

10.4 The Specialist

Note: Duplicate this section where there is more than one specialist.

Yakeen Kowlas

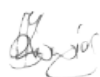
I, as the appointed specialist hereby declare/affirm the correctness of the information provided as part of the application, and that I:

- in terms of the general requirement to be independent (tick which is applicable):

X	other than fair remuneration for work performed/to be performed in terms of this application, have no business, financial, personal or other interest in the activity or application and that there are no circumstances that may compromise my objectivity; or
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	am not independent, but another EAP that is independent and meets the general requirements set out in Regulation 13 has been appointed to review my work (Note: a declaration by the review specialist must be submitted);
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- have expertise in conducting specialist work as required, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- will ensure compliance with the EIA Regulations 2014;
- will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the application;
- will take into account, to the extent possible, the matters listed in regulation 18 of the regulations when preparing the application and any report, plan or document relating to the application;
- will disclose to the proponent or applicant, registered interested and affected parties and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority or the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority (unless access to that information is protected by law, in which case I will indicate that such protected information exists and is only provided to the competent authority);
- declare that all the particulars furnished by me in this form are true and correct;
- am aware that it is an offence in terms of Regulation 48 to provide incorrect or misleading information and that a person convicted of such an offence is liable to the penalties as contemplated in section 49B(2) of the National Environmental Management Act, 1998 (Act 107 of 1998).



Yakeen
Kowlas

Signature of the specialist

WSP Group Africa (Pty) Ltd

Name of company

21 July 2025

Date



10.5 The Review Specialist

Olivia Allen

I, as the appointed review specialist hereby declare/affirm the correctness of the information provided or to be provided as part of the application, and that I:

- am independent, and other than fair remuneration for work performed in terms of this application, have no business, financial, personal or other interest in the activity or application and that there are no circumstances that may compromise my objectivity;
- am fully aware of and meet all of the requirements of Regulation 13, and that failure to comply with any the requirements may result in disqualification;
- have reviewed/will review all the work undertaken by the specialist;
- have disclosed/will disclose, to the applicant, the EAP, other specialist (if any), the Department and interested and affected parties, all material information that have or may have the potential to influence the decision of the Department or the objectivity of any report, plan or document prepared or to be prepared as part of the application; and
- am aware that a false declaration is an offence in terms of regulation 48 of the 2014 NEMA EIA Regulations.

Signature of the review specialist

WSP Group Africa (Pty) Ltd

Name of company

21 July 2025

Date





MCCAIN FOODS (PTY) LTD

ATMOSPHERIC IMPACT REPORT

PROPOSED DELMAS WASTEWATER
TREATMENT PLANT AND EXPANSION OF
DIESEL STORAGE





MCCAIN FOODS (PTY) LTD

ATMOSPHERIC IMPACT REPORT

**PROPOSED DELMAS WASTEWATER TREATMENT
PLANT AND EXPANSION OF DIESEL STORAGE**

REPORT (VERSION 01) CONFIDENTIAL

PROJECT NO. 41107366

DATE: FEBRUARY 2026

WSP

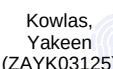
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ABBREVIATIONS

AEL	Atmospheric Emissions Licence
NH ₃	Ammonia
AIR	Atmospheric Impact Report
AQO	Air Quality Officer
AQMS	Air Quality Monitoring Station
AQMP	Air Quality Management Plan
BA	Basic Assessment
C _B	Background concentration
C _P	Model predicted concentration
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DFFE	Department of Fisheries, Forestry and the Environment
ESL	Effects Screening Levels
EU	Emission Unit
g/s	Grams per second
GNR	Government Notice Regulation
H ₂ S	Hydrogen sulphide
HPA	Highveld Priority Area
Lt	Litre
LDV	Light Duty Vehicle
m ³	Metres cubed
mg/Nm ³	Milligrams per cubic meter (under normal conditions of 273 Kelvin and 101.3 kPa)
mamsl	Meters above mean sea level
MES	Minimum Emission Standards
MBR	Membrane Bioreactor
MLR	Mixed Liquor Recycle



NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NDM	Nkangala District Municipality
NEM:AQA	National Environmental Management: Air Quality Act 39 of 2004
NO ₂	Nitrogen dioxide
NO _x	Oxides of nitrogen
NPi	National Pollutant Inventory
O ₃	Ozone
ODT	Odour Detection Threshold
OEHHA	California Office of Environmental Health Hazard Assessment
OU _E	Odour Emission Unit
P100	100 th percentile
P98	98 th percentile
P99	99 th percentile
PM	Particulate matter
PM ₁₀	Particulate matter less than 10 µm in diameter
PM _{2.5}	Particulate matter less than 2.5 µm in diameter
RAS	Return Activated Sludge
REL	Reference Exposure Levels
SAAQIS	South African Air Quality Information System
SANAS	South African National Accreditation System
SAWS	South African Weather Service
SO ₂	Sulphur dioxide
SRTM	Shuttle Radar Topography Mission
TCEQ	Texas Commission on Environmental Quality
TPH	Tonne per hour
TVOC	Total Volatile Organic Compounds
UASB	Upflow Anaerobic Sludge Blanket
ug/m ³	Microgram per metre cubed
UK	United Kingdom



UK IAQM	United Kingdom Institute of Air Quality Management
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VEB	Vegetative Environmental Buffer
WAS	Waste Activated Sludge
WHO	World Health Organisation
WRF	Weather Research and Forecasting
WSP	WSP Group Africa (Pty) Ltd
WWTP	Wastewater Treatment Plant
WWTW	Wastewater Treatment Works

EXECUTIVE SUMMARY

McCain Foods (Pty) Ltd (McCain) operates as a subsidiary of the global McCain Foods Group. The Delmas Plant primarily focuses on processing potatoes and sweet potatoes into frozen french fries (chips) for distribution in the retail market. The plant currently operates two french fry lines, each with a capacity of 7.5 tonnes per hour (TPH), resulting in a total finished product output of 15 TPH.

It is understood that, in the future, the plant will operate two lines at 8 TPH, with a total finished product output at 16 TPH. To accommodate the proposed changes and increased production capacity, a wastewater treatment plant (WWTP) designed to support the 8 TPH lines are required. A Biogas Plant linked to the new WWTP is also proposed. Additional diesel storage capacity is also required to operate the relatively new generator facility, that was installed to be used back-up power for the plant as and when needed.

For the proposed WWTP and diesel storage activities, environmental authorisation in the form of a Basic Assessment (BA) is required. As part of the BA, an Atmospheric Impact Report (AIR), including dispersion modelling, to assess emission profile changes resulting from the proposed operations compared to current operations (i.e., incorporating the new equipment) is required. WSP Group Africa (Pty) Ltd (WSP) has been appointed by McCain to undertake this AIR.

