location and value of maximum impact	Y	47-71
	6. Location and value of maximum cumulative impact.	Y	47-71
Chapter 7: Ambient impact supporting documentation		**Submitted Yes/No**	**Comments, References**
7.1	All warning and informational messages within modelling output files must be explained and evaluated	Y	ERRORFIL option ignored *(not necessary)* Pollutant NO2 not supported.

			POLLUTID switched to "OTHER" *(US NAAQS for 1-hr NO2 is not supported by multi-chemical utility. Not applicable in SA)*
7.2	Required electronic files to be submitted with report 1. Input & output files for models 2. Input & output files for pre-processors 3. Input & output files for post-processors 4. Digital terrain files 5. Plot files Final report	All files available on request	
7.3	Report shall include a list and description of electronic files	All files available on request	
7.4	Report shall include a discussion on deviations from the modelling protocol	NA	

13. Appendix C: Specialist Report Requirements[31]

Specialist reports	Submitted Yes/No	Comments, References
A specialist report prepared in terms of these Regulations must contain		
(a) details of:		
(i) the specialist who prepared the report; and	Y	81
(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Y	81
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Y	83
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Y	6
(cA) an indication of the quality and age of base data used for the specialist report;	Y	29
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Y	47-71
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Y	26
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Y	45
(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;	Y	15
(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;	Y	15, 22
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Y	47
(k) any mitigation measures for inclusion in the EMPr;	NA	
(l) any conditions for inclusion in the environmental authorisation;	NA	
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Y	As per G.N. 893 of 2013, as amended
(n) a reasoned opinion		
(i) whether the proposed activity, activities or portions thereof should be authorised;	Y	4
(iA) regarding the acceptability of the proposed activity or activities; and	Y	4

[31] Appendix 6, EIA Regulations

(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;	NA	
(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	

14. Appendix D: Curriculum Vitae of Specialist

CAITLIN MORRIS

CHEMICAL ENGINEER | YELLOW TREE

EXPERIENCE

CHEMICAL ENGINEER • YELLOW TREE • OCTOBER 2014 – PRESENT

- Stack emissions sampling
- Stack emissions reporting
- Atmospheric Emissions Licence (AEL) applications, renewals, variations
- National Atmospheric Emissions Inventory (NAEIS) reporting
- Greenhouse gas (GHG) reporting
- Carbon tax consulting
- Carbon footprint consulting
- Air dispersion modelling including the following recent projects:
    - Level 1 assessment for a creosote treatment facility in the Eastern Cape
    - Level 2 assessment for a proposed aluminium processing facility in Cape Town
    - Level 2 assessment for a foam production facility in Johannesburg
    - Level 2 assessment for a foam production facility in Durban
    - Level 2 assessment for a charcoal production facility in Mpumalanga (in progress)
    - Level 3 assessment for a sugar mill in Durban (in progress)

EDUCATION

LLM ENVIRONMENTAL LAW • 2020 • UNIVERSITY OF CAPE TOWN

Professional Master's degree in Environmental Law awarded with First Class Honours

BSC CHEMICAL ENGINEERING 2013 • UNIVERSITY OF CAPE TOWN

Honours degree in Chemical Engineering

CONTACT

083 566 2552 | caitlin@yellowtree.co.za | www.yellowtree.co.za

yellowtree
WHERE INTEGRITY & SCIENCE MEET

15. Appendix E: Applicant Declaration of Accuracy

ANNEXURE A

DECLARATION OF ACCURACY OF INFORMATION - APPLICANT

Name of Enterprise: _____

Declaration of accuracy of information provided:

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

I, _____[*duly authorised*], declare that the information provided in this atmospheric impact report is, to the best of my knowledge, in all respects factually true and correct. I am aware that the supply of false or misleading information to an air quality officer is a criminal offence in terms of section 51(1)(g) of this Act.

Signed at _____ on this _____ day of _____

_____

SIGNATURE

_____

CAPACITY OF SIGNATORY

16. Appendix F: Specialist Declaration of Independence

ANNEXURE B

DECLARATION OF INDEPENDENCE - PRACTITIONER

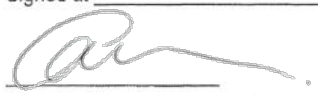
Name of Practitioner: Caitlin Morris
Name of Registration Body: NA
Professional Registration No.: NA

Declaration of independence and accuracy of information provided:

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

I, Caitlin Morris, declare that I am independent of the applicant. I have the necessary expertise to conduct the assessments required for the report and will perform the work relating the application in an objective manner, even if this results in views and findings that are not favourable to the applicant. I will disclose to the applicant and the air quality officer all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the air quality officer. The information provided in this atmospheric impact report is, to the best of my knowledge, in all respects factually true and correct. I am aware that the supply of false or misleading information to an air quality officer is a criminal offence in terms of section 51(1) (g) of this Act.

Signed at Cape Town on this 09th day of September 2022



SIGNATURE

Chemical Engineer

CAPACITY OF SIGNATORY