FFS REFINERS (PTY) LTD

ATMOSPHERIC IMPACT REPORT

FFS EVANDER

APRIL 2024

CONFIDENTIAL

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ATMOSPHERIC IMPACT REPORT

FFS EVANDER

REPORT (VERSION 01) CONFIDENTIAL

PROJECT NO. 41106607

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CONTENTS

TABLES

FIGURES

EXECUTIVE SUMMARY

FFS Refiners (Pty) Ltd (FFS) operates a tar and waxy oil processing and petroleum storage facility at their Evander Depot, Mpumalanga. FFS is the largest supplier of industrial heating fuels in South Africa. The company markets products for a wide variety of uses, including glass making, brick making, steam raising in boilers, billet re-heating, baking incineration, road-mix heating, lime kilns, sand and stone drying.

Currently, the facility holds an Atmospheric Emissions Licence (AEL) for the following listed activities, in line with Section 21 of the National Environmental Management: Air Quality Act, No 39 of 2004, Government Notice 248 of 2010 (Government Gazette 33064):

- Subcategory 2.4 – Storage and Handling of Petroleum Products.
- Subcategory 3.3 – Carbonization and Coal Gasification – Tar Processes.

FFS intends to process and store hydrocarbon waste streams at the existing facility. Although, the existing authorised production and storage capacities will not be increased, the proposed operations will fall under *Subcategory 2.5: Industrial Fuel Oil Recyclers*, requiring an AEL amendment. In support of the AEL amendment application, an Atmospheric Impact Report (AIR) is required to determine the potential impacts associated with the proposed changes. To assist FFS in this regard, WSP Group Africa (Pty) Ltd (WSP) has been appointed to facilitate the AEL application and supporting AIR for the proposed changes.

This report presents the findings from the AIR, using a Level two dispersion model (AERMOD) to predict the potential air quality impacts associated with the facility. Included in this report is a description of the background of the facility; a discussion on the associated atmospheric emissions and relevant air quality legislation; a description of the methodology utilised in the study; identification of sensitive receptors; dispersion modelling predictions as well as an assessment of the related impacts and the recommended management and mitigation measures for the facility.

As part of the AIR, a baseline assessment was undertaken that included a review of available meteorological data and an evaluation of the current ambient air quality situation.

To accurately represent meteorological conditions at FFS Evander, modelled Weather Research and Forecasting (WRF) meteorological data was obtained for the period January 2021 to December 2023. It must be noted that site-specific data from the nearest weather station (Secunda weather station – 9 km away) indicated poor data recovery (less than 30%) and as such was not used for this assessment. No other weather stations were within close proximity of the site and were deemed relevant for this assessment.

Potential impacts were quantified through the compilation of an emissions inventory and subsequent dispersion modelling simulations. The key pollutants associated with the facility are sulphur dioxide (SO_2), carbon monoxide (CO) and volatile organic compounds (VOCs), with specific reference to benzene (C_6H_6). Where available, emission rates were provided for point sources by the Client. Fugitive tank emissions were estimated using the United States Environmental Protection Agency

(USEPA) TANKS 4.09d model (TANKS), while vehicle exhaust emissions were estimated using the USEPA Emissions Fact Sheet for Idling Vehicles. Emission rates were used as input for a Level 2 dispersion model, AERMOD, together with modelled meteorological WRF data. Predicted ambient SO_2, CO and VOC concentrations were compared with the available National Ambient Air Quality Standards (NAAQS) to determine the potential for human health impacts. Since C_6H_6 is the only VOC regulated under NAAQS, predicted VOC concentrations were conservatively compared with the annual average C_6H_6 standard.

Emissions were assessed with respect to two dispersion modelling scenarios for the facility:

- Scenario 1: Impacts associated with the existing operations.
- Scenario 2: Impacts associated with the existing and proposed operations (i.e. with waste oil processing taking place).

BASELINE ASSESSMENT

An analysis of the surface meteorological conditions indicated that:

- Summer temperatures for the region average at 20.8°C while winter temperatures average at 11.7°C.
- FFS Evander receives on average 659.5 mm of rainfall annually, with 67% received during summer (December, January and February) and 0.2% during winter (June, July and August).
- Light to strong north-westerly and north-north-westerly winds prevail in the region, with calm conditions occurring 5.2% of the time.

An analysis of the available monitoring data indicated the following:

- Modderfontein Laboratory Services (Pty) Ltd conducted passive monitoring campaigns at FFS Evander during December 2019 to June 2022. The campaign measured SO_2 and C_6H_6 concentrations, using Radiello^{TM} passive samplers for the selected monitoring period.
- For all sampling points, SO_2 concentrations consistently remain below the NAAQS annual limit of 50 µg/m^3, indicating compliance with NAAQS standards. The Evander High School experienced the highest SO_2 concentration (40.63 µg/m^3) during the 18 June - 3 July 2020 period, although it remained below the annual limit. It also had the highest average concentration (6.98 µg/m^3) compared to other sampling locations.
- For most positions, C_6H_6 concentrations are generally below the NAAQS annual limit, indicating compliance with air quality standards. Perimeter Fence North experienced a high C_6H_6 concentration (98.88 µg/m^3) during the Jun-Jul 2019 period, significantly surpassing the annual limit. Additionally, Perimeter fence South and Perimeter fence East also showed increased concentrations during specific periods, but they generally remained within acceptable limits. Furthermore, the Perimeter fence North and Perimeter fence South had the highest average concentrations compared to others for the selected monitoring period.
- *The results presented are derived from a fourteen-day monitoring period and should not be interpreted as annual averages. It is important to note that comparing the measured SO_2/C_6H_6 concentrations over a fourteen-day exposure period with the annual average standard is environmentally conservative. Therefore, it is not possible to rule out exceedances of the NAAQS without a complete year of monitoring data.*

IMPACT ASSESSMENT

- All ambient pollutant concentrations were predicted to be compliant beyond the site boundary and at all sensitive receptors for all relevant averaging periods and for each model scenario.
- Furthermore, it was noted that there were minimal changes in concentrations between Scenario 1 and Scenario 2.

Although concentrations are considered to be low, various mitigation measures are recommended to be maintained.

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1 INTRODUCTION

FFS Refiners (Pty) Ltd (FFS) operates a tar and waxy oil processing and petroleum storage facility at their Evander Depot, Mpumalanga. FFS is the largest supplier of industrial heating fuels in South Africa. The company markets products for a wide variety of uses, including glass making, brick making, steam raising in boilers, billet re-heating, baking incineration, road-mix heating, lime kilns, sand and stone drying.

Currently, the facility holds an Atmospheric Emissions Licence (AEL) for the following listed activities, in line with Section 21 of the National Environmental Management: Air Quality Act, No 39 of 2004, Government Notice 248 of 2010 (Government Gazette 33064):

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- Subcategory 3.3 – Carbonization and Coal Gasification – Tar Processes.

FFS intends to process and store hydrocarbon waste streams at the existing facility. Although, the existing authorised production and storage capacities will not be increased, the proposed operations will fall under *Subcategory 2.5: Industrial Fuel Oil Recyclers*, requiring an AEL amendment. In support of the AEL amendment application, an Atmospheric Impact Report (AIR) is required to determine the potential impacts associated with the proposed changes. To assist FFS in this regard, WSP Group Africa (Pty) Ltd (WSP) has been appointed to facilitate the AEL application and supporting AIR for the proposed changes.

This report presents the findings from the AIR, using a Level two dispersion model (AERMOD) to predict the potential air quality impacts associated with the facility. Included in this report is a description of the background of the facility; a discussion on the associated atmospheric emissions and relevant air quality legislation; a description of the methodology utilised in the study; identification of sensitive receptors; dispersion modelling predictions as well as an assessment of the related impacts and the recommended management and mitigation measures for the facility.

2 ENTERPRISE DETAILS

2.1 ENTERPRISE DETAILS

The details of the FFS Evander facility are provided in **Table 2-1** below, with the details of the responsible contact person presented in **Table 2-2**.

Table 2-1: Facility information

Enterprise Name	FFS Refiners (Pty) Ltd, Evander
Trading As / Site Name	FFS Refiners (Pty) Ltd, Evander
Type of Enterprise, e.g. Company/Close Corporation/Trust, etc.	Company
Company/Close Corporation/Trust Registration Number	1986/003962/07
Registered Address	3 Brunel Road, Evander Industrial, Evander
Postal Address	PO Box 1967 Secunda 2302
Telephone Number (General)	017 632 9100
Fax Number (General)	017 632 9119
Industry Type/Nature of Trade	Tar Processing and Storage of Petroleum Products
Land Use Zoning as per Town Planning Scheme	Industrial
AEL reference number	Govan Mbeki/FFS (Pty) Ltd /0007/2020/F04
EIA reference number	N/A
Modelling consultant	WSP Group Africa (Pty) Ltd

Table 2-2: Contact details

Name of Accountable Control Officer (ACO)	Mr Barry Visagie
Name of Emission Control Officer (ECO)	Mr Barry Visagie
Telephone Number	017 632 9100
Cell Phone Number	083 645 5260
Fax Number	017 632 9119
E-mail Address	BarryV@ffs.co.za
After Hours Contact Details	083 645 5260

2.2 LOCATION AND EXTENT OF FACILITY

The existing FFS Evander facility occupies stands 1941 through 1943 on 3 Brunel Road (26.486222° S; 29.097964° E), in Evander, Mpumalanga Province. The site falls within the Govan Mbeki Local Municipality, forming part of the Gert Sibande District Municipality. The Govan Mbeki Local Municipality falls within the Highveld Priority Area (HPA), declared on 23 November 2007. The HPA is associated with poor air quality due to the high concentration of both industrial and non-industrial sources.

The small town of Evander, originally founded on gold mining, currently comprises light industries, a couple of residential areas, schools and a golf course. Evander is a small and sparsely developed town and the primary sources of air quality concern are vehicular emissions, dust from decommissioned mining operations, and potential odours from a nearby sewage works. SASOL Secunda is located approximately 8 km south-east of the site and is the only industrial polluter in the region that is likely to have significant stack emissions of sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and particulates. The facility extent and location details are summarised in **Table 2-3** with a graphical location map presented in **Figure 2-1.**

Table 2-3: Location details

Physical Address of the Facility	3 Brunel Road, Evander Industrial, Evander
Description of Site (Where No Street Address)	N/A
Coordinates of Approximate Centre of Operations	Latitude: -26.48666667 S Longitude: 29.10055556 E
Extent (km^2)	0.0339
Elevation Above Mean Sea Level (m)	1 640
Province	Mpumalanga
Metropolitan/District Municipality	Gert Sibande District Municipality
Local Municipality	Govan Mbeki Local Municipality
Designated Priority Area	Highveld Priority Area

Figure 2-1: Locality map of the FFS Evander facility

2.3 ATMOSPHERIC EMISSION LICENCE AND OTHER AUTHORISATIONS

Listed activities and associated Minimum Emission Standards (MES) were published in Government Notice 248, Government Gazette 33064 (31 March 2010) in-line with Section 21 of NEM:AQA. An amended list of activities was published in Government Notice 893, Government Gazette 37054 (22 November 2013). FFS Evander falls under *Subcategory 2.4: Storage and Handling of Petroleum Products* and *Subcategory 3.3 Tar Processes* of Government Notice Regulation 893 of 2013, promulgated in line with Section 21 of the National Environmental Management: Air Quality Act 39 of 2004 (NEMAQA). As such, FFS Evander currently hold an AEL for the operations (licence number Govan Mbeki/FFS (Pty) Ltd /0007/2020/F04, expiring 3 June 2024). FFS has submitted the renewal application for this AEL on the 15/03/2024 and await the renewed licence., this excludes the new activity. The proposed changes will fall under *Subcategory 2.5: Industrial Fuel Oil Recyclers.* For the proposed operations, an amendment to the current AEL is also required before the changes in operations can commence.

3 NATURE OF THE PROCESS

3.1 LISTED ACTIVITY

The listed activities as applicable to the current and proposed operations are presented in **Table 3-1**.

Table 3-1: Listed activities as applicable to FFS Evander operations

Listed Activity Number	Category of Listed Activity	Sub-category of Listed Activity	Listed Activity Name	Description of Listed Activity
Current Operations				
1	2	2.4	Petroleum Industry – Storage and Handling of Petroleum Products	Petroleum product storage tanks and product transfer facilities
2	3	3.3	Carbonization and Coal Gasification – Tar Processes	Processes in which tar, creosote or any other product of distillation of tar is distilled or heated in any manufacturing process
Proposed Operations				
3	2	2.5	Petroleum Industry – Industrial Fuel Oil Recyclers	Installations used to recycle or recover oils from waste oils

3.2 PROCESS DESCRIPTION

FFS have owned and operated the FFS Evander Depot since 2006. The original Environmental Authorisation (EA) was issued by Department of Agriculture, Rural Development, land and Environmental Affairs (DARDLEA), formally known as the Provincial Department of Agriculture and Land Administration, for the construction and operation of a Tar Processing Facility (Reference number: 17.2.25.16 H 45). In 2011, FFS were issued with an EA (reference number: 17/2/2/1 © MP-07) for the construction of twelve additional onsite tanks for the storage of petroleum products.

In 2014, DARDLEA issued FFS with an EA (Reference number: 17/2/3/GS-175) for the construction of a waxy oil processing facility and storage of oil and petroleum products. The process facility entailed the construction of six 250 m^3 and seven 60 m^3 storage tanks for a static plant with a combined total capacity of 1,920 m^3. The plant has a footprint of 25,000 m^2. FFS Evander has partially implemented this authorisation with the construction of the Filtration plant that was commissioned in May 2016.

In addition, FFS are proposing to process hydrocarbon waste streams. The proposed development will form part of the existing FFS Facility.

3.2.1 PRODUCT STORAGE, CLASSIFICATION AND LOADING

Liquid hydrocarbons are received at the processing facility via road tanker, quantified and sampled for commercial purposes. The liquid hydrocarbons are off-loaded and stored according to their true vapour pressure (TVP) at product storage temperature as Type 1, 2,3 or 4 liquids as defined in the NEM:AQA, where:

- Type 1: TVP <= 14 kPa.
- Type 2 is from 14 kPa TVP <= 91 kPa (with throughput < 50 000 m^3 per annum).
- Type 3 is from 14 kPa TVP <= 91 kPa (with throughput > 50 000 m^3 per annum).
- Type 4 is 91 kPa < TVP.

These are stored in a total of 22 storage tanks with a combined volume of 26 878 m^3 and FFS currently have an environmental authorisation to build a further 12 920 m^3 of storage tanks for which the plinths have been laid and will be hard surfaced and bunded to comply with SANS 10089-1:2008.

Tanks E1 to E14 are linked via a common vapour space manifold to a VOC scrubber while Tanks TF1 to TF4 and TF6 to TF8 have air cooled vent radiators while TF5 has a vacuum pressure vent to minimise tank operating and standing vapour losses.

After processing the products certified, the products are loaded from the storage tanks via a bottom loading into road tankers and quantified for commercial purposes.

3.2.2 COAL TAR AND USED OILS PROCESSING PLANT

The used oils will be sampled to ascertain which process would best suit the ultimate product specification for a customer. Based on the sample results the used oil will either go through the normal process or the deash process or a combination of the two may be used.

Coal tar and used oils products are offloaded into conical bottom processing tanks or feedstock storage tanks during which time a running (lor drip) sample is taken. From the conical bottom processing tanks the product is circulated through heat exchangers to maintain a temperature of approximately 90 °C and a homogenous mixture. Feed to the liquid-solid phase separation equipment (typically filters, centrifugal separators and similar devices) are drawn off this circulating load via flow control valves that are set by the operator. This is done to obtain the best separation of ash and carbon particulate from the tar stream. The ash and carbon particulate report to the high MIT product, while tar reduced in MIT and ash is pumped to the forced feed evaporator (FFE). The high MIT product is either further processed to a solid combustion fuel in-house or a third party's premises.

Product is pumped from the FFE feed tank to the FFE where it is circulated through a heat exchanger and heated to above 125 °C. This results in the water and the light ends boiling off. The water vapour and light ends are then condensed in a water cooled condenser and separated in a static separator with condensed water going to the water storage tank and the light ends going to the light ends storage tank. Light ends are used to blend back into the wood preserve and CTF to adjust viscosity or are sold as an industrial heating fuel. Condensed water is sent through the FFS effluent water treatment plant and then sent back to the suppliers who reuse the water in the charring process for quenching.

The dry tar and oil exiting the FFE is then returned for further liquid-solid phase separation using similar systems as described above for final MIT trimming and ash reduction at temperatures up to 200 °C. The product is then pumped to intermediate process storage tanks where quality control is again done to determine what additives the tar requires in order to meet the South African Bureau of Standards (SABS) specification for wood preserve or the internal and customer specification for industrial heating fuel (CTF).