BASELINE AMBIENT AIR QUALITY

To assess existing baseline air quality conditions, data was obtained from the nearest air quality monitoring station (AQMS) to McCain, namely the Delmas AQMS (~2.2 km southeast; 26.1403°S, 28.6970°E).

Delmas AQMS

Pollutants monitored by the AQMS are limited to nitrogen dioxide (NO₂), particulate matter – PM₁₀, sulphur dioxide (SO₂) and ozone (O₃), notably O₃ is not a pollutant of concern for this AIR.

Data recovery for the Delmas AQMS was below 90% for all pollutants during all years (2022, 2023 and 2024 respectively), below the minimum requirement of 90% as stipulated by the South African National Accreditation System TR 07-03 (SANAS, 2012). Data recovery for SO₂ (2022) and CO (2022 and 2023) was between 57.6% and 77.2%, which is below the minimum requirement of 90% and although discussed, must be viewed with caution.

Sulphur Dioxide

- The 1-hour average SO₂ concentrations remained below the 1-hour (350 µg/m³) National Ambient Air Quality Standard (NAAQS) in 2022 with no exceedances recorded, thus compliant with the respective NAAQS.
- The 24-hour average SO₂ concentrations exceeded the 24-hour (125 µg/m³) NAAQS in 2022 one time; however, remaining compliant as four exceedances of the 24-hour NAAQS are permitted per calendar year.
- The annual average SO₂ concentrations for 2022 (15.0 µg/m³) remained below the annual average NAAQS (50 µg/m³), thus compliant with the respective NAAQS.

Carbon Monoxide

- The 1-hour average CO concentrations remained below the 1-hour (10,000 µg/m³) NAAQS in 2022 and 2023 with no exceedances recorded, thus compliant with the respective NAAQS.

- The 8-hour average CO concentrations remained below the 8-hour (30,000 $\mu\text{g}/\text{m}^3$) NAAQS in 2022 and 2023 with no exceedances recorded, thus compliant with the respective NAAQS
- The annual average CO concentrations were 456.1 $\mu\text{g}/\text{m}^3$ and 557.6 $\mu\text{g}/\text{m}^3$ for 2022 and 2023 respectively. Notably there is no annual average NAAQS for CO.

Existing Emission Sources

Within the Delmas area, several existing sources contribute to atmospheric emissions. These include the Thando Tech Botleng Colliery (~1.4 km west) and the Sephaku Cement Plant (~ 3.3 km south-southeast). Agricultural activities dominate the landscape surrounding McCain. In addition, vehicle exhaust emissions and domestic fuel burning within nearby communities further contribute to local air pollution.

EMISSIONS INVENTORY AND DISPERSION MODELLING

To accurately quantify the potential impacts associated with the Project, an emissions inventory was compiled.

Two scenarios were calculated, namely:

Scenario 1 - Existing Operations: Coal handling, boilers, diesel generators, storage tanks, vehicles on paved roads and clarifier.

Scenario 2 - Proposed Operations: Coal handling, boilers, diesel generators, storage tanks, vehicles on paved roads, clarifier and aeration basin, and the biogas engine.

Following the emissions inventory compilation, dispersion modelling was conducted using a Level 2 atmospheric dispersion model, AERMOD, as prescribed in the Regulations Regarding Air Dispersion Modelling (GNR 533 of 2014). Predicted concentrations were compared with the relevant NAAQS and international guidelines to assess compliance.

Based on the dispersion modelling predictions, the following key findings are noted:

- PM_{10} concentrations:
 - All predicted PM_{10} concentrations at sensitive receptors under Scenarios 1 and 2 do not result in exceedances of the ambient PM_{10} 24-hour (75 $\mu\text{g}/\text{m}^3$) or annual (40 $\mu\text{g}/\text{m}^3$) NAAQS.
- $\text{PM}_{2.5}$ concentrations:
 - All predicted $\text{PM}_{2.5}$ concentrations at sensitive receptors under Scenarios 1 and 2 do not result in exceedances of the ambient $\text{PM}_{2.5}$ 24-hour (40 $\mu\text{g}/\text{m}^3$) or annual (20 $\mu\text{g}/\text{m}^3$) NAAQS.
- CO concentrations:
 - All predicted CO concentrations at sensitive receptors under Scenarios 1 and 2 do not result in exceedances of the ambient CO 1-hour (30,000 $\mu\text{g}/\text{m}^3$) or 8-hour (10,000 $\mu\text{g}/\text{m}^3$) NAAQS.
- SO_2 concentrations:
 - All predicted SO_2 concentrations at sensitive receptors under Scenarios 1 and 2 do not result in exceedances of the ambient SO_2 1-hour (350 $\mu\text{g}/\text{m}^3$), 24-hour (125 $\mu\text{g}/\text{m}^3$) or annual (50 $\mu\text{g}/\text{m}^3$) NAAQS.
- NO_2 concentrations:

- All predicted NO₂ concentrations at sensitive receptors under Scenarios 1 and 2 do not result in exceedances of the ambient NO₂ 1-hour (200 µg/m³) or annual (40 µg/m³) NAAQS.
- Total Volatile Organic Compound (TVOC) concentrations, repressed by benzene:
 - There are no established local or international standards for cumulative ambient TVOC concentrations. In South Africa, benzene is the only Volatile Organic Compounds with a defined NAAQS. For this assessment, TVOC is conservatively assumed to be equivalent to benzene. Therefore, if benzene levels remain below its NAAQS, the overall impact of TVOCs can be considered safe.
 - All predicted benzene concentrations at sensitive receptors under Scenarios 1 and 2 do not result in exceedances of the ambient benzene annual NAAQS (5 µg/m³).
 - In Scenario 2 two offsite exceedances (7.0 µg/m³ and 6.1 µg/m³ respectively) of the benzene NAAQS are predicted to occur ~53.8 m and 14.2 m from the eastern boundary of McCain, near the proposed WWTP expansion.
 - Notably, these exceedances occur near the public road, where no residential occupancy is present.
- Ammonia (NH₃) concentrations:
 - All predicted NH₃ concentrations at sensitive receptors under Scenarios 1 and 2 do not result in exceedances of the ambient Texas Commission on Environmental Quality Reference Exposure Levels (REL) NH₃ 1-hour guideline (180 µg/m³) and annual guideline (92 µg/m³).
- Hydrogen sulphide (H₂S) concentrations:
 - All predicted H₂S concentrations at sensitive receptors under Scenarios 1 and 2 do not result in exceedances of the ambient 1-hour H₂S California Office of Environmental Health Hazard Assessment REL 1-hour guideline (42.0 µg/m³).
- Odour:
 - All predicted P98 1-hour odour concentrations at sensitive receptors under Scenarios 1 and 2 fall well below the 1-hour United Kingdom odour criteria limit (1.5 OU_E/m³).

With the inclusion of the biogas engine, aeration basin and the diesel tank predicted concentrations for all pollutants are unlikely to significantly affect the surrounding environment. Peak concentrations across all pollutants occur either within the operational boundary or adjacent to the facility's fenceline.

Without mitigation, the risks for this Project are considered low, with moderate magnitude, limited extent, and partial reversibility over the medium term. With mitigation measures in place, both the magnitude and likelihood of occurrence are reduced, resulting in a very low residual risk.

Based on the findings of this AIR, it is recommended that McCain proceed with the Project.

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APPENDICES

APPENDIX A

CURRICULUM VITAE

APPENDIX B

IMPACT ASSESSMENT METHODOLOGY

APPENDIX C

TANKS MODEL RESULTS

1 INTRODUCTION

McCain Foods (Pty) Ltd (McCain) operates as a subsidiary of the global McCain Foods Group. The Delmas Plant primarily focuses on processing potatoes and sweet potatoes into frozen french fries (chips) for distribution in the retail market. The plant currently operates two french fry lines, each with a capacity of 7.5 tonnes per hour (TPH), resulting in a total finished product output of 15 TPH.

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For the proposed WWTP and diesel storage activities, environmental authorisation in the form of a Basic Assessment (BA) is required. As part of the BA, an Atmospheric Impact Report (AIR), including dispersion modelling, to assess emission profile changes resulting from the proposed operations compared to current operations (i.e., incorporating the new equipment) is required. WSP Group Africa (Pty) Ltd (WSP) has been appointed by McCain to undertake this AIR.

1.1 TERMS OF REFERENCE

The terms of reference, designed to best meet the Project requirements are summarised below:

- Compilation of a baseline assessment including:
 - An assessment of the area, identifying sensitive receptors and neighbouring sources of emissions.
 - An assessment of prevailing meteorological conditions for the area.
 - An assessment of existing pollutant concentrations in the area based on ambient monitoring data.
 - A review of applicable air quality legislation.
- Development of an emissions inventory for the existing and proposed operations. The pollutants of focus included:
 - Particulate Matter (PM):
 - Particulate matter with an aerodynamic diameter of less than 10 µm (PM₁₀).
 - Particulate matter with an aerodynamic diameter of less than 2.5 µm (PM_{2.5}).
 - Carbon Monoxide (CO).
 - Sulphur dioxide (SO₂).
 - Nitrogen dioxide (NO₂).
 - Ammonia (NH₃).
 - Hydrogen sulphide (H₂S).
 - Total Volatile Organic Compounds (TVOCs)
 - Since no local or international standards exist for ambient TVOC concentrations, WSP has calculated and modelled the benzene component of TVOC, for which there are local standards.
 - Odour.

- Modelling the existing and proposed operations based on the emissions inventory calculations to map the impact footprint. The modelled scenarios included:
 - Scenario 1: Existing operating conditions.
 - Scenario 2: Proposed operating conditions, with the inclusion of the new infrastructure that has an impact on air quality.
- Visual presentation of the results, presented as isopleth maps indicating the spatial extent of emissions.
- Compilation of an AIR (this report) assessing the potential health and nuisance impacts on the identified sensitive receptors and adjacent land use.

1.2 DECLARATION OF INDEPENDENCE

Yakeen Kowlas is a Principal Air Quality Consultant with a Bachelor of Science Honours degree in Environmental Management obtained from the University of South Africa. He is currently employed by WSP and has worked on air quality impact assessments, monitoring, and modelling for a variety of clients over the past ten years. He has provided air quality consulting support to various client industries including petrochemical, mining, and production industries among others. Please see **Appendix A** for a CV detailing project experience.

I hereby declare that I am fully aware of my responsibilities in terms of the National Environmental Management Act (NEMA) (Act 107 of 1998): Environmental Impact Assessment Regulations of 2014, as amended and that I have no financial or other interest in the undertaking of the proposed activity other than the imbursement of consultant's fees.

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 Company: WSP Group Africa (Pty) Ltd
 Contact Details: +27 11 361 1359
 Yakeen.Kowlas@wsp.com

Signature:  Kowlas, Yakeen (ZAYK03125)
 Yakeen (ZAYK03125)
 (ZAYK03125)

2 ENTERPRISE DETAILS

2.1 FACILITY INFORMATION

Facility details are presented in **Table 2-1** and contact details of responsible personnel are presented in **Table 2-2**.

Table 2-1 – Facility information

Enterprise Name	McCain Foods SA (Pty) Ltd
Trading As/Site Name	McCain Foods SA (Pty) Ltd
Type of Enterprise, e.g. Company/Close Corporation/Trust, etc.	Private company
Company/Close Corporation/Trust Registration Number	2000/008184/07
Registered Address	Harrison McCain Road, Delmas, Mpumalanga Province

Postal Address	P.O. Box 1023, Delmas, 2210
Telephone Number (General)	013 665 8600
Fax Number (General)	013 665 1275
Industry Type/Nature of Trade	Retail and Food service
Land Use Zoning as per Town Planning Scheme	Industrial
Physical Address of the Facility	Harrison McCain Road, Delmas
Designated Priority Area	Highveld Priority Area
AEL Reference Number	N/A
Modelling Consultant	WSP Group Africa (Pty) Ltd

Table 2-2 – Contact details

Responsible Person	Itanje Seymore
Emissions Control Officer	Itanje Seymore
Telephone Number	013 665 8682
Cell Phone Number	083 7688 936
Fax Number	013 665 1275
Email Address	itanje.seymore@mccain.co.za
After Hours Contact Details	083 7688 936

2.2 LOCATION AND EXTENT OF PLANT

The McCain Delmas Plant is situated on Portion 5 of Farm Leeuwpoort 205 IR approximately 1.3 km north of the town of Delmas in Mpumalanga Province. The industrial area is bordered by large farmlands to the west, north and east (with prominent dry land cash crop farming and irrigations systems), and small industries/factories and agricultural plots to the south and southwest.

The McCain site consists of, but is not limited to, office blocks, warehouses, coal storage area, boilers and stacks.

McCains's extent and location details are summarised in **Table 2-3** with a graphical location map presented in **Figure 2-1**.