From these storage tanks the product is then sent to the onsite batch blending plant and blended into the correct specification with enriching and viscosity cutting materials. After blending, the product is stored in finished goods tanks awaiting transportation to customers over the weighbridge.

Should the intermediate quality control reveal a low flash point then the tar is sent to a vacuum stripper to adjust this and then returned to the intermediate storage tanks.

The processing equipment is slinked to a wet scrubber to control emissions that may occur during operations.

3.2.3 WAXY OIL PROCESS

The aim of the proposed processing facility is to remove particulates and contaminates of varying sizes from the liquid hydrocarbon oils. Construction is completed on the filtration process which is in full operation and the distillation unit is currently being commissioned.

Liquid hydrocarbons that can go directly to filtration without pre-treatment are blended and heated, the hydrocarbons are then passed through a filter to remove the ash particulates. Once the filtration rate is reduced then the filter is stopped, the filter cake removed and blended into a solid fuel for use in the boiler to generate steam. After filtration, the processed filtrate is stored in a blend tank. It is then blended into an industrial heating fuel with various other fuel oils before final storage if required. Hence the process is of a batch nature.

Hydrocarbon feed materials that cannot go directly to the filtration unit are fed into the distillation unit. Vapours generated under closed conditions are then cooled back into liquid hydrocarbons while the remaining residual ashes are placed in skips for blending into solid fuel, sale as iron or dumping as inert ash.

As the process requirements grow the following processing steps will be followed:

- The viscosity of the waxy oil is reduced by using a fired oil heater. The product will be heated to around 450 °C under pressure. Further “trimming” of the viscosity is done with additives.
- Once the viscosity is reduced, the large particles within the material are separated using a static separator. This process is assisted by the temporary reduction of viscosity by means of heat (120 °C), reduction of pH and surface tension through the addition of proprietary chemicals.
- From the static separator, material containing a high content of solids is fed into the de-ashing vessel where wash water is used to facilitate the removal of the ash in a liquid phase.
- The water is then removed and recovered by using an FFE and multistage evaporator.
- Further removal of solids may be required using centrifugal separation. Any carbon particulate is then removed by filtration. However excessive waxes in the process stream may bind filter media requiring the chilling of the stream which will result in the separation and removal of waxes prior to filtration. This stream of wax would be retreated in the de-ashing plant and re-constituted with the oil after the filtration stage.

The remainder of the equipment as per the environmental authorisation will be installed as demand and qualities dictate.

3.2.4 ANCILLARY EQUIPMENT AND SERVICES

A 12 ton/hour coal fired boiler and a 4 ton/hour oil fired boiler provide steam for the facility to raise heat and purge the filter cake. Air compressors and air dryers provide instrument air, filter cake drying medium and truck tyre compressed air. Cooling towers and chillers ensure products and vapours are cooled and condensed. Volatile organic compounds (VOC) scrubbers remove VOCs to meet the emission limits as set down for point source emission legislation limits as per NEM:AQA.

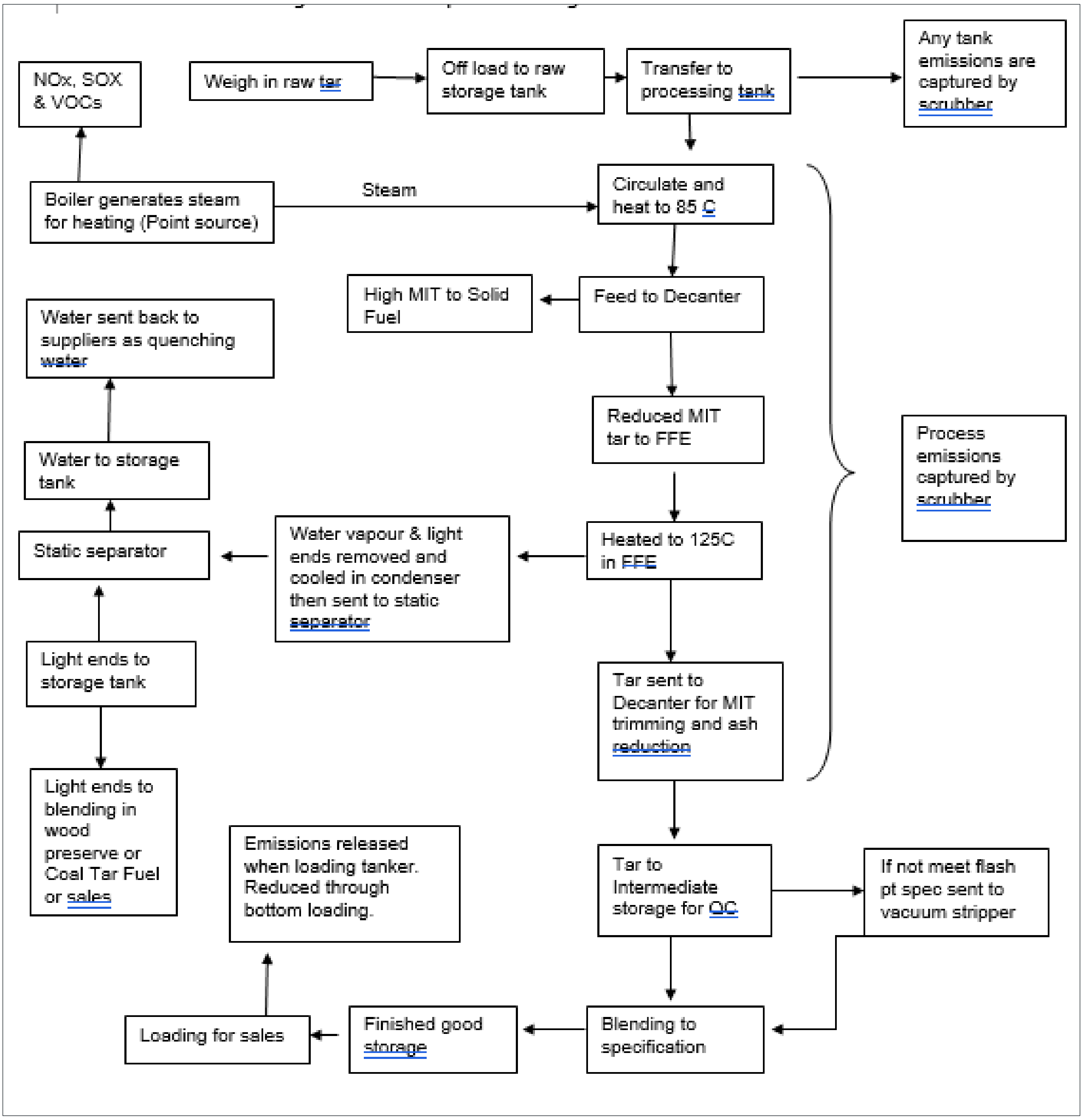


Figure 3-1: Current tar and creosote production process

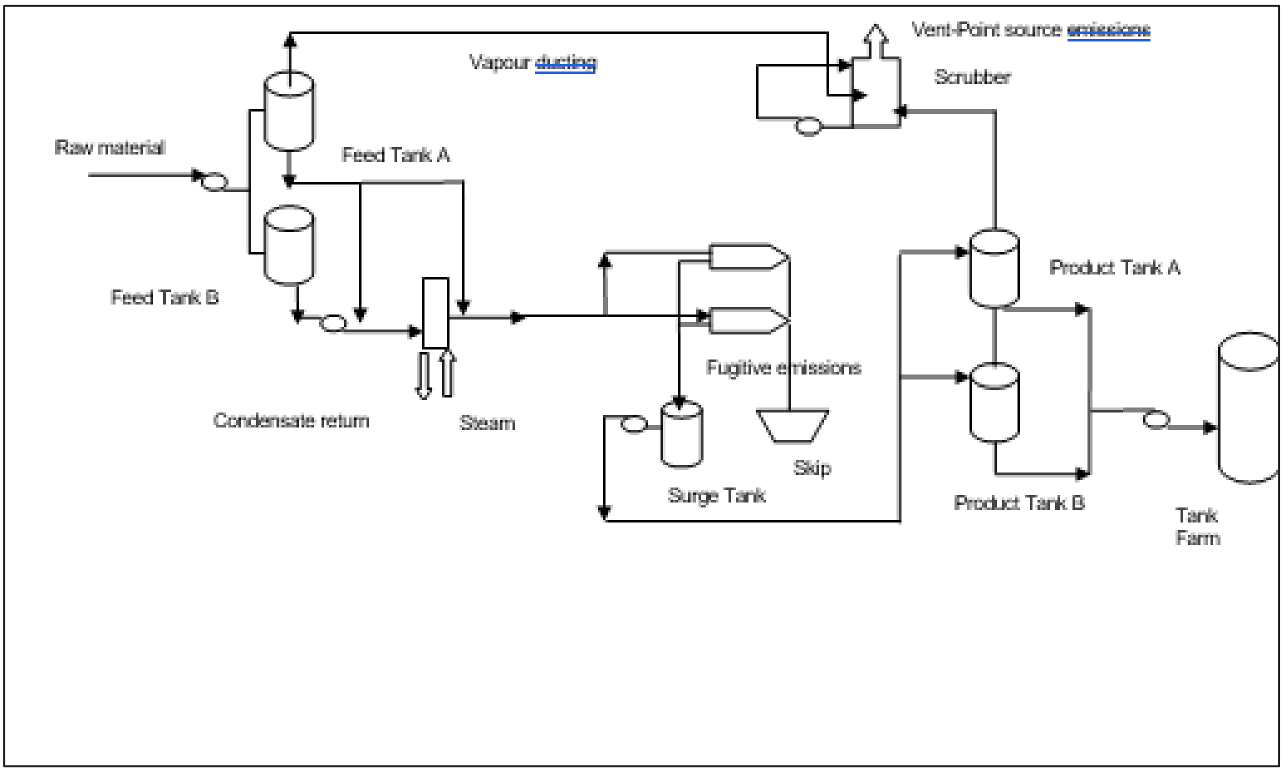


Figure 3-2: Waxy oil process in addition to tar and creosote manufacture

3.3 UNIT PROCESSES

The unit processes occurring at the facility are presented in **Table 3-2**.

Table 3-2: List of unit processes associated with FFS Evander

Name of the Unit Process	Unit Process Function	Batch or Continuous Process
2X Boilers	Steam generation (1 standby boiler, 1 operational boiler)	Continuous
5X Decanter Centrifuge and Filtration Plant	Separation of solid coal particles from liquid tar	Continuous
Forced Feed Evaporator	Evaporation of water from the liquid tar	Continuous
Mixer	Mix tar and blend material for sale as Wood Preserve	Batch
Vacuum Stripper	Remaining water and light ends are removed from the product to ensure the correct flash point	Batch
Petroleum Storage Tanks & 11 000 m^3 storage capacity (new) & waxy oil tanks 1 920 m^3	Storage (26 878 m^3 storage capacity)	Continuous
Scrubbers x4	VOCS are scrubbed from the vapour stream with the use of water	Continuous
Cooling Towers	Remove heat from the process streams and reuse the colling water	Continuous
2 Oil Fired Heaters	Heat generated to be used in waxy oil process	Continuous
2 Chillers	To reduce temperature of waxy oil process stream to allow separation and removal of waxes prior to filtration	Continuous
Magnetic Separation Plant	Removes iron contamination in waxy oil	Continuous
Heat Exchangers	Heat generation for process	Continuous
Filtration unit	Removal of particulates in waxy oil	Batch
Distillation unit	Separation of water, soils, and hydrocarbon fractions	Continuous
Static separators	To assist with removal of solid contaminants in waxy oil	Continuous
4 centrifugal separators	To assist with removal of contaminants in waxy oil	Continuous

4 TECHNICAL INFORMATION

4.1 RAW MATERIALS USED

Details on the raw materials handled at the facility are presented in **Table 4-1**.

Table 4-1: Raw materials associated with FFS Evander

Raw Material Type	Design Consumption Rate (quantity)	Actual Consumption Rate (quantity)	Units (quantity/period)
Coal Tar	44 400	44 400	Tons per annum
Type 1, 2 and 3 liquid hydrocarbons	640 200	475 000	Tons per annum

4.2 APPLIANCES AND ABATEMENT EQUIPMENT CONTROL TECHNOLOGY

The abatement equipment currently installed at the facility is presented in **Table 4-2**.

Table 4-2: Abatement appliances installed at FFS Evander

Appliance Name	Appliance Type / Description	Appliance Function / Purpose
Wet Scrubber	Scrubber	A scrubber is a device or system designed remove pollutants, or contaminants from a gas, liquid, or air stream
VOC Scrubber	Dry Scrubber	A scrubber is a device or system designed remove pollutants, or contaminants from a gas, liquid, or air stream

5 ATMOSPHERIC EMISSIONS

Two Scenarios have been assessed for the FFS Evander facility:

- Scenario 1: Impacts associated with all existing operations (i.e point source stacks, idling trucks and tanks on site).
- Scenario 2: Impacts associated with the existing and proposed operations (i.e. the proposed operations include the waste oil processing taking place which are point source stacks, idling trucks and waste oil processing tanks on site).

*Importantly, with the proposed operation changes there are no changes to the stacks and idling trucks on site, as such Scenario 1 and Scenario 2 parameters and emissions remain the same for these sources. The **only source changes** applicable to the proposed operations are to the tanks on site which may have waste oils stored in them. To represent a worst case, conservative Scenario which is likely to produce the highest amount of emissions with these waste oils stored in the tanks, jet kerosene (which is the worst oil type) has been assumed to be stored in all tanks (**Table 5-6** and **Table 5-7** – Scenario 2 presents this).*

5.1 POINT SOURCE PARAMETERS

Physical parameters and emission rates for each stack were sourced from the Modderfontein Laboratory Services Stack Testing 2024 Reports (**Table 5-1** and **Table 5-2**). The point sources are assumed to operate continuously for both Scenarios. Important to note is that the dry scrubber 2 and wet scrubber 2 are not operational currently and have been excluded from this assessment. Additionally, boiler 7 no longer exists, and has also been excluded from this assessment.

Table 5-1: Stack parameters for the point sources at FFS Evander

Source	X (UTM 35S)	Y (UTM 35S)	Stack Height (m)	Diameter (m)	Volumetric Flowrate (m^3/h)	Exit Velocity (m/s)	Temperature (ºC)
Scenario 1 and 2							
VOC Scrubber Discharge	709085.91 m E	7068784.35 m S	6	0.048	86.76	5.66	36
Vapour Recovery Scrubber Vent	709089.01 m E	7068790.95 m S	10	0.1	115.92	4.10	32
Boiler 8	709122.36 m E	7068757.16 m S	33.5	1.255	17 634.96	3.96	175
Boiler 9	709122.36 m E	7068757.16 m S	33.5	1.255	9 529.92	2.14	120

Table 5-2: Emission rates for the point sources at FFS Evander

Source	Emission Rate (g/s)			
	SO_2	CO	C_6H_6	TVOCs
Scenario 1 and 2				
VOC Scrubber Discharge	9.90E-05	8.60E-05	5.63E-04	5.98E-04
Vapour Recovery Scrubber Vent	1.35E-04	1.47E-04	4.76E-03	3.56E-02
Boiler 8	2.39E+00	6.28E-01	N/A	N/A
Boiler 9	3.47E-01	1.13E-02	N/A	N/A

5.2 POINT SOURCE MAXIMUM EMISSION RATES (NORMAL OPERATING CONDITIONS)

As per Section 21 of the NEM:AQA, 2004, the maximum permitted emission rates for point sources for the project operations are presented in **Table 5-3**.

Table 5-3: Point source emission rates under normal operating conditions

Point Source Code	Pollutant Name	Maximum Release Rate			Duration of Emissions
		(mg/Nm^3)	Plant Status	Average Period	
VOC Scrubber Discharge/ Vapour Recovery Scrubber Vent / Boiler 8 / Boiler 9	CO	130	New	Daily	Continuous
		250	Existing	Daily	Continuous
	SO_2	500	New	Daily	Continuous
		3 500	Existing	Daily	Continuous
	VOC (thermal treatment)	40 000	New	Daily	Continuous
		40 000	Existing	Daily	Continuous
	VOC (non-thermal treatment)	150	New	Daily	Continuous
		150	Existing	Daily	Continuous

5.3 POINT SOURCE MAXIMUM EMISSION RATES (START-UP, SHUT-DOWN, UPSET AND MAINTENANCE CONDITIONS)

No special start-up or shut-down conditions are applicable to the process.

5.4 FUGITIVE EMISSIONS

Fugitive emissions at FFS Evander were calculated using the United States Environmental Protection Agency (USEPA) AP-42 emission factors. An emission factor is a value representing the relationship between an activity and the rate of emissions of a specified pollutant. These emission factors have been developed based on test data, material mass balance studies and engineering estimates.