Table 2-3 – Location and extent of the plant

Physical Address of the Facility	Harrison McCain Road, Delmas
Description of Site (Where No Street Address)	N/A
Coordinates of Approximate Centre of Operations	Latitude: 26.1267 ° S Longitude: 28.6799 ° E
Extent (km²)	0.25
Elevation Above Mean Sea Level (m)	1,579
Province	Mpumalanga
Metropolitan/District Municipality	Nkangala District Municipality

Local Municipality	Victor Khanye Local Municipality
Designated Priority Area	Highveld Priority Area

2.3 TOPOGRAPHY

Delmas is situated on the Highveld plateau. The landscape surrounding the McCain facility is predominantly flat and expansive, with sparse vegetation and minimal tree cover. The Bronkhorstspuit River lies approximately 2 km's east of the site (iSHEcon, 2021).

The general topography of the site and surrounding areas is depicted in **Figure 2-2**.

2.4 SENSITIVE RECEPTORS

Sensitive receptors, as defined by the United States Environmental Protection Agency (USEPA) include, but are not limited to, hospitals, schools, day-care facilities, elderly housing and convalescent facilities (USEPA, 2023). These are areas where the occupants are more susceptible to the adverse effects of exposure to toxic chemicals, pesticides and other pollutants. Extra care must be considered when dealing with pollutants in proximity to areas recognised as sensitive receptors. In line with this definition the residential, educational, and recreational land in the surrounding area is considered sensitive receptors.

For this AIR, sensitive receptors were selected using Google Earth Pro™. Identified sensitive receptors are displayed in **Table 2-4** and **Figure 2-3**.

Table 2-4 - Sensitive receptors within a 5 km radius of McCain

ID	Description	Receptor Type	Latitude (°S)	Longitude (°E)	~Distance from Site Boundary (km)	Direction from Site
Rec 01	Farmstead 1	Farm	26.1108	28.6535	2.8	NNW
Rec 02	Farmstead 2	Farm	26.1194	28.6413	3.5	WNW
Rec 03	Farmstead 3 - Rossouw Jan A	Farm	26.1445	28.6366	4.4	WSW
Rec 04	Farmstead 4	Farm	26.1368	28.6511	2.7	WSW
Rec 05	Farmstead 5 - Wolmarans Boedary	Farm	26.1253	28.6646	1.1	WNW
Rec 06	Farmstead 6	Farm	26.1085	28.6680	2.1	NNW
Rec 07	Bernice Samuel Hospital	Medical	26.1524	28.6667	2.8	SW
Rec 08	Vezimfundo Primary School	School	26.0916	28.6942	3.8	NNE
Rec 09	Mafa Max Motoung Secondary School	School	26.1011	28.6997	3.1	NE
Rec10	Botleg Secondary School	School	26.1305	28.6981	1.4	ESE
Rec 11	Farmstead 7	Farm	26.1251	28.7195	3.6	E
Rec 12	Farmstead 8	Farm	26.1450	28.7072	3.1	SE
Rec 13	Swartklip Combined School	School	26.1672	28.6890	4.4	S
Rec 14	Informal housing settlement	Residential	26.1586	28.6694	3.3	SSW
Rec 15	Laerskool Delmas	School	26.1477	28.6811	2.1	S
Rec 16	Farmstead 9	Farm	26.0906	28.6667	3.9	NNW

ID	Description	Receptor Type	Latitude (°S)	Longitude (°E)	~Distance from Site Boundary (km)	Direction from Site
Rec 17	Botleng Mall	Commercial operations	26.1040	28.6789	2.2	N
Rec 18	Farmstead 10	Farm	26.1215	28.6790	0.3	N
Rec 19	Phaphamani Secondary School	School	26.1060	28.6901	2.1	NE
Rec 20	Simon Gondwe Sports Centre Boteng	Recreational	26.1209	28.6974	1.5	ENE
Rec 21	Acasisa Crescent Villas	Residential	26.1391	28.6703	1.3	SW
Rec 22	VKB	Commercial operations	26.1275	28.6837	0.08	S
Rec 23	Q4 Fuel Delmas	Commercial operations	26.1288	28.6786	0.08	S
Rec 24	Residence on Boekenhout St	Residential	26.1359	28.6791	0.8	S
Rec 25	Delpark Primary School	Residential	26.1398	28.6962	2.0	SE
Rec 26	Housing along R55	Residential	26.1365	28.7057	2.6	SE
Rec 27	Residence on Mlangeni St	Residential	26.1353	28.6923	1.4	SE
Rec 28	Residence East of McCain	Residential	26.1263	28.6913	0.7	E