Emission factors are expressed as a function of the weight, volume, distance or duration of the activity emitting the pollutant. The general equation used for the estimation of emissions is:

$$E = A \times EF \times \left(1 - \frac{ER}{100}\right)$$

Where:

E = emission rate

A = activity rate

EF = emission factor

ER = overall emission reduction efficiency (%)

Emission estimates from vehicles at FFS Evander were based on the USEPA emissions fact sheet for idling vehicle emissions (EPA, 1998), as presented within the FFS Evander Air Quality Impact Assessment undertaken by WSP in 2018. Fugitive VOC and C6H6 emissions were estimated for all tanks using the USEPA TANKS 4.09d (TANKS) model. The TANKS model calculates emissions from organic liquids, crude oils and petroleum distillates in storage tanks using the USEPA's AP42 emission factors. An emissions report was generated for each tank, providing details of both breathing and working losses and total emissions for each tank. Importantly, all tanks are vertical fixed roof tanks with the exception of tank E41. The emission calculations and resultant emission rates are discussed in the section below (**Table 5-4** to **Table 5-7**).

Table 5-4: Idling truck parameters at FFS Evander

Source	SW corner X (UTM 35S)	SW corner Y (UTM 35S)	Area (m^2)	Height of release (m)	Length x Width (m)	Hours per annum
Scenario 1 and 2						
Weighbridge	709013.4	7068750.9	82.7	1	19.5 x 4.3	8760
Loading / offloading area	709036.1	7068800.3	838.3	1	107.6 x 7.8	8760

Table 5-5: Idling truck emission rates at FFS Evander

Source	Emission rate ($g/m^2/s$)		
	SO_2	CO	TVOCs
Scenario 1 and 2			
Weighbridge	1.20E-07	3.20E-04	4.20E-05
Loading / offloading area	1.20E-08	3.10E-05	4.20E-06

Table 5-6: Tank emission parameters and rates at FFS Evander

Source	TF1	TF2	TF3	TF4	TF5	TF6	TF7	TF8	E1	E2	E3	E4	E6	E7	E8	E9	E10	E11	E12	E13
Product Name	RFO	RFO	RFO	CTF	RFO	RFO	RFO	CTF	CTF	CTF	CTF	CFT	RFO	CF40	GASOLINE	RFO	RFO	RFO	RFO	RFO
Scenario 1																				
Shell height (m)	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	10.40	12.05	12.05	12.05	8.08	7.95	7.15	7.20	7.20	16.50	9.95	14.40
Shell diameter (m)	14.00	8.20	8.20	11.46	11.46	11.46	11.46	11.46	12.70	12.72	10.55	10.52	12.72	2.9	2.88	11.12	11.12	2.89	12.73	10.5
Maximum liquid height (m)	16.20	16.20	16.20	16.20	16.20	16.20	16.20	16.20	10.05	11.75	11.60	11.60	7.50	7.16	6.65	6.75	6.75	16	9.5	14
Average liquid height (m)	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10	5.03	5.88	5.80	5.80	3.75	3.58	3.33	3.38	3.38	8.00	4.75	7.00
Working volume (m^3)	2,493.80	855.52	855.52	1,670.99	1,670.99	1,670.99	1,670.99	1,670.99	1,273.10	1,493.14	1,014.03	1,008.28	953.07	47.29	43.32	655.55	655.55	104.96	1,209.12	1,212.26
Turnovers per annum	7.04	17.82	17.82	10.12	7.59	5.68	5.68	5.48	3.30	2.81	7.10	7.14	6.30	38.84	42.47	10.07	10.07	12.01	9.92	9.90
Net throughput (m^3 per annum)	17,548.00	15,243.00	15,243.00	16,904.00	12,683.00	9493.00	9493.00	9158.00	4200.00	4200.00	7200.00	7200.00	6000.00	1837	1840	6600	6600	1260	12000	12000
Storage temperature	30.00	90.00	90.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	40.00	25	20	30	30	35	30	30
Shell colour	Black	Black	Black	Black	Black	Black	Black	Black	Grey	Grey	Grey	Grey	Grey	Black	Black	Grey	Grey	Grey	Grey	Grey
Shell condition	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
Roof type (cone/dome)	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone
Vapour pressure (kPa)	0.0008	0.0013	0.0013	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008		0.0008	0.0008
Emission rates (g/s)																				
TVOC	3.42E-05	4.98E-05	4.98E-05	3.30E-05	2.49E-05	1.86E-05	1.86E-05	1.79E-05	1.44E-06	1.44E-06	2.45E-06	2.45E-06	2.01E-06	5.75E-07	1.52E-01	2.30E-06	2.30E-06	4.31E-07	4.17E-06	1.86E-05
Benzene	3.42E-08	4.98E-08	4.98E-08	3.30E-08	2.49E-08	1.86E-08	1.86E-08	1.79E-08	2.07E-14	2.07E-14	3.52E-14	3.52E-14	2.90E-14	8.28E-15	2.19E-09	3.31E-14	3.31E-14	6.21E-15	6.00E-14	1.86E-08
Source	**TF1**	**TF2**	**TF3**	**TF4**	**TF5**	**TF6**	**TF7**	**TF8**	**E1**	**E2**	**E3**	**E4**	**E6**	**E7**	**E8**	**E9**	**E10**	**E11**	**E12**	**E13**
Product Name	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	GASOLINE	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene
Scenario 2																				
Shell height (m)	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	10.40	12.05	12.05	12.05	8.08	7.95	7.15	7.20	7.20	16.50	9.95	14.40
Shell diameter (m)	14.00	8.20	8.20	11.46	11.46	11.46	11.46	11.46	12.70	12.72	10.55	10.52	12.72	2.9	2.88	11.12	11.12	2.89	12.73	10.5
Maximum liquid height (m)	16.20	16.20	16.20	16.20	16.20	16.20	16.20	16.20	10.05	11.75	11.60	11.60	7.50	7.16	6.65	6.75	6.75	16	9.5	14
Average liquid height (m)	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10	5.03	5.88	5.80	5.80	3.75	3.58	3.33	3.38	3.38	8.00	4.75	7.00
Working volume (m^3)	2,493.80	855.52	855.52	1,670.99	1,670.99	1,670.99	1,670.99	1,670.99	1,273.10	1,493.14	1,014.03	1,008.28	953.07	47.29	43.32	655.55	655.55	104.96	1,209.12	1,212.26
Turnovers per annum	7.04	17.82	17.82	10.12	7.59	5.68	5.68	5.48	3.30	2.81	7.10	7.14	6.30	38.84	42.47	10.07	10.07	12.01	9.92	9.90
Net throughput (m^3 per annum)	17,548.00	15,243.00	15,243.00	16,904.00	12,683.00	9493.00	9493.00	9158.00	4200.00	4200.00	7200.00	7200.00	6000.00	1837	1840	6600	6600	1260	12000	12000
Storage temperature	30.00	90.00	90.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	40.00	25	20	30	30	35	30	30
Shell colour	Black	Black	Black	Black	Black	Black	Black	Black	Grey	Grey	Grey	Grey	Grey	Black	Black	Grey	Grey	Grey	Grey	Grey
Shell condition	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
Roof type (cone/dome)	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone
Vapour pressure (kPa)	0.0008	0.0013	0.0013	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008		0.0008	0.0008
Emission rates (g/s)																				
TVOC	8.46E-04	7.35E-04	7.35E-04	8.16E-04	6.12E-04	4.58E-04	4.58E-04	4.42E-04	2.03E-04	2.02E-04	3.52E-04	3.52E-04	2.90E-04	8.70E-05	1.52E-01	3.18E-04	3.18E-04	6.07E-05	5.78E-04	5.79E-04
Benzene	8.46E-07	7.35E-07	7.35E-07	8.16E-07	6.12E-07	4.58E-07	4.58E-07	4.42E-07	2.03E-07	2.02E-07	3.52E-07	3.52E-07	2.90E-07	8.70E-08	1.52E-04	3.18E-07	3.18E-07	6.07E-08	5.78E-07	5.79E-07

Where: RFO = residual fuel oil, CFT = coal tar fuel, DFO = distillate fuel oil, WO = waste oil

Table 5-7: Tank emission parameters and rates at FFS Evander

Source	E14	E22	E23	E24	E25	E30	E31	E34	E37	E38	E39	E40	E41	E51	E52	E63	MVF (M4)	BODYFEED (M2)	PRECOAT (M1)
Product Name	CFT	CFT	CFT	CFT	CFT	CFT	CFT	CFT	RFO	RFO	DFO1	WO	WO	RFO	RFO	WO	RFO	RFO	RFO
Scenario 1: Existing Operations																			
Shell height (m)	14.40	5.02	4.83	6.43	5.90	8.00	9.55	16.00	15.10	15.10	15.10	15.10	13.40	4.83	4.83	12.50	2.15	2.73	2.73
Shell diameter (m)	10.5	3.85	3.85	3.85	3.85	2.86	2.87	1.87	2.85	2.85	2.85	2.85	2.86	4.2	4.2	2.91	1.2	2.736	2.736
Maximum liquid height (m)	10	4.63	4.43	6.03	5.5	7.5	8.5	13	13.59	13.59	13.59	13.59	12.06	4.5	4.5	11.25	1.94	2.46	2.46
Average liquid height (m)	5.00	2.32	2.22	3.02	2.75	3.75	4.25	6.50	6.80	6.80	6.80	6.80	6.03	2.25	2.25	5.63	0.97	1.23	1.23
Working volume (m^3)	865.90	53.90	51.57	70.20	64.03	48.18	54.99	35.70	86.70	86.70	86.70	86.70	77.48	62.34	62.34	74.82	2.19	14.46	14.46
Turnovers per annum	12.47	11.80	12.33	11.11	11.24	12.45	12.00	13.44	81.25	17.58	30.42	120.36	11.93	12.51	11.55	28.95	18.69	92.10	92.10
Net throughput (m^3 per annum)	10800	636	636	780	720	600	660	480	7044	1524	2637	10435	924	780	720	2166	41	1332	1332
Storage temperature	20	20	20	20	20	20	60	60	20	20	20	20	20			25	50	100	100
Shell colour	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Black	Grey	Grey
Shell condition	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
Roof type (cone/dome)	Cone	Dome	Dome	Dome	Dome	Cone	Cone	Cone	Dome	Dome	Dome	Dome	N/A	Dome	Dome	Dome	Dome	Dome	Dome
Vapour pressure (kPa)	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0004	0.0004	0.0724	0.0004	0.0004			0.0006	0.0013	0.0013	0.0013
Emission rates (g/s)																			
TVOC	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	3.65E-06	1.47E-06	3.27E-04	4.19E-06	4.19E-06	2.30E-06	2.30E-06	3.02E-06	1.34E-07	2.14E-06	2.14E-06
Benzene	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	1.79E-08	3.65E-09	1.47E-09	3.27E-07	4.19E-09	4.19E-09	2.30E-09	2.30E-09	3.02E-09	1.34E-10	2.14E-09	2.14E-09
Source	E14	E22	E23	E24	E25	E30	E31	E34	E37	E38	E39	E40	E41	E51	E52	E63	MVF (M4)	BODYFEED (M2)	PRECOAT (M1)
Product Name	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene	Jet Kerosene
Scenario 2: Existing and Proposed Operations																			
Shell height (m)	14.40	5.02	4.83	6.43	5.90	8.00	9.55	16.00	15.10	15.10	15.10	15.10	13.40	4.83	4.83	12.50	2.15	2.73	2.73
Shell diameter (m)	10.5	3.85	3.85	3.85	3.85	2.86	2.87	1.87	2.85	2.85	2.85	2.85	2.86	4.2	4.2	2.91	1.2	2.736	2.736
Maximum liquid height (m)	10	4.63	4.43	6.03	5.5	7.5	8.5	13	13.59	13.59	13.59	13.59	12.06	4.5	4.5	11.25	1.94	2.46	2.46
Average liquid height (m)	5.00	2.32	2.22	3.02	2.75	3.75	4.25	6.50	6.80	6.80	6.80	6.80	6.03	2.25	2.25	5.63	0.97	1.23	1.23
Working volume (m^3)	865.90	53.90	51.57	70.20	64.03	48.18	54.99	35.70	86.70	86.70	86.70	86.70	77.48	62.34	62.34	74.82	2.19	14.46	14.46
Turnovers per annum	12.47	11.80	12.33	11.11	11.24	12.45	12.00	13.44	81.25	17.58	30.42	120.36	11.93	12.51	11.55	28.95	18.69	92.10	92.10
Net throughput (m^3 per annum)	10800	636	636	780	720	600	660	480	7044	1524	2637	10435	924	780	720	2166	41	1332	1332
Storage temperature	20	20	20	20	20	20	60	60	20	20	20	20	20			25	50	100	100
Shell colour	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Black	Grey	Grey
Shell condition	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
Roof type (cone/dome)	Cone	Dome	Dome	Dome	Dome	Cone	Cone	Cone	Dome	Dome	Dome	Dome	N/A	Dome	Dome	Dome	Dome	Dome	Dome
Vapour pressure (kPa)	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0004	0.0004	0.0724	0.0004	0.0004			0.0006	0.0013	0.0013	0.0013
Emission rates (g/s)																			
TVOC	5.54E-03	2.63E-04	2.57E-04	3.29E-04	2.95E-04	2.17E-04	1.73E-04	1.16E-04	7.44E-04	4.57E-04	4.57E-04	8.16E-04	3.87E-04	2.94E-04	2.86E-04	5.05E-04	2.01E-06	3.16E-05	3.16E-05
Benzene	5.54E-06	2.63E-07	2.57E-07	3.29E-07	2.95E-07	2.17E-07	1.73E-07	1.16E-07	7.44E-07	4.57E-07	4.57E-07	8.16E-07	3.87E-07	2.94E-07	2.86E-07	5.05E-07	2.01E-09	3.16E-08	3.16E-08

Where: RFO = residual fuel oil, CFT = coal tar fuel, DFO = distillate fuel oil, WO = waste oil

6 IMPACT OF ENTERPRISE ON THE RECEIVING ENVIRONMENT

This section presents the background, methodology and results of the AIR undertaken for the facility. An AIR was specifically requested by the local authorities in support of FFS's AEL amendment application for the proposed changes. The following scenarios were considered in this assessment:

- Scenario 1: Existing Operations.
- Scenario 2: Existing and Proposed Operations.

6.1 ANALYSIS OF EMISSIONS' IMPACT ON HUMAN HEALTH

6.1.1 ATMOSPHERIC EMISSIONS AND IMPACTS

The key pollutants associated with the facility are sulphur dioxide (SO_2), carbon monoxide (CO) and volatile organic compounds (VOCs), with specific reference to benzene (C_6H_6). These pollutants are discussed in the sections below.

6.2 SULPHUR DIOXIDE

SO_2 is produced via the combustion of sulphur rich fuel. SO_2 is a major respiratory irritant, resulting in respiratory illnesses, alterations in pulmonary defences and aggravation of existing cardiovascular disease. SO_2 may also create sulphuric acid because of its water solubility, producing acid rain. Once emitted, SO_2 may oxidize in the atmosphere to produce sulphate aerosols, which are harmful to human health, limit visibility and in the long term have an effect on global climate (Seinfeld and Pandis, 1998; Fenger, 2002; US EPA, 2011).

6.3 CARBON MONOXIDE

CO is a product of incomplete combustion of carbon in fuels and is a colourless, odourless, and toxic gas at high concentrations. When CO enters the bloodstream, it reduces the flow of oxygen to various organs and tissue and is particularly dangerous to individuals who suffer from cardiovascular disease. High concentrations of CO may affect healthy individuals through impaired vision and a reduction in brain activity. These concentrations tend only to be reached in indoor environments (Fenger, 2002; US EPA, 2011).

6.4 VOLATILE ORGANIC COMPOUNDS

Total VOCs rapidly vaporise from the solid or liquid phase to gas at ambient temperatures. They consist of a variety of chemicals that have both long and short-term health effects. Many VOCs are hazardous air pollutants with their particular impacts determined by each compound's unique chemistry. Impacts from exposure to VOCs include eye, nose and throat irritation; headaches; nausea; dizziness; fatigue; skin allergies; damage to kidneys, liver and the nervous system; loss of coordination; and some VOCs are suspected to cause cancer. When combined with oxides of nitrogen (NO_x), VOCs react to form ground level ozone, which is a component of photochemical smog and can contribute to climate change (Seinfeld and Pandis, 1998; Colls, 2002; USEPA, 2011).

6.4.1 BENZENE

C_6H_6 is the only VOC for which a national ambient air quality standard has been established. Inhalation is the dominant pathway for benzene exposure in humans and smoking is the largest source of personal exposure, but other sources include travelling and refuelling of motor vehicles. Chronic exposure can affect bone marrow and have chromosomal effects (WHO, 2000). Carcinogenicity of benzene has been established in both laboratory animals and humans, with tumours in the Zymbal gland, liver, mammary gland and nasal cavity induced in mice and rats. There is a higher incidence of mortality from leukaemia in humans occupationally exposed (WHO, 2000). Since benzene is carcinogenic in humans, there is no safe level recommended by WHO (2000). The geometric mean of the range of estimates of excess lifetime risk of leukaemia at air concentrations of 1 $\mu g.m^{-3}$ is 6 x 10^{-6}. The concentrations of airborne benzene associated with an excess lifetime risk of 1/10,000, 1/100,000, 1/1,000,000 are 17, 101.7 and 0.17 $\mu g.m^{-3}$ respectively.

6.5 THE REGULATORY FRAMEWORK FOR AIR QUALITY

6.5.1 NATIONAL AMBIENT AIR QUALITY STANDARDS

Ambient air quality standards and guidelines are specified in the NEM:AQA, SANS 69 as well as SANS 1929:2005.The priority pollutants as defined by the Act are SO_2, nitrogen dioxide (NO_2), particulate matter (PM_{10}), particulate matter ($PM_{2.5}$), ozone (O_3), C_6H_6, lead (Pb) and CO. The legislated standards for ambient air quality as it relates to FFS Evander are presented in **Table 6-1**. These pollutants are regulated by MES under Subcategory 2.4, Subcategory 2.5 and Subcategory 3.3, applicable to FFS Evander.

Table 6-1: National ambient air quality standards applicable to FFS Evander

Pollutant	Averaging Period	Concentration ($\mu g/m^3$)	Frequency of Exceedance	Compliance Date
SO_2	10 minutes	500	526	Immediate
	1 hour	350	88	Immediate
	24 hours	125	4	Immediate
	1 year	50	0	Immediate
CO	1 hour	30 000	88	Immediate
	8 hour	10 000	11	Immediate
C_6H_6	1 year	10	0	Immediate – 31 Dec 2014
		5	0	01 Jan 2015

Listed activities and associated MES were published in Government Notice 248, Government Gazette 33064 (31 March 2010) in-line with Section 21 of NEM:AQA. An amended list of activities was published in Government Notice 893, Government Gazette 37054 (22 November 2013). FFS Evander falls under *Subcategory 2.4: Storage and Handling of Petroleum Products* and *Subcategory 3.3 Tar Processes.* The proposed changes will fall under *Subcategory 2.5: Industrial Fuel Oil Recyclers.* The associated emission standards and special arrangements are detailed below.

6.5.2 LISTED ACTIVITIES

6.5.2.1 SUBCATEGORY 2.4: STORAGE AND HANDLING OF PETROLEUM PRODUCTS

a) The following transitional arrangement shall apply for the storage and handling of raw materials, intermediate and final products with a vapour pressure greater than 14 kPa at operating temperature: -
Leak detection and repair (LDAR) program approved by licensing authority to be instituted, by 01 January 2014.

b) The following special arrangements shall apply for control of TVOCs from storage of raw materials, intermediate and final products with a vapour pressure of up to 14 kPa at operating temperature, except during loading and offloading. (Alternative control measures that can achieve the same or better results may be used) –

i. Storage vessels for liquids shall be of the following type (**Table 6-2**):

Table 6-2: Vapour pressure of liquid with recommended type of storage unit.

Application	All permanent immobile liquid storage facilities at a single site with a combined storage capacity of greater than 1000 cubic meters.
True vapour pressure of contents at product storage temperature	**Type of tank of vessel**
Type 1: Up to 14 kPa	Fixed-roof tank vented to atmosphere, or as per Type 2 and 3
Type 2: Above 14kPa and up to 91 kPa with a throughput of less than 50,000 m^3 per annum	Fixed-roof tank with Pressure Vacuum Vents fitted as minimum, to prevent “breathing” losses, or as per Type 3
Type 3: Above 14kPa and up to 91 kPa with a throughput greater than 50,000 m^3 per annum	a) External floating-roof with primary rim seal and secondary rim seal for tank with diameter greater than 20m, or b) Fixed-roof tank with internal floating deck / roof fitted with primary seal, or c) Fixed-roof tank with vapour recovery system.
Type 4: Above 91 kPa	Pressure vessel

ii. The roof legs, slotted pipes and/or dipping well on floating roof tanks (except for domed floating roof tanks or internal floating roof tanks) shall have sleeves fitted to minimise emissions.

iii. The relief valves on pressurised storage should undergo periodic checks for internal leaks. This can be carried out using portable acoustic monitors or if venting to atmosphere with an accessible open end, tested with a hydrocarbon analyser as part of a Leak Detection and Repair (LDAR) Programme.

c) The following special arrangements shall apply for control of TVOCs from the loading and unloading (excluding ships) of raw materials, intermediate and final products with a vapour pressure of greater the 14 kPa at handling temperature. Alternative control measures that can achieve the same or better results may be used:

i. All installations with a throughput of greater than 50,000 m^3 per annum of products with a vapour pressure greater than 14 kPa, must be fitted with a vapour recovery / destruction units. Emission limits are set out in **Table 6-3**.

Table 6-3: Vapour recovery units and emission limits for Subcategory 2.4.

Description:	**Vapour Recovery Units.**		
Application:	All loading / offloading facilities with a throughput greater than 50 000 m^3.		
Substance of mixture of substances		Plant Status	Mg/Nm^3 under normal conditions of 273 Kelvin and 101.3 kPa
Common name	**Chemical Symbol**		
Total volatile organic compounds from vapour recovery/ destruction units using thermal treatment.	N/A	New	150
		Existing	150
Total volatile organic compounds from vapour recovery/ destruction units using non-thermal treatment.	N/A	New	40,000
		Existing	40,000

ii. For road tanker and rail car loading/offloading facilities where the throughput is less than 50,000 m^3 per annum, and where ambient air quality is, or is likely to be impacted, all liquid products shall be loaded using bottom loading, or equivalent, with the venting pipe connected to a vapour balancing system. Where vapour balancing and/or bottom loading is not possible, a recovery system utilizing absorption, condensation or incineration of the remaining VOC's, with a collection efficiency of at least 95%, shall be fitted.

6.5.2.2 Subcategory 2.5: Industrial Fuel Oil Recyclers

Table 6-4: Subcategory 2.5: Industrial Fuel Oil Recyclers

Description:	**Installations used to recycle or recover oils from waste oils.**		
Application:	Industrial fuel oil recyclers with a throughput >5000 ton/month.		
Substance of mixture of substances		Plant Status	Mg/Nm^3 under normal conditions of 273 Kelvin and 101.3 kPa
Common name	**Chemical Symbol**		
Carbon monoxide	CO	New	130
		Existing	250
Sulphur dioxide	SO_2	New	500
		Existing	3,500
Total volatile organic compounds from vapour recovery/destruction units.	N/A	New	40
		Existing	90

a) The following transitional arrangement shall apply for the storage and handling of raw materials, intermediate and final products with a vapour pressure greater than 14 kPa at operating temperature: -
LDAR program approved by licensing authority to be instituted, by 01 January 2014.

b) The following special arrangements shall apply for control of TVOCs from storage of raw materials, intermediate and final products with a vapour pressure of up to 14 kPa at operating temperature, except during loading and offloading. (Alternative control measures that can achieve the same or better results may be used) –

i. Storage vessels for liquids shall be of the following type (**Table 6-5**):

Table 6-5: Vapour pressure of liquid with recommended type of storage unit for Subcategory 2.5

Application	**All permanent immobile liquid storage facilities at a single site with a combined storage capacity of greater than 1000 cubic meters.**
True vapour pressure of contents at product storage temperature	**Type of tank of vessel**
Type 1: Up to 14 kPa	Fixed-roof tank vented to atmosphere, or as per Type 2 and 3
Type 2: Above 14kPa and up to 91 kPa with a throughput of less than 50,000 m^3 per annum	Fixed-roof tank with Pressure Vacuum Vents fitted as minimum, to prevent "breathing" losses, or as per Type 3
Type 3: Above 14kPa and up to 91 kPa with a throughput greater than 50,000 m^3 per annum	a) External floating-roof with primary rim seal and secondary rim seal for tank with diameter greater than 20m, or b) Fixed-roof tank with internal floating deck / roof fitted with primary seal, or c) Fixed-roof tank with vapour recovery system.
Type 4: Above 91 kPa	Pressure vessel

ii. The roof legs, slotted pipes and/or dipping well on floating roof tanks (except for domed floating roof tanks or internal floating roof tanks) shall have sleeves fitted to minimise emissions.

iii. The relief valves on pressurised storage should undergo periodic checks for internal leaks. This can be carried out using portable acoustic monitors or if venting to atmosphere with an accessible open end, tested with a hydrocarbon analyser as part of an LDAR Programme.

c) The following special arrangements shall apply for control of TVOCs from the loading and unloading (excluding ships) of raw materials, intermediate and final products with a vapour pressure of greater the 14 kPa at handling temperature. Alternative control measures that can achieve the same or better results may be used:

i. All installations with a throughput of greater than 50,000 m^3 per annum of products with a vapour pressure greater than 14 kPa, must be fitted with a vapour recovery / destruction units.

ii. For road tanker and rail car loading/offloading facilities where the throughput is less than 50,000 m3 per annum, and where ambient air quality is, or is likely to be impacted, all liquid products shall be loaded using bottom loading, or equivalent, with the venting pipe connected to a vapour balancing system. Where vapour balancing and/or bottom loading is not possible, a recovery system utilizing absorption, condensation or incineration of the remaining VOC's, with a collection efficiency of at least 95%, shall be fitted.

6.5.2.3 Subcategory 3.3: Tar Processes

Table 6-6: Subcategory 3.3: Tar Processes

Description:	**Processes in which tar, creosote or any other product of distillation of tar is distilled or is heated in any manufacturing process.**		
Application:	All installations.		
Substance of mixture of substances		Plant Status	Mg/Nm^3 under normal conditions of 273 Kelvin and 101.3 kPa
Common name	**Chemical Symbol**		
Total volatile organic compounds	N/A	New	130
		Existing	250

a) The following transitional arrangement shall apply for the storage and handling of raw materials, intermediate and final products with a vapour pressure greater than 14 kPa at operating temperature: -
Leak detection and repair (LDAR) program approved by licensing authority to be instituted, by 01 January 2014.

b) The following special arrangements shall apply for control of TVOCs from storage of raw materials, intermediate and final products with a vapour pressure of up to 14 kPa at operating temperature, except during loading and offloading. (Alternative control measures that can achieve the same or better results may be used) –

i. Storage vessels for liquids shall be of the following type (**Table 6-7**):

Table 6-7: Vapour pressure of liquid with recommended type of storage unit for Subcategory 3.3

Application	**All permanent immobile liquid storage facilities at a single site with a combined storage capacity of greater than 1000 cubic meters.**
True vapour pressure of contents at product storage temperature	**Type of tank of vessel**
Type 1: Up to 14 kPa	Fixed-roof tank vented to atmosphere, or as per Type 2 and 3
Type 2: Above 14kPa and up to 91 kPa with a throughput of less than 50,000 m^3 per annum	Fixed-roof tank with Pressure Vacuum Vents fitted as minimum, to prevent "breathing" losses, or as per Type 3
Type 3: Above 14kPa and up to 91 kPa with a throughput greater than 50,000 m^3 per annum	a) External floating-roof with primary rim seal and secondary rim seal for tank with diameter greater than 20m, or

	b) Fixed-roof tank with internal floating deck / roof fitted with primary seal, or c) Fixed-roof tank with vapour recovery system.
Type 4: Above 91 kPa	Pressure vessel

ii. The roof legs, slotted pipes and/or dipping well on floating roof tanks (except for domed floating roof tanks or internal floating roof tanks) shall have sleeves fitted to minimise emissions.

iii. The relief valves on pressurised storage should undergo periodic checks for internal leaks. This can be carried out using portable acoustic monitors or if venting to atmosphere with an accessible open end, tested with a hydrocarbon analyser as part of an LDAR Programme.

c) The following special arrangements shall apply for control of TVOCs from the loading and unloading (excluding ships) of raw materials, intermediate and final products with a vapour pressure of greater the 14 kPa at handling temperature. Alternative control measures that can achieve the same or better results may be used:

i. All installations with a throughput of greater than 50,000 m^3 per annum of products with a vapour pressure greater than 14 kPa, must be fitted with a vapour recovery / destruction units. Emission limits are set out in Table 6-8 below -

Table 6-8: Vapour recovery units and emission limits for Subcategory 3.3

Description:	**Vapour Recovery Units.**		
Application:	All loading / offloading facilities with a throughput greater than 50 000 m^3.		
Substance of mixture of substances		Plant Status	Mg/Nm^3 under normal conditions of 273 Kelvin and 101.3 kPa
Common name	**Chemical Symbol**		
Total volatile organic compounds from vapour recovery/ destruction units using thermal treatment.	N/A	New	150
		Existing	150
Total volatile organic compounds from vapour recovery/ destruction units using non-thermal treatment.	N/A	New	40,000
		Existing	40,000

i. For road tanker and rail car loading/offloading facilities where the throughput is less than 50,000 m^3 per annum, and where ambient air quality is, or is likely to be impacted, all liquid products shall be loaded using bottom loading, or equivalent, with the venting pipe connected to a vapour balancing system. Where vapour balancing and/or bottom loading is not possible, a recovery system utilizing adsorption, absorption, condensation or incineration of the remaining VOC's, with a collection efficiency of at least 95%, shall be fitted.

6.6 HIGHVELD PRIORITY AREA AIR QUALITY MANAGEMENT PLAN

FFS Evander is located within the Highveld plateau region of South Africa. The Highveld area is associated with poor air quality and elevated concentrations of trace gas pollutants due to the region having a high concentration of industry, mining, power generation and other non-industrial sources (Held *et al*, 1996 and DEAT, 2006). For this reason, the Minister of Environmental Affairs declared the region a priority area, namely the HPA in November 2007.

The primary motive of the HPA declaration and the HPA Air Quality Management Plan (HPA AQMP) is to achieve and maintain compliance with the national ambient air quality standards across the HPA, using the constitutional principal of progressive realisation of air quality improvements (DEAT, 2007). The HPA AQMP thus allows for the alignment of air quality practices with legal and regulatory requirements to ensure air quality management planning is implemented effectively (DEAT, 2007). As the FFS operations are located within the HPA, the facility is thus required to operate within the air quality requirements of the HPA AQMP.

6.7 LOCAL CLIMATE AND METEOROLOGY

6.7.1 CLIMATIC OVERVIEW

The climate experienced along the south-western coastline and adjacent interior of South Africa is controlled predominantly by subtropical high pressure, with temporary disruptions by low pressure cells or fronts. This high-pressure zone is located along 33°S latitude and is associated with strong divergence at the surface and convergence in the upper atmosphere (Tyson and Preston-Whyte, 2000). **Figure 6-1** shows the predominant macroscale atmospheric circulations over the subcontinent. Easterly waves and lows tend to be summer phenomena, while the westerly wave and lows tend to be autumn to spring phenomena.

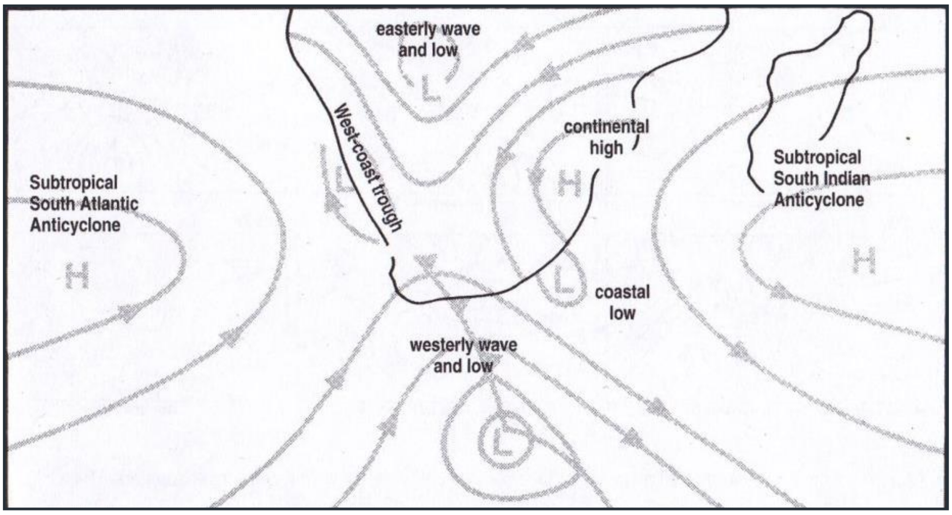


Figure 6-1: South African meteorological phenomena (Tyson and Preston-Whyte, 2000)

Rainfall occurs predominantly in winter and spring over the south-western sector of the country due to the influence of westerly waves. Upper-level divergence and surface-level convergence occurs to the rear of a trough, which causes uplift and cloud formation resulting in precipitation. A surface trough over the west coast and an upper-tropospheric westerly atmospheric wave to the west of the continent can results in widespread rainfall over the western region. During summer, cold fronts associated with these westerly waves migrate further south and thus away from the coast of South Africa, limiting frontal rainfall in the region. While a warm ocean current and onshore winds promote summer rainfall along the east coast of South Africa, the cold Benguela Ocean Current along the west coast of South Africa limits evaporation off the ocean surface (Tyson and Preston-Whyte, 2000). Saldanha consequently has a semi-arid Mediterranean climate of warm, dry summers and cool, wet winters.