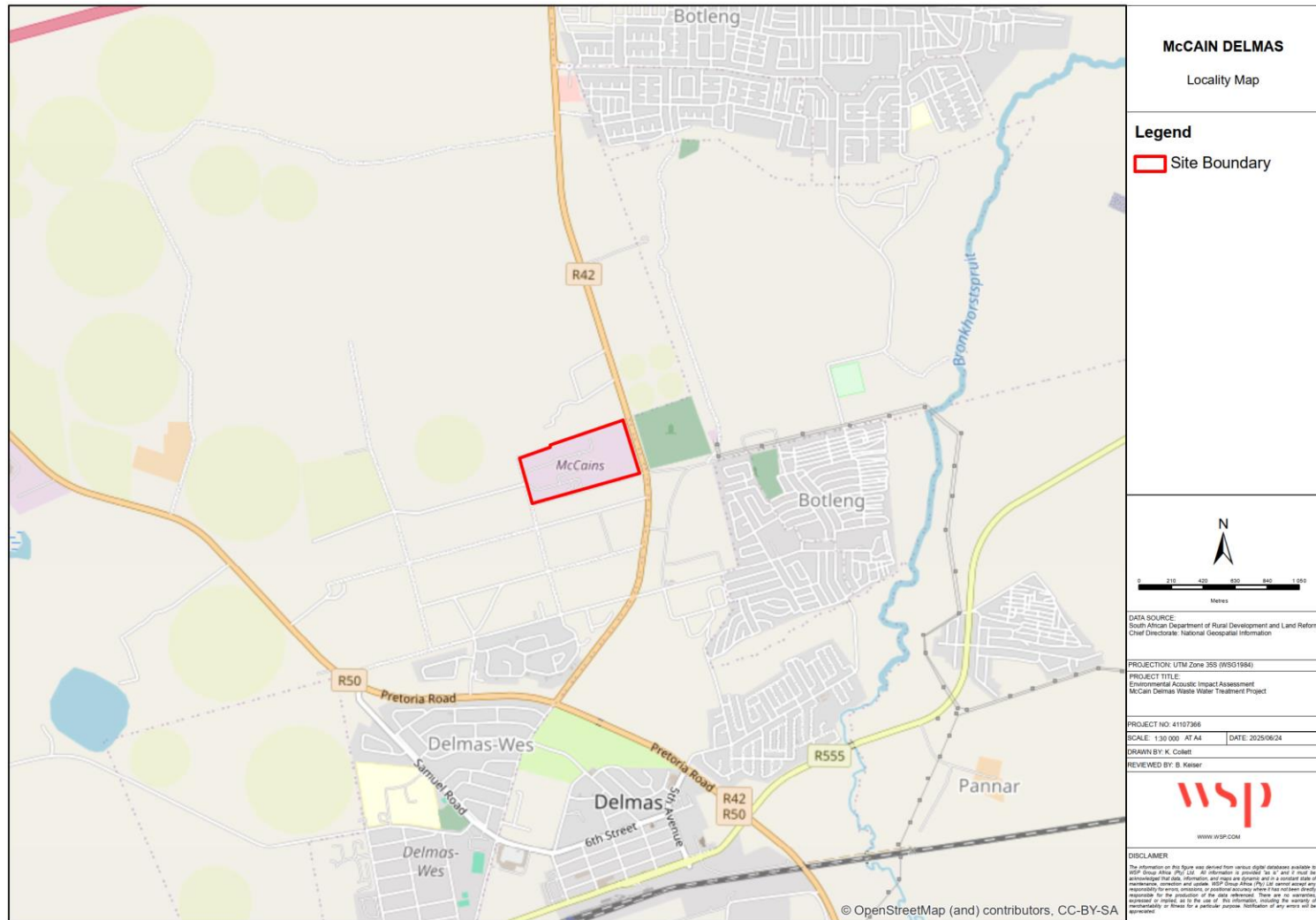


Figure 2-1 – Locality map of McCain



Figure 2-2 – Topography surrounding McCain

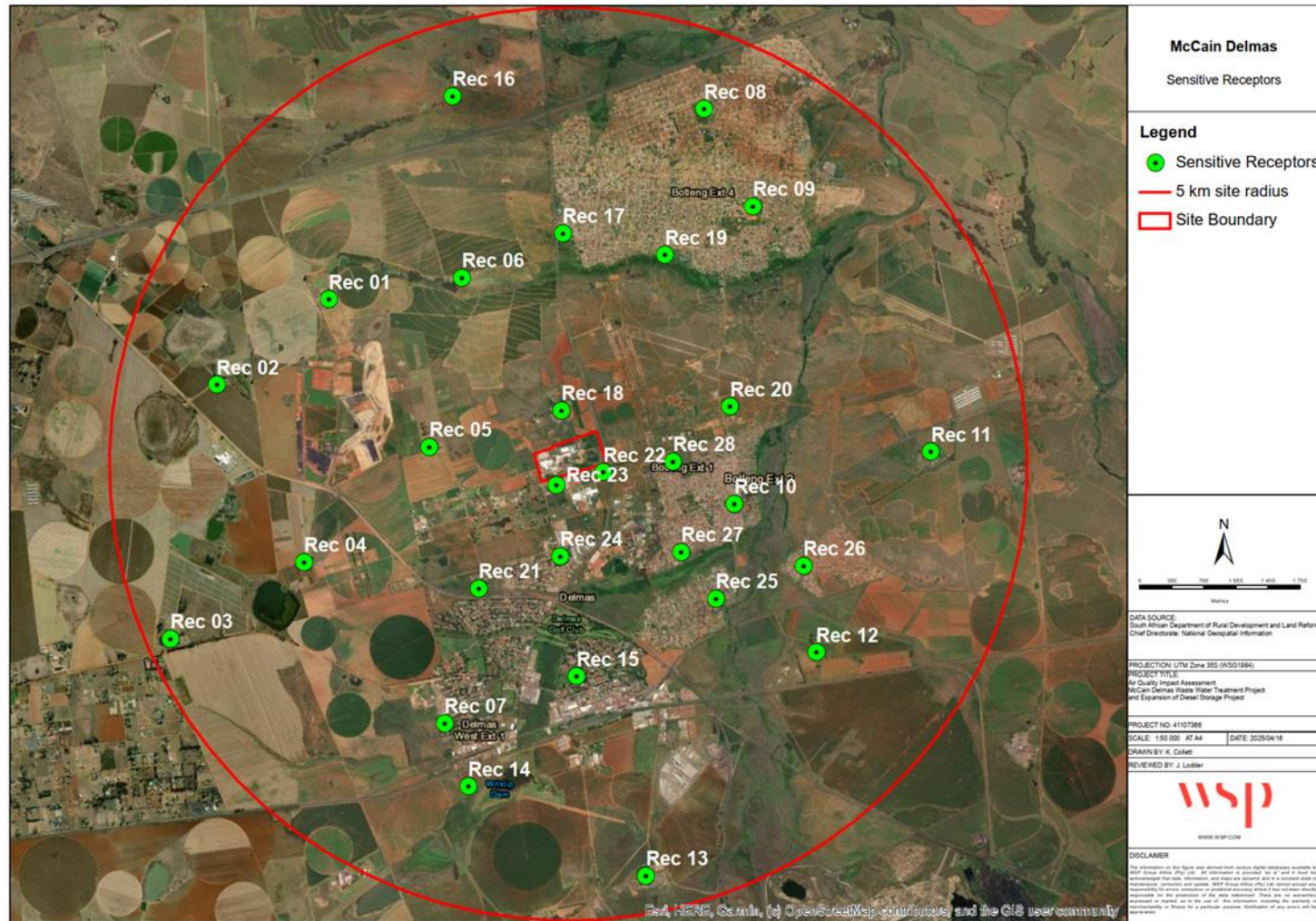


Figure 2-3 – Sensitive receptors within a 5 km radius of McCain

3 NATURE OF PROCESS

3.1 LISTED ACTIVITY

Listed activities and associated minimum emission standards (MES) were published in Government Notice 248, Government Gazette 33064 of 2010, in line with Section 21 of NEM: AQA. An amended list of activities was published in Government Notice 893 of Government Gazette 37054 in 2013, Government Notice 551 of Government Gazette 38863 in 2015 and further in Government Notice 1207 of Government Gazette 42013 in 2018.

The current operations at McCain do not trigger any of the Listed Activities under Section 21 of NEM:AQA, as amended. This is because the cumulative net heat input from the four boilers (~23.6 MW) remains below the 50 MW threshold specified in Subcategory 1.1: Solid Fuel Combustion Installations. The specifications of the biogas equipment are unknown; however, it is assumed that its net heat input also falls below 50 MW, likely between 2 - 4 MW. Therefore, the operations are outside the scope of Section 21 requirements.

3.2 PROCESS DESCRIPTION

3.2.1 EXISTING OPERATIONS

Fresh vegetables, primarily potatoes and sweet potatoes, are transported to the facility by road. Upon arrival, they are stored in ammonia-cooled refrigeration units until required for processing. The preparation involves washing, peeling, and cutting the vegetables to meet specific standards (iSHEcon, 2021). They are then partially fried using sunflower and palm oils before being rapidly frozen in tunnel freezers. After freezing, the products are packaged and returned to cold storage, awaiting shipment. Final goods are distributed to retailers as needed, following a first-in, first-out inventory system (iSHEcon, 2021).

3.2.1.1 Ammonia System

All cooling and refrigeration needs are met by five dedicated ammonia-based refrigeration units. The five ammonia systems are replenished every three to four months using a 30-tonne road tanker, which connects through non-return valves at the respective ammonia facilities. During routine purging of the main system, any released ammonia gas is channelled into a water tank, where it is neutralized through dissolution (iSHEcon, 2021).

3.2.1.2 Diesel Tanks

McCain cumulatively stores approximately 44 m³ of diesel in various tanks on site. Diesel is used for forklifts, back-up generators and a diesel fire water pump¹.

3.2.1.3 Oil Tanks and Boilers

Sunflower and palmoline oils are maintained at a temperature of 60 to 65 °C in three pencil tanks, each with a capacity of 100 m³. Additionally, two tanks, one holding 75 m³ and the other 100 m³, are

¹ A diesel fire water pump is a fire protection device powered by a diesel engine, designed to deliver high-pressure water to firefighting systems when electrical power is unavailable or unreliable.

used to store oily wastewater from the production process, also kept at the same temperature range. Four day-use tanks hold the oil designated for fryer operations, with their contents similarly heated to 60 to 65 °C (iSHEcon, 2021). Steam for heating is generated by four coal-fired boilers, and a dedicated coal storage area is located near the boilers.

A production flow diagram of the chip making process is illustrated in **Figure 3-1** below.

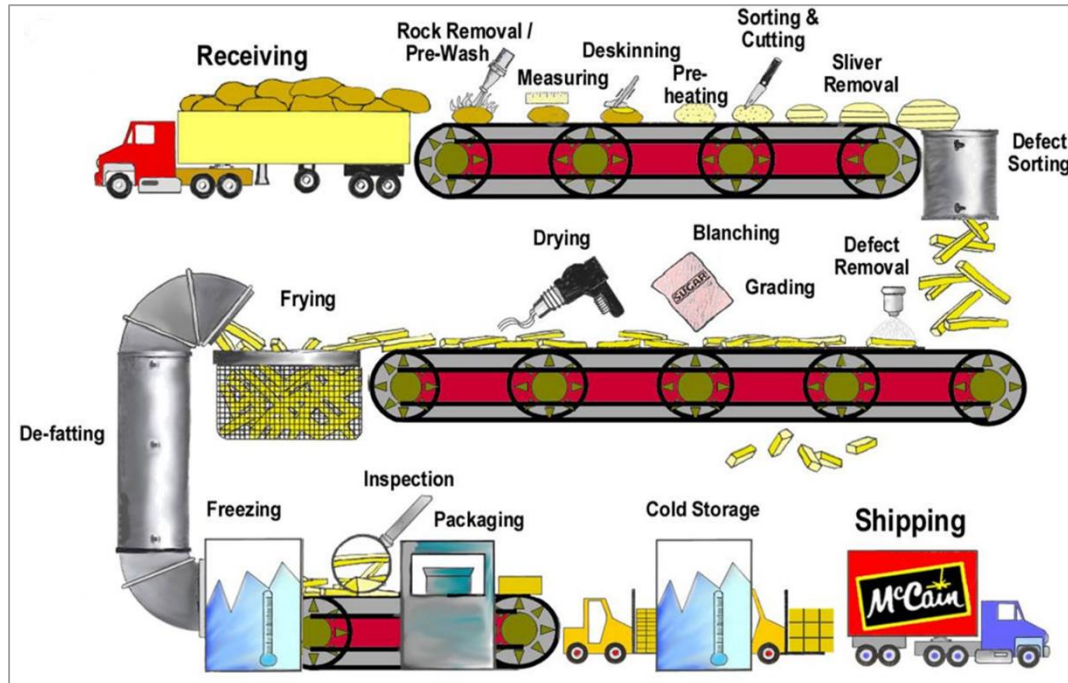


Figure 3-1 - Production flow diagram

3.2.1.4 Wastewater Treatment Plant

Wastewater generated at the plant is currently sent to a rotary screening reel and a primary clarifier. Effluent clarified by the primary unit is released into the sewer system. Additionally, an oily water system is in place, consisting of an oily water screen, a separation tank, a dissolved air flotation (DAF) unit, and a dedicated oil storage tank (WSP E&I Canada Limited, 2024). This system is designed to handle oily wastewater generated in the fryer sections of the facility. Caustic cleaning from the fryers is planned to bypass this oily water treatment process (WSP E&I Canada Limited, 2024).

The Victor Khanye Local Municipality has set specific discharge compliance targets for the facility. McCain has indicated interest in retaining the flexibility to either release treated effluent directly to the environment or implement additional treatment processes to enable water recycling within the facility (WSP E&I Canada Limited, 2024).

3.2.2 PROPOSED OPERATIONS

3.2.2.1 Proposed Wastewater Treatment Plant

The proposed WWTP is required to treat effluent that is generated from the manufacturing process. The plant will have a maximum daily treatment volume flowrate of 3,457 m³/day and will be in the northeastern corner of the McCain site.

The effluent will be treated to meet the quality requirements that would be suitable for direct discharge to the environment, or for plant use (potable water quality). Waste Activated Sludge

(WAS) from the treatment plant will be temporarily stored in hoppers on site and ultimately disposed off-site.

The plant will include an anaerobic digestion process that will cater for chemical oxygen demand (COD) containing wastes on-site, such as fryer waste, slivers, and other materials that are collected in the main wastewater screen and oily water screen. The anaerobic digester will convert the COD into biogas, which can be used to either generate power or displace natural gas in the processing plant's boilers. The digester feed flow will be approximately 385 m³/day, with a total digestion volume of 9,074 m³.