Along the coastline, sea and land breeze circulations influence the diurnal wind profile. During the day, the land heats up more rapidly than the ocean surface, which has a higher heat capacity. The warmer air over the land rises causing a low pressure to develop. The cool air over the sea subsides and flows along the pressure gradient, causing a sea-land breeze to develop. The converse is true for night-time conditions, where the air above the land cools due to a lack of insulation, while the air above the sea remains warm. A land-sea breeze will therefore prevail at night.

6.8 METEOROLOGICAL OVERVIEW

Since meteorological conditions affect how pollutants emitted into the air are directed, diluted and dispersed within the atmosphere, the incorporation of reliable data into an air quality assessment is of the utmost importance. Dispersion comprises vertical and horizontal components of motion. The stability of the atmosphere and the depth of the atmospheric mixing layer control the vertical component. The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field. The wind speed determines both the distance of downwind transport and the rate of dilution as the plume 'stretches'. Mechanical turbulence is influence by wind speed in combination with surface roughness.

Parameters that need to be taken into account in the characterisation of dispersion potential include wind speed, wind direction, extent of atmospheric turbulence, ambient air temperature and mixing depth. To accurately represent meteorological conditions at FFS Evander, modelled Weather Research and Forecasting (WRF) meteorological data was obtained for the period January 2021 to December 2023. It must be noted that site-specific data from the nearest weather station (Secunda weather station – 9 km away) indicated poor data recovery (less than 30%) and as such was not used for this assessment. No other weather stations were within close proximity of the site and were deemed relevant for this assessment. The AERMOD-ready WRF dataset was purchased from Lakes Environmental Software. The data coverage is centred over the FFS Evander study area (709251.25 mE, 7068873.75 mS) with a grid cell dimension of 4 km x 4 km over a 50 km x 50 km domain.

The South African National Accreditation System (SANAS, 2012) TR 07-03 standards stipulate a minimum data recovery of 90% for the dataset to be deemed representative of conditions during a particular reporting period. The percentage recovery for parameters recorded is 100 % and is thus considered reliable for use in this assessment.

6.8.1 TEMPERATURE, RAINFALL AND HUMIDITY

Air temperature in any pollutant study is important for assessing the effects of plume buoyancy as well as the development of inversion and mixing layers, while rainfall is an important pollutant removal mechanism. **Figure 6-2** presents the average monthly temperature, rainfall and humidity recorded using modelled WRF meteorological data for the 2021 to 2023 period.

The modelled WRF data exhibits seasonal trends typical for the area. Higher rainfall occurs during the warmer summer months (December, January and February), with drier conditions during cooler winter months (June, July and August). Summer temperatures for the region average at 20.8°C while winter temperatures average at 11.7°C. FFS Evander receives on average 659.5 mm of rainfall annually, with 67% received during summer (December, January and February) and 0.2% during winter (June, July and August).

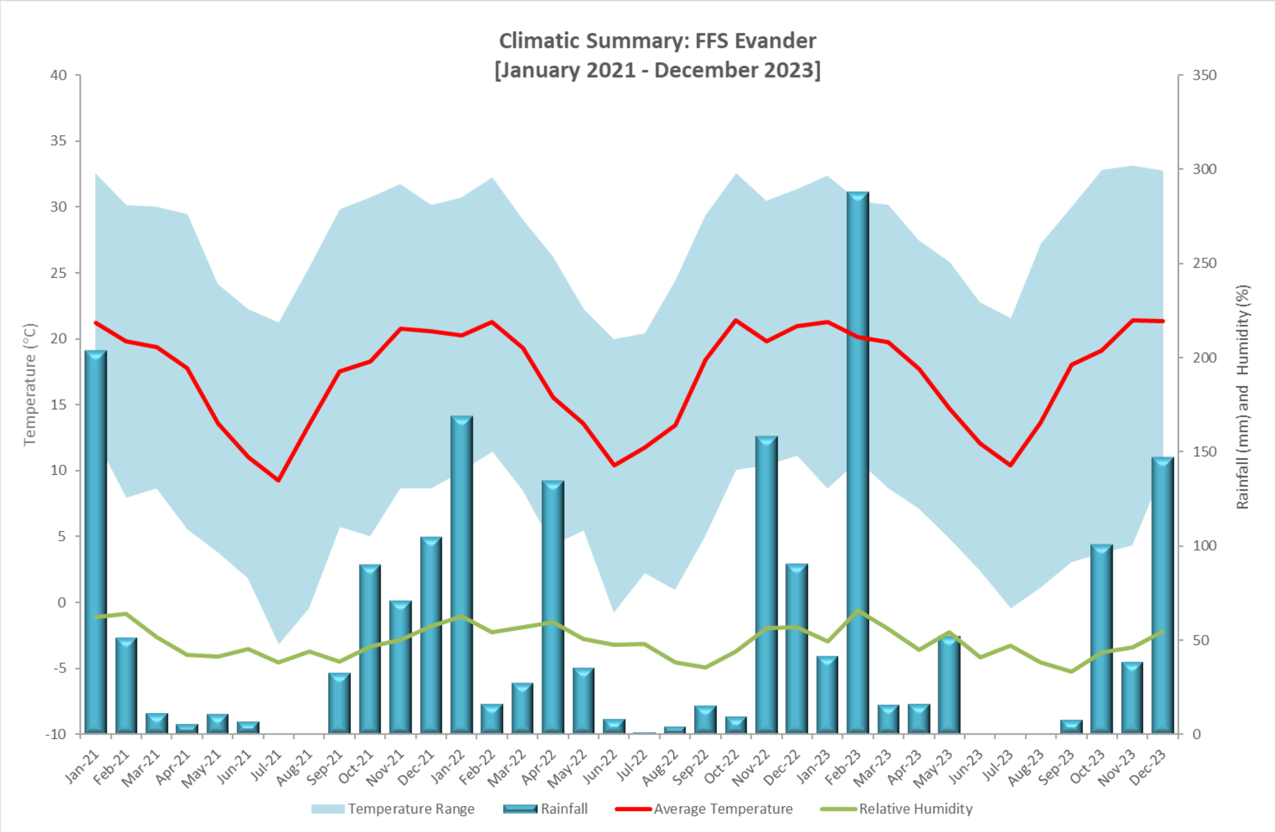


Figure 6-2: Total monthly average temperature, rainfall and humidity (2021 – 2023) at FFS Evander from WRF meteorological data

6.8.2 WIND FIELD

Wind roses summarize wind speed and directional frequency at a location. Calm conditions are defined as wind speeds less than 1.0 m/s. Each directional branch on a wind rose represents wind originating from that direction. Each directional branch is divided into segments of colour, each representative of different wind speeds.

Typical wind fields are analysed for the full period (January 2021 – December 2023); diurnally for early morning (00h00 - 06h00), morning (06h00 - 12h00), afternoon (12h00 - 18h00) and evening (18h00 - 23h00); and seasonally for summer (December, January and February), autumn (March, April and May), winter (June, July and August) and spring (September, October and November) are presented for both sets of data and a comparison provided between the both sets.

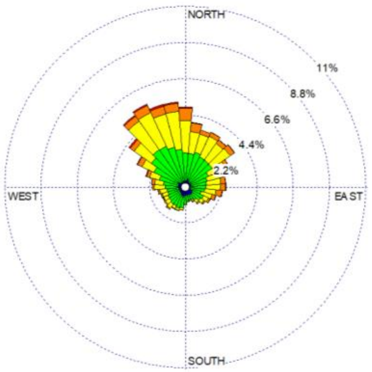
Wind roses from the WRF modelled meteorological data are presented in **Figure 6-3** and are further discussed below.

- Light to strong north-westerly and north-north-westerly winds prevail in the region, with calm conditions occurring 5.2% of the time.
- Northerly winds prevail during the early morning hours (00h00 - 06h00).
- Towards the later morning (06h00 - 12h00) hours, winds shift to a north-north-westerly direction.
- In the afternoon (12h00 - 18h00) and during the night (18h00 - 00h00) north-westerly winds prevail.

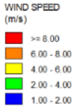
- Winds from the north-east prevail in summer, with a shift in winds to a north-westerly direction in autumn and winter, whilst spring has dominant winds from a north-north-westerly direction.
- The strongest wind speeds were measured during spring.

FFS Evander	**Diurnal**			
Jan 2021 – Dec 2023	00h00 – 06h00	06h00 – 12h00	12h00 – 18h00	18h00 – 00h00

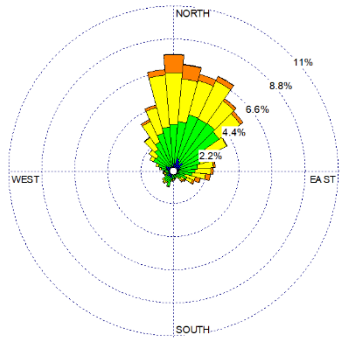
Jan 2021 – Dec 2023



Calms = 5.24%

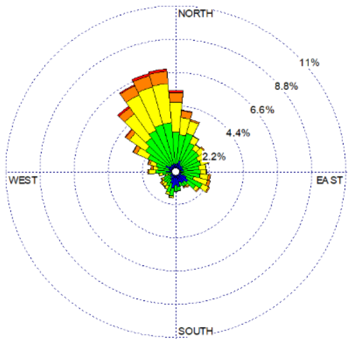


00h00 – 06h00



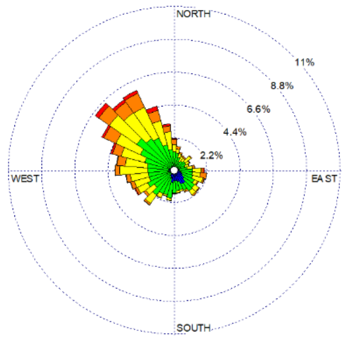
Calms = 5.41%

06h00 – 12h00



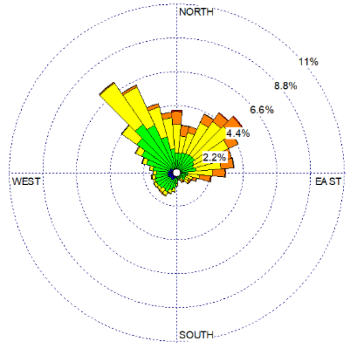
Calms = 7.93%

12h00 – 18h00



Calms = 4.89%

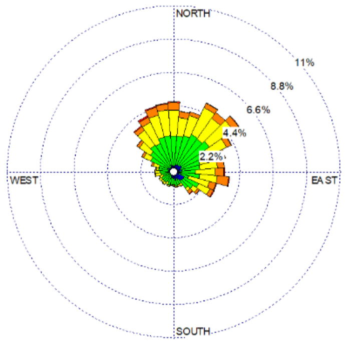
18h00 – 00h00



Calms = 2.35%

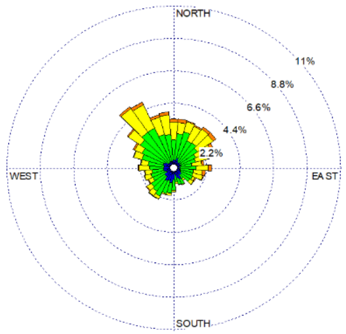
Seasonal			
Summer	Autumn	Winter	Spring

Summer



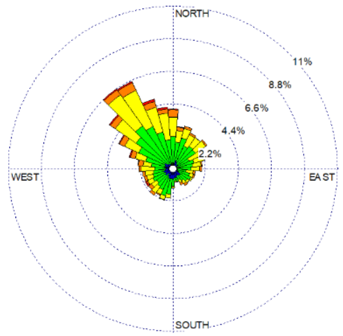
Calms = 4.74%

Autumn



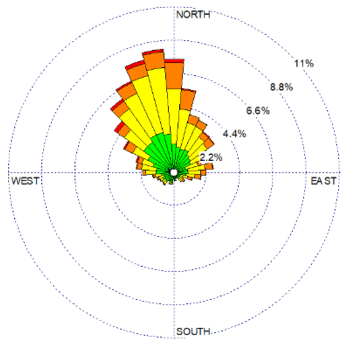
Calms = 7.43%

Winter



Calms = 6.05%

Spring



Calms = 2.70%

Figure 6-3: Local wind conditions for FFS Evander for the period January 2021 to December 2023 using modelled WRF meteorological data

6.9 AIR QUALITY OVERVIEW

6.9.1 REGIONAL AMBIENT AIR QUALITY

Air pollution is the emission of pollutants into the atmosphere that have the potential to cause negative impacts on the environment and human health. Two main factors contributing to air quality issues can be identified and include factors causing a pollutant either to be emitted or formed; and factors causing a pollutant either to be dispersed or removed from the atmosphere.

Driving forces of poor air quality include both anthropogenic and natural processes. Anthropogenic driving forces for example include economic activity, urbanisation, industrial development and population growth. Natural process driving forces for example include climate change, natural disasters and many others.

The FFS Evander operations fall within the HPA and are therefore subject to its AQMP (DEA, 2015). The HPA AQMP was established to help alleviate the large amounts of air pollution that the region was experiencing. Exceedances of PM_{10}, SO_2, NO_2 and O_3 have often been recorded in the pollution hotspots of the eMalahleni, Kriel, Steve Tshwete, Ermelo, Secunda, Ekurhuleni, Lekwa, Balfour and Delmas areas (DEA, 2015). Despite the implementation of the HPA AQMP there continue to be exceedances in:

- PM_{10} and $PM_{2.5}$ in particular, areas proximate to significant industrial operations as well as residential areas where domestic coal burning is occurring.
- SO_2 in eMalahleni, Middelburg, Secunda, Ermelo, Standerton, Balfour, and Komati due to a combination of emissions from the different industrial sectors, residential fuel burning, motor vehicle emissions, mining and cross-boundary transport of pollutants into the HPA adding to the base loading.
- NO_2 in the eMalahleni, Steve Tshwete and Ekurhuleni areas where anthropogenically induced and naturally occurring biomass fires occur throughout the HPA at all times of the year and contribute to NO_2.
- Ozone in Kendal, Witbank, Hendrina, Middelburg, Elandsfontein, Camden, Ermelo, Verkykkop and Balfour thought to be due to biomass burning.

6.10 EXISTING SOURCES OF EMISSIONS

Evander is an industrial area where existing operations and vehicular traffic are likely to contribute to ambient dust, SO_2, NO_2, CO and TVOC concentrations in the area. It is also likely that domestic fuel burning activities will contribute to ambient pollutant concentrations, given the proximity of low-income areas to the facility. According the HPA AQMP, industrial sources are the largest contributor to total annual emissions of PM_{10} (89%), NO_X (90%) and SO_2 (99%).

6.10.1 INDUSTRIAL EMISSIONS

Industrial activities release gaseous and particulate emissions into the atmosphere. The main pollutants released from combustion processes include SO_2, CO, CO_2, NO_X and PM.

The HPA AQMP found industrial emissions to be the most significant contributors to total annual emissions, specifically power generation, mine haul roads, primary metallurgical and petrochemical industry. Power generation contributes 12% PM_{10}, 73% NO_X and 82% SO_2 of total annual emissions within the HPA. Mine haul roads and primary metallurgical industry contribute 49% and 17%, respectively, of total PM_{10} emissions within the HPA. Finally, the petrochemical industry contributes approximately 3% PM_{10}, 15% NO_X and 12% SO_2 to total annual emissions within the HPA.

6.10.2 VEHICLE TAILPIPE EMISSIONS

Atmospheric pollutants emitted from vehicles include hydrocarbons, CO, CO_2, NO_X, SO_2 and particulates. These pollutants are emitted from the tailpipe, from the engine and fuel supply system, and from brake linings, clutch plates and tyres. Hydrocarbon emissions, such as benzene, result from the incomplete combustion of fuel molecules in the engine. Carbon monoxide is a product of incomplete combustion and occurs when carbon in the fuel is only partially oxidized to carbon dioxide. Nitrogen oxides are formed by the reaction of nitrogen and oxygen under high pressure and temperature conditions in the engine. Sulphur dioxide is emitted due to the high sulphur content of the fuel. Particulates, such as lead, originate from the combustion process as well as from brake and clutch linings wear (Samaras and Sorensen, 1999).

The HPA AQMP identified motor vehicles as the third highest contributor to NO_X emissions within the HPA. Motor vehicles were found to contribute approximately 2% PM_{10}, 9% NO_X and 1% SO_2 to total annual emissions.

6.10.3 DOMESTIC FUEL BURNING

Pollutants released from these fuels include CO, NO_2, SO_2, inhalable particulates and polycyclic aromatic hydrocarbons. Particulates are the dominant pollutant emitted from the burning of wood. Smoke from wood burning contains respirable particles that are small enough in diameter to enter and deposit in the lungs. These particles comprise a mixture of inorganic and organic substances including aromatic hydrocarbon compounds, trace metals, nitrates and sulphates. Polycyclic aromatic hydrocarbons are produced as a result of incomplete combustion and are potentially carcinogenic in wood smoke (Maroni *et al.,* 1995). The main pollutants emitted from the combustion of paraffin are NO_2, particulates, carbon monoxide and polycyclic aromatic hydrocarbons.

Domestic fuel burning shows a characteristic diurnal and seasonal signature. Periods of elevated domestic fuel burning, and hence emissions, occurs in the early morning and evening for space heating and cooking purposes. During the winter months, an increase in domestic fuel burning is recorded as the demand for space heating and cooking increases with the declining temperature.

Although a high percentage of households are electrified, the burning of coal and wood for heating and cooking purposes still occurs. Even in electrified areas, households continue to make use of domestic fuels due to high electricity costs and the traditional use of such fuels.

The HPA AQMP found household fuel burning to contribute approximately 6% PM_{10} and 1% NO_X to total annual emissions.

6.11 LOCAL AMBIENT AIR QUALITY

Modderfontein Laboratory Services (Pty) Ltd conducted passive monitoring campaigns at FFS Evander during December 2019 to June 2022. The campaign measured SO_2 and C_6H_6 concentrations, using Radiello™ passive samplers for the selected monitoring period. It is noted that the recommended exposure period was between seven and fourteen days, as per Radiello™ specifications (Sigma-Aldrich Co., 2011). Four Radiello™ passive samplers were positioned along the site fenceline (northern, eastern, southern and western boundaries), while another two were deployed at background locations (Golf Course and Evander High School) (**Table 6-9**).

Table 6-9: Passive sampling location coordinates at FFS Evander

Sample location	Coordinates	
	X (m) (UTM 35S)	Y (m) (UTM 35S)
Perimeter fence West	708988.93	7068773.72
Perimeter fence North	709106.00	7068835.57
Perimeter fence South	709164.74	7068709.67
Perimeter fence East	709183.89	7068784.37
Golf Course	709974.58	7068181.18
Evander High School	709429.33	7069654.92

Resulting concentrations (**Table 6-10**) were conservatively compared against the annual average standards for SO_2 and C_6H_6 in the absence of seven- or fourteen-day standards.

Table 6-10: Passive sampling locations and measurements at FFS Evander

Sample location	Concentration (µg/m^3)	
	SO_2	C_6H_6
Dec-Jan 2019		
Perimeter fence West	5.88	1.97
Perimeter fence North	6.27	3.48
Perimeter fence South	2.31	3.09
Perimeter fence East	2.46	1.37
Golf Course	1.09	0.81
Evander High School	3.45	0.62
Mar-Apr 2019		
Perimeter fence West	6.68	4.58
Perimeter fence North	1.19	5.37
Perimeter fence South	5.9	2.64
Perimeter fence East	3.72	1.47
Golf Course	21.14	0.52
Evander High School	8.25	0.7
Jun-Jul 2019		
Perimeter fence West	2.61	12.2
Perimeter fence North	1.09	98.88
Perimeter fence South	10.58	24.13
Perimeter fence East	2.2	21.1
Golf Course	5.09	1.99
Evander High School	1.19	2.44
Sept-Oct 2019		
Perimeter fence West	4.8	9.22
Perimeter fence North	5.39	32.05
Perimeter fence South	2.72	16.74

Sample location	Concentration (µg/m³)	
	SO_2	C_6H_6
Perimeter fence East	9.35	8.26
Golf Course	0.39	1.47
Evander High School	<0.89	2.2
Dec-Jan 2020		
Perimeter fence West	6.7	2.27
Perimeter fence North	5.63	5.92
Perimeter fence South	3.47	5.68
Perimeter fence East	6.09	2.34
Golf Course	4.36	0.74
Evander High School	2.48	0.81
18 June- 3 July 2020		
Perimeter fence West	9.93	1.81
Perimeter fence North	6.8	3.22
Perimeter fence South	6.32	1.55
Perimeter fence East	9.01	1.83
Golf Course	0.07	1.11
Evander High School	40.63	1.52
3 -17 July 2020		
Perimeter fence West	4.95	1.56
Perimeter fence North	4.76	2.18
Perimeter fence South	5.24	1.53
Perimeter fence East	4.68	1.55
Golf Course	0.07	0.81
Evander High School	0.07	0.95
01-15 March 2021		
Perimeter fence West	4.6	1.9
Perimeter fence North	2.9	1.1
Perimeter fence South	3.6	1.5
Perimeter fence East	3.3	0.8
Golf Course	2.9	0.6
Evander High School	4.3	0.7
15-29 March 2021		
Perimeter fence West	9.5	0.5
Perimeter fence North	7.8	0.7
Perimeter fence South	7.1	0.9
Perimeter fence East	7.7	0.6
Golf Course	6.6	0.1
Evander High School	7.9	0.5
Sept-Oct 2021		

Sample location	Concentration (µg/m³)	
	SO_2	C_6H_6
Perimeter fence West	0.535	0.6
Perimeter fence North	0.165	1.44
Perimeter fence South	0.04	1.115
Perimeter fence East	1.84	0.9
Golf Course	0.255	0.34
Evander High School	0.05	0.87
May-June 2022		
Perimeter fence West	7.03	6.11
Perimeter fence North	7.48	6.11
Perimeter fence South	8.93	24.36
Perimeter fence East	3.93	5.24
Golf Course	6.07	1.14
Evander High School	7.56	1.2

Figure 6-4 shows SO_2 concentrations at different sampling locations during various time periods. For all sampling points, SO_2 concentrations consistently remain below the NAAQS annual limit of 50 µg/m³, indicating compliance with NAAQS standards. The Evander High School experienced the highest SO_2 concentration (40.63 µg/m³) during the 18 June - 3 July 2020 period, although it remained below the annual limit. It also had the highest average concentration (6.98 µg/m³) compared to other sampling locations.

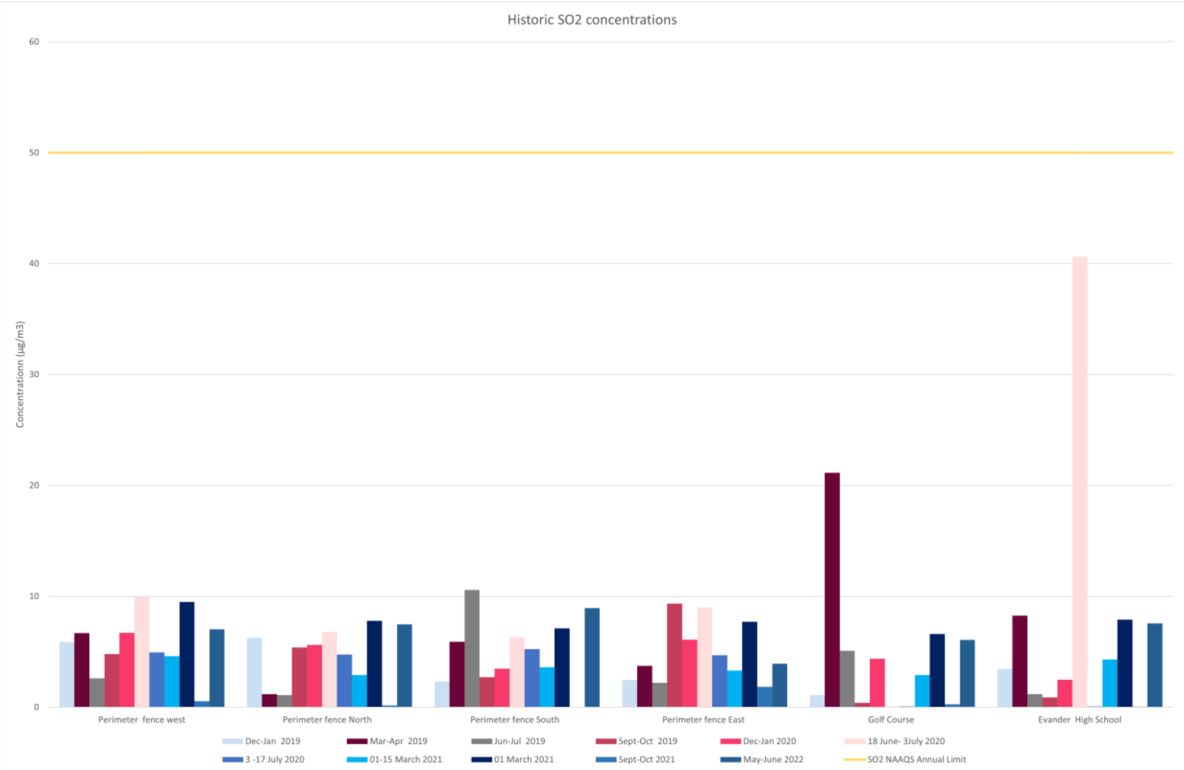


Figure 6-4: SO_2 passive monitoring results for the FSS Evander monitoring locations for December 2019 to June 2022

Figure 6-5 presents the C_6H_6 concentrations at different positions during various periods. For most positions, C_6H_6 concentrations are generally below the NAAQS annual limit, indicating compliance with air quality standards. Perimeter Fence North experienced a high C_6H_6 concentration (98.88 µg/m³) during the Jun-Jul 2019 period, significantly surpassing the annual limit. Additionally, Perimeter fence South and Perimeter fence East also showed increased concentrations during specific periods, but they generally remained within acceptable limits. Furthermore, the Perimeter fence North and Perimeter fence South had the highest average concentrations compared to others for the selected monitoring period.

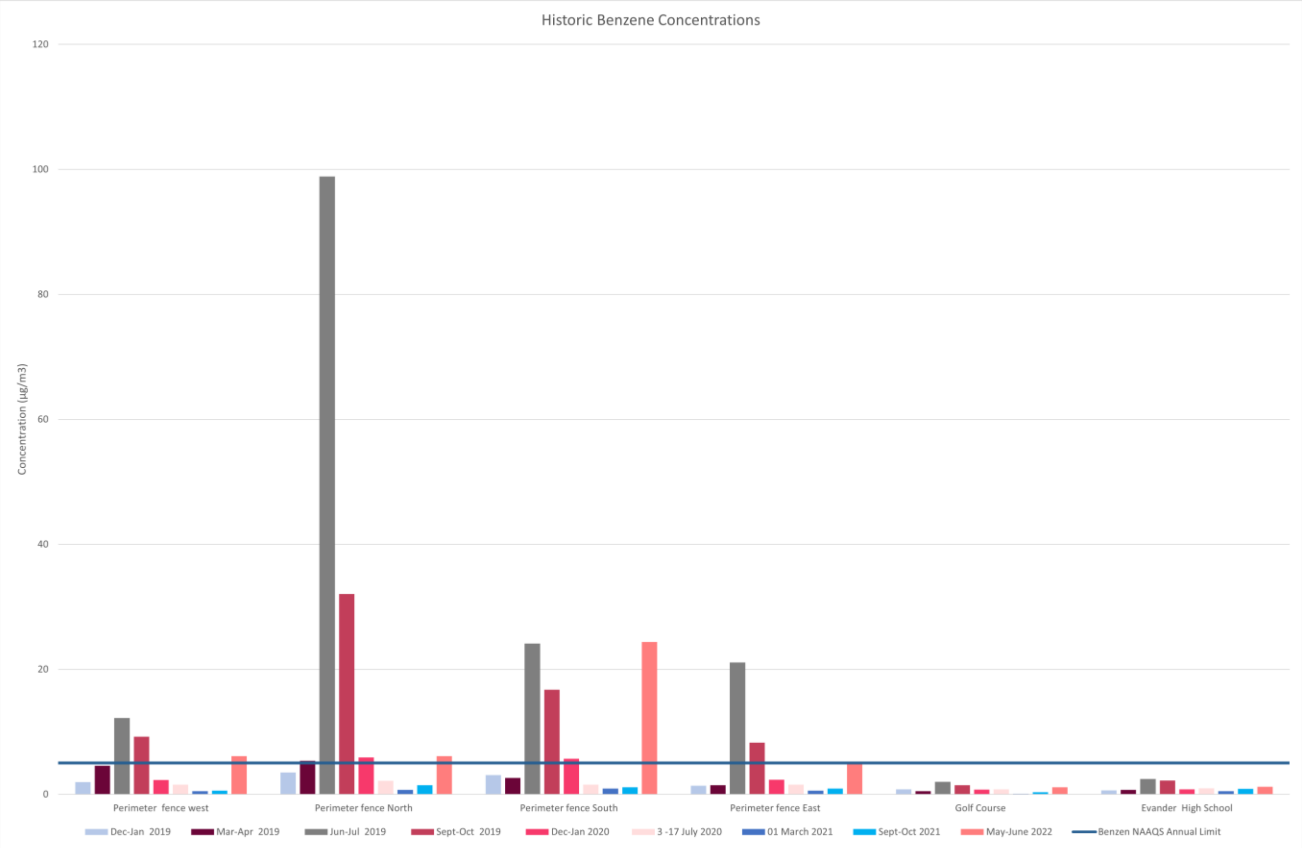


Figure 6-5: C_6H_6 passive monitoring results for the FSS Evander monitoring locations for December 2019 to June 2022

The results presented are derived from a fourteen-day monitoring period and should not be interpreted as annual averages. It is important to note that comparing the measured SO_2/C_6H_6 concentrations over a fourteen-day exposure period with the annual average standard is environmentally conservative. Therefore, it is not possible to rule out exceedances of the NAAQS without a complete year of monitoring data.

7 DISPERSION MODELLING

Atmospheric dispersion modelling mathematically simulates the transport and fate of pollutants emitted from a source into the atmosphere. Sophisticated software with algorithms that incorporate source quantification, surface contours and topography, as well as meteorology can reliably predict the downwind concentrations of these pollutants.

AERMOD, a level two dispersion modelling platform, as recommended in the South African Regulations Regarding Air Dispersion Modelling (Modelling Regulations) (GNR 533 in Government Gazette 37804, dated 11 July 2014), was utilised for this assessment to predict ground level downwind concentrations of pollutants emitted from the mine during the operational phase.

AERMOD is a new generation air dispersion model designed for short-range dispersion of airborne pollutants in steady state plumes that uses hourly sequential meteorological files with pre-processors to generate flow and stability regimes for each hour, that produces output maps of plume spread with key isopleths for visual interpretation and enables, through its statistical output, direct comparisons with the National ambient air quality standards for compliance testing.

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

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

7.1 MODELLING SCENARIOS

Two dispersion modelling simulations were undertaken for the facility:

- Scenario 1: Impacts associated with the existing operations.
- Scenario 2: Impacts associated with the existing and proposed operations (i.e. with waste oil processing taking place).

7.2 MODEL STATISTICAL OUTPUTS

For the purposes of this investigation, various statistical outputs were generated, as described below:

- **Long-term scenario**
  - The long-term scenario refers to an annual average concentration, which is calculated by averaging all hourly concentrations. The calculation is conducted for each grid point within the modelling domain. The long-term concentration for each receptor point is presented in a results table.

- **Short-term scenario**
    - The short-term scenario refers to the 99th percentile concentration. The 99th percentile concentrations are recommended for short-term assessment with the available ambient air quality standards since the highest predicted ground level concentrations can be considered outliers due to complex variability of meteorological processes. This might cause exceptionally high concentrations that the facility may never actually exceed in its lifetime. The 99th percentile results (24-hours) are graphically presented as concentration isopleths, indicating the short-term concentrations at each grid point over a specific period (e.g. annually or over the three-year meteorological period as specified).

As defined in the Modelling Regulations, ambient air quality objectives are applied to areas outside the facility fence line (i.e. beyond the facility boundary). Within the facility boundary, environmental conditions are prescribed by occupational health and safety criteria.