The development area for the facility will be approximately 9,000 m² and will include the following key infrastructure components (**Figure 3-2**):

- Existing clarifier.
- Equalisation tank.
- Upflow anaerobic sludge blanket (UASB) reactor Feed tank and Pumps.
- UASB sludge tank.
- Activated sludge system.
- Wastewater Process Building.
- Biogas digester.
- Biogas and Power Building.
- Flare.

3.2.2.2 Proposed Diesel Tank

McCain cumulatively stores approximately 44 m³ of diesel in various tanks on site. McCain proposes to install an additional 79 m³ diesel storage tank where the current 30 m³ diesel tank is located. There is limited space to accommodate both tanks at this location, therefore the existing 30 m³ tank will be moved next to generator 4, replacing the current generator 4 storage tank.

ATMOSPHERIC IMPACT REPORT
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MCCAIN FOODS (PTY) LTD

3.3 WASTEWATER TREATMENT PROCESS OVERVIEW

3.3.1.1 Upflow Anaerobic Sludge Blanket Reactor

An UASB system will be installed upstream of the main biological treatment process to reduce COD loading and generate biogas. Anaerobic pretreatment is an effective way to minimize the size of downstream aerobic processes while producing biogas as a valuable by-product.

The UASB system is a compact anaerobic unit with a high specific COD loading rate. It utilizes granular anaerobic biomass to digest soluble feedstocks and produce methane. UASB systems are widely used at McCain facilities and provide a robust pretreatment solution for potato processing wastewater. Although higher-rate systems are available, they are generally not recommended unless site-specific conditions require them, as they tend to be less stable operationally.

A pumped bypass will be included to allow a controlled portion of wastewater to bypass the UASB, ensuring sufficient COD for the aerobic treatment system. Additionally, a gravity bypass from the UASB feed tank will enable complete bypassing of the UASB, allowing the treatment system to operate entirely by gravity if necessary.

The UASB sludge tank will store excess sludge, enable reseedling of the system when required. The UASB system will also incorporate chemical dosing pumps for pH adjustment and micronutrient dosing (WSP E&I Canada Limited, 2024)

3.3.1.2 Activated Sludge Process

The aerobic treatment system achieves COD, phosphorus, and nitrogen removal using a four-stage Bardenpho process configuration: pre-anoxic zone, aerobic zone, post-anoxic zone, and re-aeration zone. This advanced activated sludge system enables efficient nitrification and denitrification by incorporating mixed pre- and post-anoxic zones for denitrification. The aerobic zone supports the growth of aerobic bacteria that consume COD and ammonia. While this design is more complex than a typical single-stage aeration basin, it is essential when low effluent total nitrogen is required.

Effluent from the activated sludge process requires clarification to separate biomass solids from the mixed liquor before discharge. This step also facilitates the creation of Return Activated Sludge (RAS) and WAS streams. RAS recycles activated sludge biomass to the start of the process, maintaining microbial populations for effective treatment. By controlling RAS flow, operators can regulate biomass concentration and maintain steady-state conditions. Traditionally, this separation is achieved through gravity settling in a secondary clarifier; however, a Membrane Bioreactor (MBR) has been selected as the preferred alternative for clarification (WSP E&I Canada Limited, 2024).

3.3.1.3 Membrane Technology Overview

A MBR uses membranes to provide a positive barrier to solids and achieve effluent clarification following activated sludge treatment. Effluent from the activated sludge system is collected in the membrane tank and drawn through the membranes using MBR effluent pumps. Solids are retained on the membrane surface, while clarified water is discharged to the final discharge point.

To maintain membrane performance, the system employs short-duration back-pulsing, where clarified effluent is pumped in reverse through the membranes. This dislodges accumulated solids into the tank, where they can be recycled as RAS or sent to sludge storage and thickening for disposal as WAS. Additionally, air scour blowers provide continuous scouring of the membranes to ensure optimal operation.



The membrane tank can be installed above or below ground; for this system, an inground concrete tank is likely, enabling gravity-fed operation. Biogas generated in the UASB and anaerobic digesters will power generators, providing backup electricity for critical WWTP infrastructure during load-shedding events and blackouts. An emergency overflow will also be included, allowing the membrane tank contents to discharge by gravity to the final discharge point in the event of backup generator failure (WSP E&I Canada Limited, 2024).

3.3.1.4 Membrane Bioreactor Activated Sludge System Overview

The MBR system is designed using a four-stage Bardenpho process, consisting of a pre-anoxic zone, aerobic zone, post-anoxic zone, and re-aeration zone. This configuration enables a high degree of total nitrogen removal by providing mixed pre- and post-anoxic conditions for effective denitrification.

Similar to a secondary clarifier-based design, the main aerobic treatment zone primarily facilitates biodegradable COD oxidation and nitrification, while also assimilating small amounts of phosphorus and nitrogen for cell growth and maintenance. The anoxic zones create conditions for denitrifying bacteria, enabling the biological reduction of nitrate to elemental nitrogen. The final re-aeration zone strips elemental nitrogen from the mixed liquor, reoxygenates the biomass, and removes any excess carbon source added to promote denitrification.

Transitioning from a secondary clarifier-based activated sludge system to an MBR maintains the same core treatment mechanisms at each stage. However, to optimize membrane performance, several key changes are required in recycle flow configurations and solids concentration, which influence the overall operation of the activated sludge system (WSP E&I Canada Limited, 2024).

3.3.1.5 Process Overview

The influent to the activated sludge system is combined in an influent splitting chamber, which includes provisions for a future treatment train if required. In this chamber, UASB effluent, UASB bypass, RAS, and Mixed Liquor Recycle (MLR) streams are combined and fed into the activated sludge system. The combined influent flows through overflow weirs into the following zones in sequence: pre-anoxic, aerobic, post-anoxic, and re-aeration.

MLR pumps withdraw nitrified mixed liquor from the outlet of the aerobic zone and return it to the influent splitting chamber to promote denitrification in the pre-anoxic zone. These pumps, located outdoors adjacent to the aeration basin, will operate at approximately two times the influent flow rate.

The aerobic and re-aeration zones will contain removable fine-bubble diffusers supplied by external hybrid aeration blowers. The membrane tank will have a dedicated blower set for periodic membrane cleaning. Diffuser grids must be removable for maintenance, and flanged connections will be provided at the blowers for future expansion.

The pre- and post-anoxic zones will not have aeration grids and must remain well-mixed. Removable submersible mixers will ensure complete mixing in these zones.

Mixed liquor from the re-aeration basin flows by gravity into the membrane tank, where it is drawn through membranes by two MBR permeate pumps into a final effluent tank before discharging by gravity to the sewer. These reversing rotary lobe pumps also function as back-pulse pumps. Frequent short back-pulses dislodge accumulated sludge from the membrane surface into the tank, where it is recycled to the influent chamber via the MLR system. A portion of sludge from the MBR



tank is removed as WAS to maintain the desired biological composition in the reactor tanks (WSP E&I Canada Limited, 2024).