The facility boundary is defined based on:

- The facility fence line or the perimeter where public access is restricted.
- If the facility is located within another larger facility boundary, the facility boundary is the boundary of the encompassing facility.
- If a public access road passes through the facility, the facility boundary is the perimeter along the road allowance.

7.3 METEOROLOGICAL INPUT

The model was run in accordance with guidance issued by the Modelling Regulations. Data input into the model includes modelled WRF surface and upper air meteorological data with wind speed, wind direction, temperature, pressure, precipitation and cloud cover for January 2021 – December 2023, with a 100% data recovery on all variables.

7.4 MODEL DOMAIN AND INPUT PARAMETERS

A modelling domain of 50 km × 50 km was used (**Table 7-1**), with multi-tier Cartesian grid receptor spacing's of 100 m and 250 m. The grid spacing selected for the receptor grid is in accordance with those specified in the Modelling Regulations. Data describing the topography of the local area was obtained from the Shuttle Radar Topography Mission (SRTM) 1 Arc-Second Global elevation data that offers worldwide coverage of void filled data at a resolution of 1 arc-second (30 meters).
Table 7-1 and

Table 7-2 presents these model domain input parameters utilised in this assessment.

Table 7-1: Modelling Domain coordinates

Domain Point	X (m) (UTM 35S)	Y (m) (UTM 35S)
North-Western Point	684341.13	7093856.15
North-Eastern Point	734238.35	7093856.15
South-Western Point	684341.13	7043740.07
South-Eastern Point	734238.35	7043740.07

Table 7-2: Dispersion model input parameters

Parameter	Model Input
Model	
Assessment Level	Level 2
Dispersion Model	Aermod 10.2.1
Supporting Models	AERMET and AERMAP
Emissions	
Pollutants modelled	VOCs, C_6H_6, CO and SO_2
Scenarios	Scenario 1 and 2
Chemical transformation	N/A
Exponential decay	N/A
Settings	
Terrain setting	Elevated
Terrain data	SRTM1/SRTM3
Terrain data resolution (m)	30
Land characteristics (bowen ratio, surface albedo, surface roughness)	Urban
Grid Receptors	
Modelling domain (km)	50 x 50
Property line resolution (m)	50
Fine grid resolution (m)	100
Medium grid resolution (m)	250
Course grid resolution (m)	N/A

7.5 SENSITIVE RECEPTOR IDENTIFICATION

Sensitive receptors are defined by the USEPA as areas where occupants are more susceptible to the adverse effects of exposure to pollutants. These areas include but are not limited to residential areas, hospitals/clinics, schools and day care facilities and elderly housing. The sensitive receptors identified in the area surrounding FFS Evander are presented in **Table 7-3** and **Figure 7-1**.

Table 7-3: Sensitive receptors identified for FFS Evander

Receptors	X (UTM 35S)	Y (UTM 35S)	Distance from site (m)	Direction from site
Evander High School	709429.78	7069633.96	1 230	N
Evander (residential area)	709537.98	7069366.31	992	NNE
Walker Park Golf Course	709606.32	7068939.20	415	NE
Walker Park Golf Course (west boundary)	709446.87	7068637.37	240	SE
Brendan (residential area)	703832.55	7067693.15	5 251	W
eMbalenhle (residential area)	708073.85	7065155.98	3 747	SSW
Newtown (residential area)	711664.17	7066499.84	3 175	SE
Secunda (residential area)	716467.39	7066743.83	8 215	ESE
Kinross (residential area)	709896.76	7075581.51	6 687	N

Figure 7-1: Sensitive receptor locations for the FSS Evander facility

8 RESULTS AND DISCUSSION

This section presents the predicted results of the atmospheric dispersion modelling conducted for the FFS operations. Concentration results at specified sensitive receptors and the highest predicted offsite (beyond the site boundary) concentrations are presented in tabular format, while concentration isopleths (for the FFS operations only) are presented graphically to indicate the dispersion of pollutants.

8.1 SULPHUR DIOXIDE

Table 8-1 presents the predicted annual average, daily P99 and hourly P99 SO_2 concentrations for the FFS Evander facility at the receptor locations and at the highest offsite concentration. Ambient SO_2 concentrations are predicted to be compliant beyond the site boundary and at all sensitive receptors with the annual average, daily P99 and hourly P99 SO_2 standards of 350 µg/m^3, 125 µg/m^3 and 50 µg/m^3 respectively, for each model scenario (**Figure 8-1 to Figure 8-3**).

Importantly there is no change in concentrations from Scenario 1 to Scenario 2.

Table 8-1: Predicted SO_2 concentrations at surrounding receptors

Receptors	SO_2 Concentrations (µg/m^3)		
	Annual Average	P99 24-hour Average	P99 1-hour Average
Scenario 1 and 2:			
Evander High School	0.51	5.10	12.47
Evander (residential area)	0.75	6.68	15.35
Walker Park Golf Course	1.04	6.45	15.64
Walker Park Golf Course (west boundary)	2.55	11.72	24.82
Brendan	0.06	0.36	1.06
eMbalenhle	0.13	0.62	2.15
Newtown	0.15	0.91	2.47
Secunda	0.03	0.24	0.73
Kinross	0.03	0.32	0.78
Highest offsite concentration	5.34	18.49	31.66

Figure 8-1: Predicted annual average SO_2 concentrations for Scenario 1 and Scenario 2 at the FFS Evander facility

Figure 8-2: Predicted 24-hour average SO_2 concentrations for Scenario 1 and Scenario 2 at the FFS Evander facility

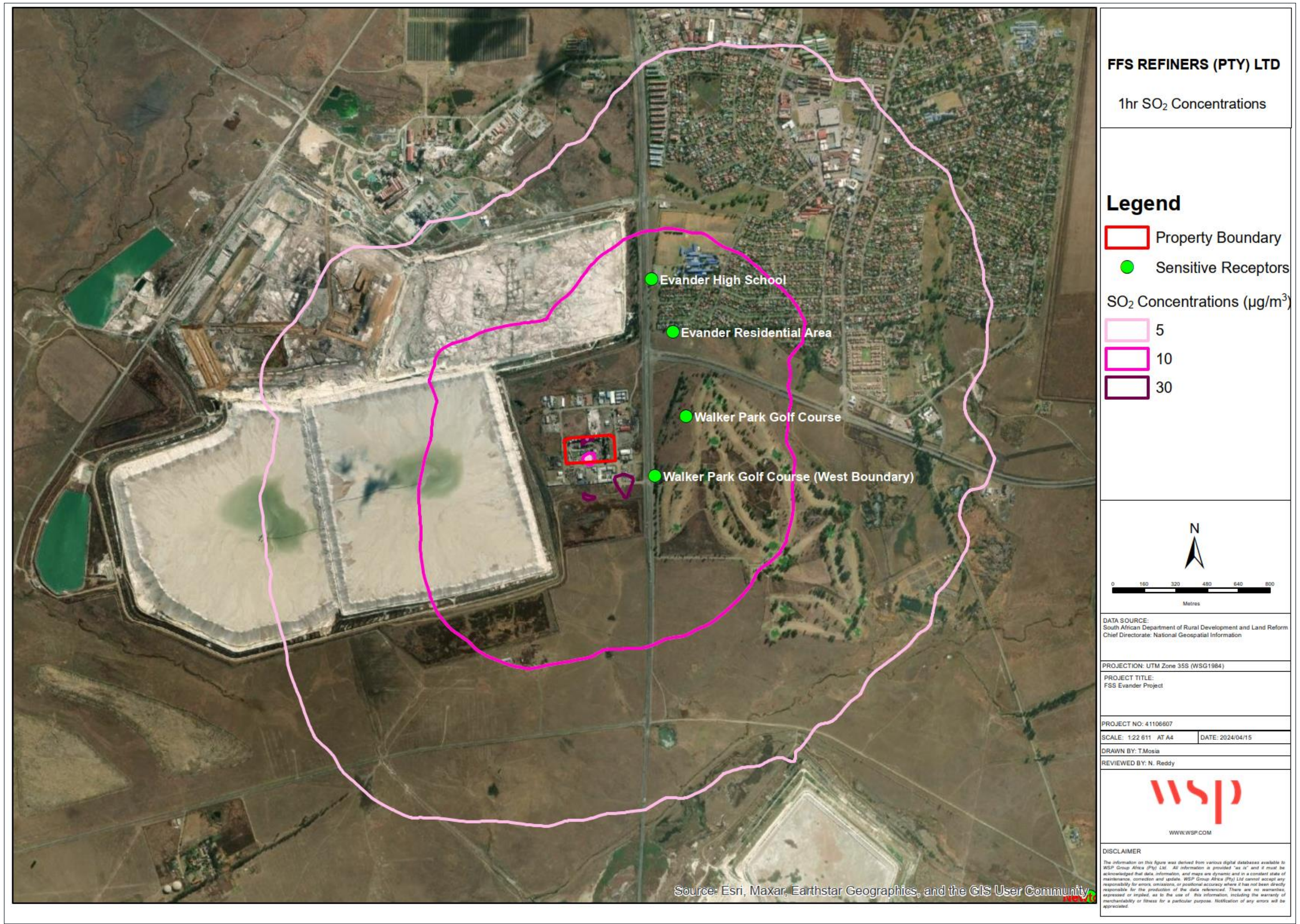


Figure 8-3: Predicted 1-hour average SO_2 concentrations for Scenario 1 and Scenario 2 at the FFS Evander facility

8.2 CARBON MONOXIDE

Table 8-2 presents the predicted P99 8-hourly and hourly CO concentrations for the FFS Evander facility at the receptor locations and at the highest offsite concentration. Ambient CO concentrations are predicted to be compliant beyond the site boundary and at all sensitive receptors with the 8-hourly and hourly CO standards of 10 000 µg/m^3 and 30 000 µg/m^{3,} respectively, for each scenario (**Figure 8-4** and **Figure 8-5**).

Importantly there is no change in concentrations from Scenario 1 to Scenario 2.

Table 8-2: Predicted CO concentrations at surrounding receptors

Receptors	CO Concentrations (µg/m^3)	
	P99 8-hour Average	P99 1-hour Average
Scenario 1 and 2:		
Evander High School	2.26	3.61
Evander (residential area)	2.73	4.38
Walker Park Golf Course	3.00	4.76
Walker Park Golf Course (west boundary)	5.17	7.56
Brendan	0.19	0.31
eMbalenhle	0.32	0.62
Newtown	0.39	0.68
Secunda	0.12	0.22
Kinross	0.15	0.23
Highest offsite concentration	27.61	41.27

Figure 8-4: Predicted 8-hour average CO concentrations for Scenario 1 and Scenario 2 at the FFS Evander facility

Figure 8-5: Predicted 1-hour average CO concentrations for Scenario 1 and Scenario 2 at the FFS Evander facility

8.3 VOLATILE ORGANIC COMPOUNDS

Table 8-3 presents the predicted annual average VOC concentrations for the FFS Evander facility at the receptor locations and at the highest offsite concentration.

Ambient VOC concentrations are predicted to be compliant beyond the site boundary and at all sensitive receptors with the annual C_6H_6 standard of 5 µg/m, for each model scenario (**Figure 8-6**), with slightly higher concentrations noted in Scenario 2.

Importantly, given that the C_6H_6 standard is the most stringent standard for VOCs, VOCs have thus been compared to the annual standard of C_6H_6.

Table 8-3: Predicted VOC concentrations at surrounding receptors

Receptors	VOC Annual Average Concentrations (µg/m^3)		Change in Concentrations (µg/m^3)
	Scenario 1	Scenario 2	
Evander High School	0.100	0.109	0.009
Evander (residential area)	0.164	0.180	0.016
Walker Park Golf Course	0.331	0.363	0.032
Walker Park Golf Course (west boundary)	0.693	0.762	0.069
Brendan	0.006	0.007	0.001
eMbalenhle	0.014	0.015	0.001
Newtown	0.015	0.017	0.002
Secunda	0.004	0.004	0
Kinross	0.003	0.003	0
Highest offsite concentration	3.50	3.74	0.24

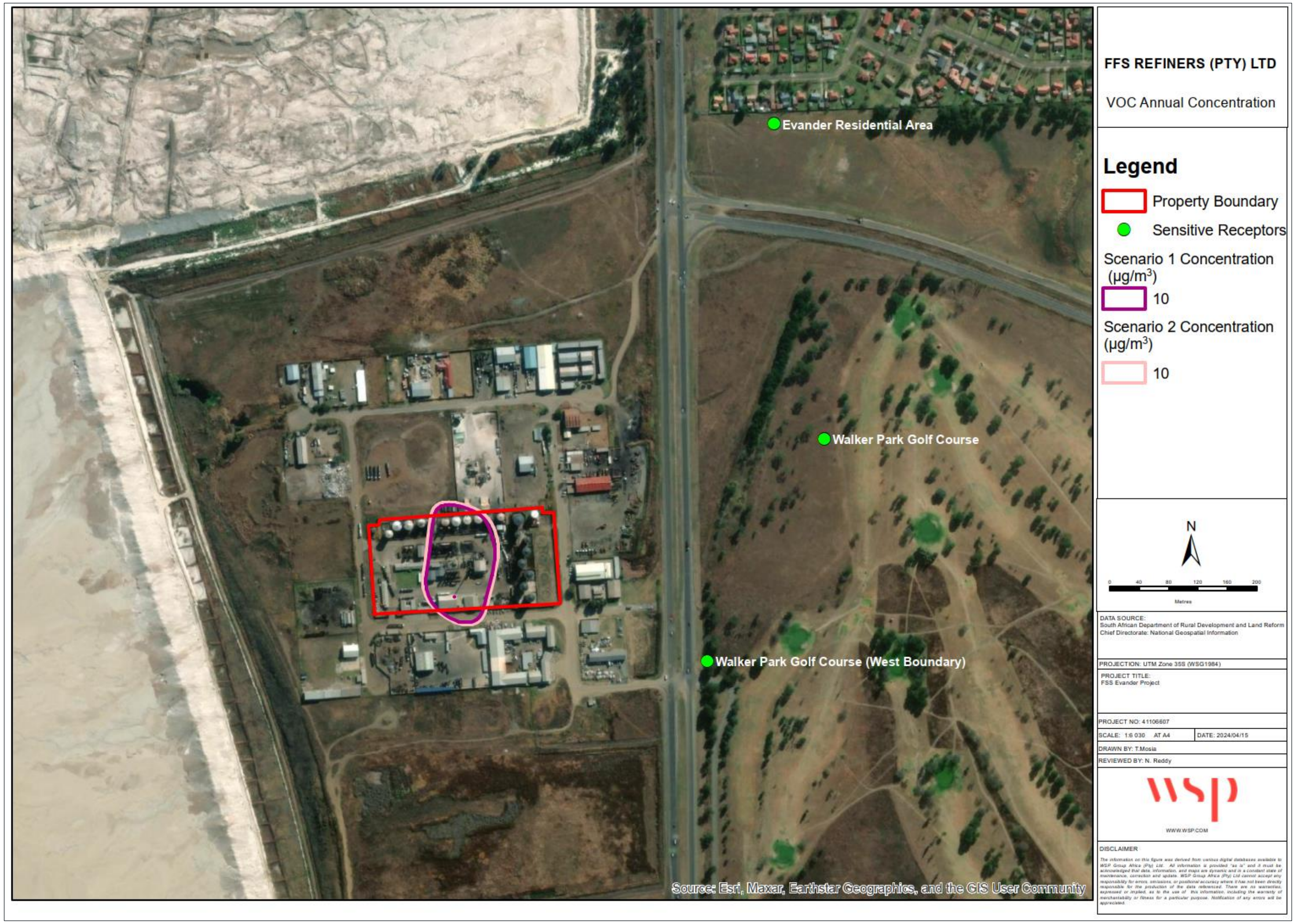


Figure 8-6: Predicted annual average VOC concentrations for Scenario 1 and Scenario 2 at the FFS Evander facility

8.4 BENZENE

Table 8-4 presents the predicted annual average C_6H_6 concentrations for the FFS Evander facility at the receptor locations and at the highest offsite concentration. Ambient C_6H_6 concentrations are predicted to be compliant beyond the site boundary and at all sensitive receptors with the annual C_6H_6 standard of 5 µg/m^3, for each model scenario, with slightly higher concentrations noted in Scenario 2 (**Figure 8-7**).

Table 8-4: Predicted C_6H_6 concentrations at surrounding receptors

Receptors	C_6H_6 Annual Average Concentrations (µg/m^3)		Change in Concentrations (µg/m^3)
	Scenario 1	Scenario 2	
Evander High School	2.00E-05	1.10E-04	9.00E-05
Evander (residential area)	4.00E-05	1.80E-04	1.40E-04
Walker Park Golf Course	7.00E-05	3.60E-04	2.90E-04
Walker Park Golf Course (west boundary)	1.40E-04	7.60E-04	6.20E-04
Brendan	0	1.00E-05	1.00E-05
eMbalenhle	0	2.00E-05	2.00E-05
Newtown	0	2.00E-05	2.00E-05
Secunda	0	0	0
Kinross	0	0	0
Highest offsite concentration	4.6E-04	3.74E-03	3.28E-03

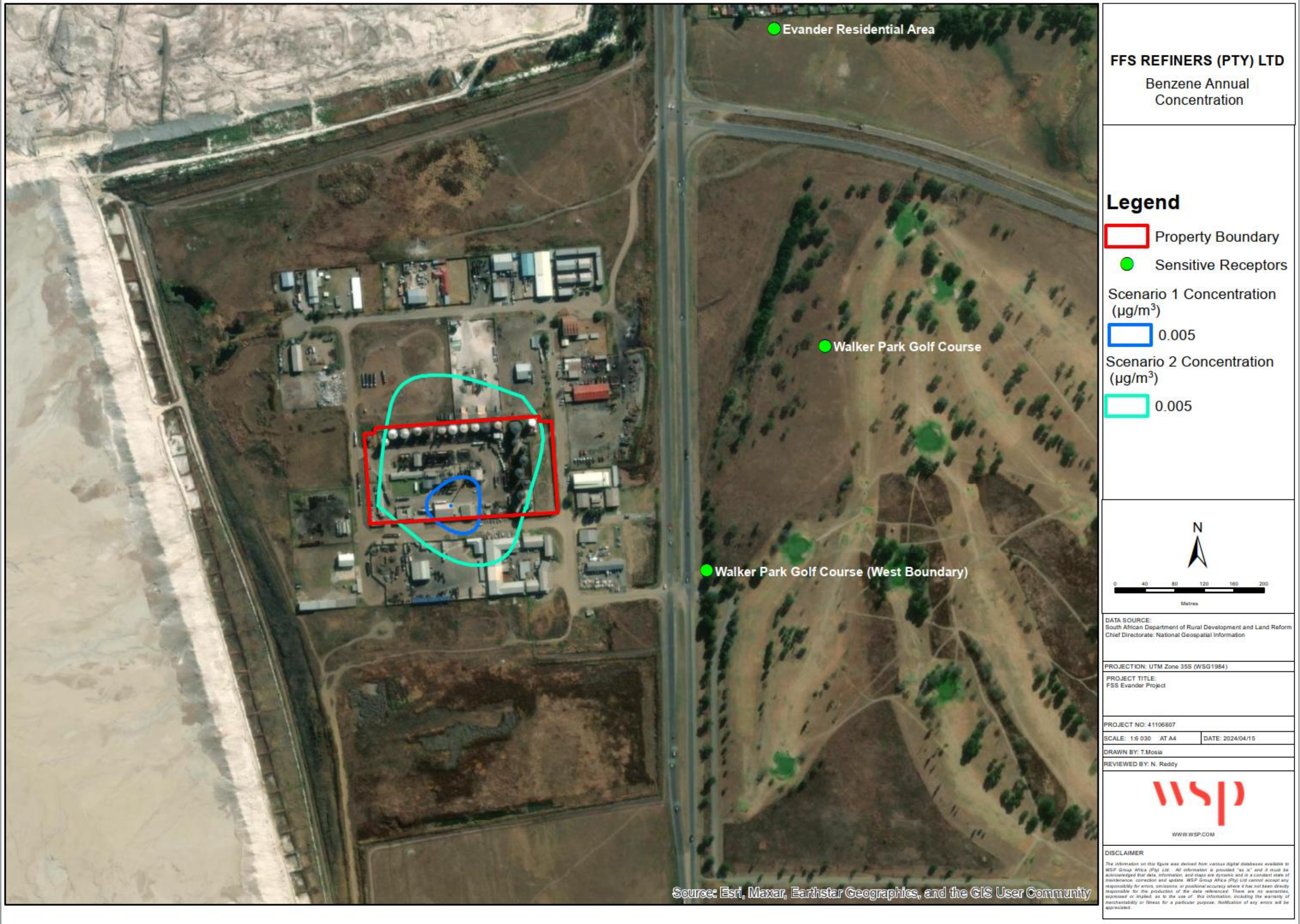


Figure 8-7: Predicted annual average C_6H_6 concentrations for Scenario 1 and Scenario 2 at the FFS Evander facility

8.5 CUMULATIVE IMPACTS

The National Framework for Air Quality Management in South Africa calls for air quality assessment in terms of cumulative impacts rather than the contributions from an individual facility. Compliance with the NAAQS is to be determined by considering all local and regional contributions to background concentrations. For each averaging time, the sum of the model predicted concentration (C_P) and the background concentration (C_B) must be compared with the NAAQS. The background concentrations C_B must be the sum of contributions from non-modelled local sources and regional background air quality. If the sum of background and predicted concentrations (C_B + C_P) is more than the NAAQS, the design of the facility must be reviewed (including pollution control equipment) to ensure compliance with NAAQS. Compliance assessments must provide room for future permits to new emissions sources, while maintaining overall compliance with NAAQS. For the different facility locations and averaging times, the comparisons with NAAQS must be based on recommendations in **Table 8-5**.

Table 8-5: Summary of recommended procedures for assessing compliance with NAAQS

Facility Location	Annual NAAQS	Short-term NAAQS (24 hours or less)
Isolated facility not influenced by other sources, C_B insignificant*.	Highest C_P must be less than the NAAQS, no exceedances allowed.	99th percentile concentrations must be less than the NAAQS. Wherever one year is modelled, the highest concentrations shall be considered.
Facilities influenced by background sources e.g. in urban areas and priority areas.	Sum of the highest C_P and background concentrations must be less that the NAAQS, no exceedances allowed.	Sum of the 99th percentile concentrations and background CB must be less than the NAAQS. Wherever one year is modelled, the highest concentrations shall be considered.
*For an isolated facility influenced by regional background pollution C_B must be considered.		

Existing background concentrations were not used to assess the cumulative impact of the FFS Evander facility as inclusion of any baseline data would essentially double account for emissions from the FFS Facility (in the background measurements and the inputted emission rates).

8.6 ASSUMPTIONS

In this AIR, various assumptions were made that may impact on the results obtained. These assumptions include:

- The operational information provided by the Client is assumed to be correct and accurate.
- The modelled meteorological data is representative of the prevailing meteorological conditions in the area.
- Physical parameters and emission rates for each stack were sourced from the Modderfontein Laboratory Services Stack Testing 2024 Reports. The point sources are assumed to operate continuously in Scenario 1 and Scenario 2. Important to note is that the dry scrubber 2 and wet scrubber 2 are not operational currently and have been excluded from this assessment. Additionally, boiler 7 no longer exists, and has been excluded from this assessment.
- Emission estimates for FFS Evander were based on the USEPA emissions fact sheet for idling vehicle emissions (EPA, 1998).

- Fugitive VOC and C_6H_6 emissions were estimated for all tanks using the USEPA TANKS 4.09d (TANKS) model and were deemed representative of the facility.

9 MITIGATION AND MONITORING MEASURES

Although concentrations are considered to be low, the following mitigation measures should be maintained, as discussed below:

- Maintaining stable tank pressure and vapour space:
  - All tank lines should remain charged (i.e. liquid full), and only emptied for maintenance or product change.
  - Coordinating filling and withdrawal schedules and implementing vapour balancing between tanks (a process whereby vapour displaced during filling activities is transferred to the vapour space of the tank being emptied or to other containment in preparation for vapour recovery).
  - Thermal relief valves should be present to protect the pipes against overpressure due to solar heating.
  - Reducing breathing losses by using white or other reflective colour paints with low heat absorption properties on the exteriors of storage tanks for lighter distillates or by insulating tanks.
- Use of bottom loading truck/rail car filling systems.
- The annual fugitive emissions survey should be ongoing, and pipes, pumps, tanks must be maintained through the central maintenance management system to reduce fugitive emissions.
- The quantity of vapour in an air-and-vapour mixture can be measured by means of a gas detector. Gas detector scales are graduated from 0 to 100, their graduation being based on the lower limit of flammability of 1 %. A reading of 50 indicates 50 % of the lower limit of flammability (i.e. the mixture contains 0,5 % of vapour), and a reading of 20 on that scale indicates 0,2 % of vapour (SANS 10089-1).
- The instrument used for recording the concentration of this vapour should be of an approved design and shall be regularly calibrated and tested for accuracy.
- During tank cleaning, the following should be observed:
  - Tanks should be periodically inspected internally. An inspection frequency based on the condition of the tank at the previous internal inspection should be established (typically 10 years or less).
- During the operational phase, benzene, toluene, ethylbenzene and xylene (BTEX), SO_2 and NO_2 passive monitoring campaign should be ongoing.
- During the operational phase, stack emissions testing should be ongoing on an annual basis.

10 CONCLUSION

This report presents the findings from the AIR, using a Level two dispersion model (AERMOD) to predict the potential air quality impacts associated with the facility.

As part of the AIR, a baseline assessment was undertaken that included a review of available meteorological data and an evaluation of the current ambient air quality situation.

To accurately represent meteorological conditions at FFS Evander, modelled WRF meteorological data was obtained for the period January 2021 to December 2023. It must be noted that site specific data from the nearest weather station (Secunda weather station – 9 km away) indicated poor data recovery (less than 30%) and as such was not used for this assessment. No other weather stations were within close proximity of the site and were deemed relevant for this assessment.

Potential impacts were quantified through the compilation of an emissions inventory and subsequent dispersion modelling simulations. The key pollutants associated with the facility are SO_2, CO and VOCs, with specific reference to C_6H_6. Where available, emission rates were provided for point sources by the Client. Fugitive tank emissions were estimated using the USEPA TANKS 4.09d model (TANKS), while vehicle exhaust emissions were estimated using the USEPA Emissions Fact Sheet for Idling Vehicles. Emission rates were used as input for a Level 2 dispersion model, AERMOD, together with modelled meteorological WRF data. Predicted ambient SO_2, CO and VOC concentrations were compared with the available NAAQS to determine the potential for human health impacts. Since C_6H_6 is the only VOC regulated under NAAQS, predicted VOC concentrations were conservatively compared with the annual average C_6H_6 standard.

Emissions were assessed with respect to two dispersion modelling scenarios for the facility:

- Scenario 1: Impacts associated with the existing operations.
- Scenario 2: Impacts associated with the existing and proposed operations (i.e. with waste oil processing taking place).

All ambient pollutant concentrations were predicted to be compliant beyond the site boundary and at all sensitive receptors for all relevant averaging periods and for each model scenario. Furthermore, it was noted that there were minimal changes in concentrations between Scenario 1 and Scenario 2. Although, concentrations are considered to be low, various mitigation measures are recommended to be maintained.

11 ANALYSIS OF EMISSIONS' IMPACT ON THE ENVIRONMENT

As pollutants disperse into the air, workers and people close to the source might be exposed directly through inhalation, or indirectly through consumption of food or water contaminated by deposition of the pollutants to soil and vegetation (NRC, 2000). Others can be exposed through a different mix of environmental pathways after the particles travel some distance in the atmosphere. This includes, going through various chemical and physical transformations, or passing through soil, water, or food. Inhalation has shown to be the most direct path for exposure to pollutants emitted from stacks and dispersed into the atmosphere. However, the combination of long-range transport, deposition, and uptake of the pollutants by the food chain, appears to be a significant mode of exposure (NRC, 2000).

11.1 EFFECTS ON VEGETATION

Air pollution in South Africa was first identified as a potential threat to vegetation in 1988 (Tyson *et al*., 1988). The commercial forests of the eastern escarpment were highlighted as a threatened resource due to their proximity to the heavily industrialised Highveld. Marshal *et al.,* (1998) also identified concerns around the potential impacts on crop yields on the Highveld. Air pollutants that could impact on vegetation include PM, SO_2, O_3, NO_x and hydrogen fluoride (HF).

The effects of pollution on plants include mottled foliage, 'burning' at leaf tips or margins, twig dieback, stunted growth, premature leaf drop, delayed maturity, abortion or early drop of blossoms, and reduced yield or quality. In general, the visible injury to plants is of three types: (1) collapse of leaf tissue with the development of necrotic patterns, (2) yellowing or other colour changes, and (3) alterations in growth or premature loss of foliage (Sikora and Chappelka, 2004).

Factors that govern the extent of damage and the region where air pollution is a problem are (1) type and concentration of pollutants, (2) distance from the source, (3) length of exposure, and (4) meteorological conditions. Other important factors are city size and location, land topography, soil moisture and nutrient supply, maturity of plant tissues, time of year, and species and variety of plants. A soil moisture deficit or extremes of temperature, humidity, and light often alter a plant's response to an air pollutant (Sikora and Chappelka, 2004).

11.2 EFFECTS ON ANIMALS

Air pollution is a recognized health hazard to domestic animals and wildlife. Industrial air pollutants effect both wild birds and mammals, causing notable decreases in local populations (Newman, 1979). The major effects include direct mortality, debilitating injury and disease, stress, anaemia, and bioaccumulation (Newman, 1979). Certain air pollutants are also known to cause variation in the distribution of certain wildlife species (Schreiber, and Newman, 1988). Animals are typically exposed to air pollution through a) inhalation of gases or small particles, b) ingestion of particles suspended in food or water, or c) absorption of gases through the skin (Burdo, 2018). Soft-bodied invertebrates (such as earthworms), or animals with thin, moist skin (such as amphibians) are the most susceptible to absorption of pollutants. Individual responses to pollutants are dependent on the type of pollutant involved, the duration and time of exposure, and the concentration taken up by the animal (Wong and Candolin, 2015). The individual's age, sex, health, and reproductive condition also determines its response. There is much variability observed between animal classes, species, and even genotypes, in terms of the level of tolerance to a specific pollutant (Wong and Candolin, 2015).

12 COMPLAINTS

No complaints have been received to date.

13 CURRENT OR PLANNED AIR QUALITY MANAGEMENT INTERVENTIONS

There are no other current or planned air quality management interventions to date.

14 COMPLIANCE AND ENFORCEMENT ACTIONS

No compliance and enforcement actions have been received to date as the development is not yet operational.

15 ADDITIONAL INFORMATION

No additional information is required.

16 FORMAL DECLARATIONS

16.1 ANNEXURE A: DECLARATION OF ACCURACY OF INFORMATION

DECLARATION OF ACCURACY OF INFORMATION - APPLICANT

Name of Enterprise: FFS Refiners (Pty) Ltd, Evander

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

16.2 ANNEXURE B: DECLARATION OF INDEPENDENCE OF PRACTITIONER

DECLARATION OF INDEPENDENCE - PRACTITIONER

Name of Practitioner: Kirsten Collett

Name of Registration Body: South African Council for Natural Scientific Professions (SACNASP)

Professional Registration No:

Declaration of independence and accuracy of information provided:

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

I, ___________________, 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 on this _______ day of .

____

SIGNATURE

____

CAPACITY OF SIGNATORY

17 REFERENCES

- Department of Environmental Affairs (2014): The Regulations Regarding Air Dispersion Modelling, Notice 533 of 2014 (Government Gazette 37804).
- Republic of South Africa, Government Notice 1210 (2009), Government Gazette 32816: National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), National Ambient Air Quality Standards.
- Republic of South Africa, Government Notice 827 (2013), Government Gazette 36974: National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), National Dust Control Regulations.
- Republic of South Africa, Government Notice 533 (2014), Government Gazette 37804: National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), Regulations Regarding Air Dispersion Modelling.
- Tyson, P. D., Kruger, F. J., and Louw, C. W. (1988). Atmospheric pollution and its implications in the Eastern Transvaal Highveld. National Scientific Programmes Unit: CSIR.
- Tyson, P.D. & Preston-Whyte, R.A. (2000). The Weather and Climate of Southern Africa, 2nd Ed, Oxford University Press Southern Africa, Cape Town.
- United States Environmental Protection Agency (USEPA, 1983). Compilation of Air Pollutant Emission Factors, AP-42, Third Edition. Supplement 14. United States Environmental Protection Agency, Office of Air and Radiation, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, 27711.
- United States Environmental Protection Agency (USEPA, 1988). Supplement B to Compilation of Air Pollutant Emission Factors, AP-42, Fourth Edition, United States Environmental Protection Agency, Office of Air and Radiation Office of Air Quality Planning and Standards, North Carolina.
- United States Environmental Protection Agency (USEPA) (2011): Health Effects of Pollution. Available online at: http://www.epa.gov/region07/air/quality/health.htm.
- United States Environmental Protection Agency (USEPA) (2011): Emissions Factors & AP 42, Compilation of Air Pollutant Emission Factors. Available online at: http://www.epa.gov/ttn/chief/ap42/index.html#toc.

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