3.3.1.6 Phosphorus Removal

Chemical phosphorus removal is required to achieve the targeted effluent limits, as biological uptake accounts for only a small fraction of the necessary removal. This process typically involves dosing iron (ferric) or aluminium (alum) salts to precipitate insoluble phosphorus. The resulting phosphorus sludge cannot pass through the membranes and is removed via the WAS line.

Chemical phosphorus removal introduces inert suspended solids into the activated sludge basins, increasing overall solids volume. This requires careful management to maintain biological treatment performance and prevent operational imbalances (WSP E&I Canada Limited, 2024).

3.3.1.7 Sludge Handling

As treatment bacteria grow in the activated sludge process, an equivalent amount of mixed liquor must be removed to maintain biomass balance. This excess mixed liquor is removed as WAS and transferred to a sludge storage tank, where it is thickened using a centrifuge. The same centrifuge will handle both WAS and digestate from the anaerobic digester. Dewatered sludge (centrifuge cake) will discharge into the existing sludge conveyance system and hoppers for off-site disposal. Nutrient-rich centrate from thickening will return to the influent equalization chamber for further treatment (WSP E&I Canada Limited, 2024).

3.3.1.8 Waste Collection

White waste is primarily collected at the existing wastewater screen and oily water screen. Additional waste streams may periodically be directed to the anaerobic digester as required. The existing screens will remain in use, and a new reversing conveyor will be installed to allow screenings to be directed either to the hammermill for maceration or to a truck for disposal (WSP E&I Canada Limited, 2024).

3.3.1.9 White Waste Acidification

Anaerobic digestion begins with processing white waste and other digestible materials into a slurry with a solid's concentration of approximately 8–12%. White waste from the screens is directed into a feed hopper above the hammermill, which macerates the material into a paste. Dilution water or other materials are added to maintain the target slurry concentration. In this system, primary clarifier sludge and liquid production waste will be pumped into the hammermill feed hopper to achieve ~8% solids. The macerated material is continuously pumped to the acidification tank for pre-acidification before feeding the digesters.

Acidification tank feed pumps discharge at a fixed flow rate, with dilution water added based on slurry pump discharge pressure. As the slurry is shear-thinning, discharge pressure will be higher at start-up and decrease as velocity increases. Dilution water is expected only during start-up and flushing. The acidification tank is continuously mixed, promoting partial breakdown of material, improving COD accessibility, and enhancing biogas yield in the digesters (WSP E&I Canada Limited, 2024).

3.3.1.10 Anaerobic Digester

The digester is fed in batches from the acidification tank and mixed continuously using a jet mixing system. Jet mixing pumps, mounted externally, discharge through a header inside the digester. Heat, caustic, micronutrients, and defoaming agents are added as needed to maintain optimal

conditions. COD in the waste is converted into biogas, which accumulates in the digester headspace.

The digester features a double membrane roof for biogas collection. A fresh air blower pressurizes one side of the membrane to maintain internal pressure and push biogas into the piping system. An emergency pressure relief prevents membrane damage. Digestate is removed in batches before feeding and sent to the sludge holding tank for dewatering (WSP E&I Canada Limited, 2024).

3.3.1.11 Biogas Handling

Biogas from the anaerobic digester and UASB is combined in a common handling system for treatment and utilization in power generation or as a natural gas substitute in plant boilers. Individual streams are analysed and measured before merging into a common header. The combined biogas passes through a condensate trap to remove moisture, then through blowers to an H₂S scrubber for desulfurization. After treatment, biogas is directed to factory boilers or a biogas engine. A flare system is provided for emergency combustion or when biogas production exceeds demand (WSP E&I Canada Limited, 2024).

3.4 UNIT PROCESSES

A summary of the current and proposed unit processes, function and operational hours at McCain is provided in **Table 3-1**.

Table 3-1 – Unit process and operational times for McCain

Unit Process	Unit Process Function	Batch or Continuous Process	Operating Hours Per Day	Days of Operation per Year
Current				
Storage of raw materials and products	Bulk storage of cooking oils, petroleum products and process chemicals.	Continuous	24	365
	Bulk storage of potatoes	Continuous	24	365
Loading	Loading and handling of cooking oils, petroleum products and process chemicals.	Batch	4	365
	Loading and handling of potatoes	Batch	24	365
	Loading and handling coal	Batch	1	365
Boilers	Combustion of coal in boilers for steam generation	Continuous	24	365
Waste water treatment plant	Industrial wastewater treatment	Continuous	24	365
Proposed				
Biogas system ⁽¹⁾	Power or steam generation	Continuous	24	365
⁽¹⁾ The proposed biogas system will be used to either generate power or displace natural gas in the plant boilers.				

4 TECHNICAL INFORMATION

Table 4-1 lists the raw materials used at McCain. In addition, **Table 4-2** and **Table 4-3** present the energy sources and production rates, respectively. The raw materials, energy sources and production rates are provided by McCain.

4.1 RAW MATERIALS USED

Table 4-1 – Raw materials

Raw Material Type	Actual Consumption Rate (Quantity)		Units (Quantity per Period)
	Current	Proposed	
Potatoes	175,000	200,000	Tonnes/annum
Sunflower oil, Palmoline oil and Canol oil	6,000	6,000	Tonnes/annum

Table 4-2 – Energy sources

Energy source	Actual Consumption Rate (Quantity)		Units (Quantity per Period)
	Current	Proposed	
Electricity	28,000,000	28,000,000	kWh/annum
Solar power	6,000,000	6,000,000	kWh/annum
Coal	18,500	18,500	Tonnes/annum
Diesel	100	100	Tonnes/annum
Liquid Petroleum Gas	4	4	Tonnes/annum
Biogas handling system ⁽¹⁾	N/A	TBC	TBC

⁽¹⁾ The details of the biogas handling system are unknown at this phase of the Project.

Table 4-3 – Production rates

Product	Actual Production Rate (Quantity)		Units (Quantity per Period)
	Current	Proposed	
French fries	95,000	110,000	Tonnes/annum

4.2 APPLIANCES AND ABATEMENT TECHNOLOGY

As confirmed by McCain, no air quality abatement equipment is currently installed for the current operations. A flare and H₂S scrubber will be installed as part of the proposed biogas systems, however, there is no detailed design specification available at this stage of the Project.

5 ATMOSPHERIC EMISSIONS

5.1 POINT SOURCE PARAMETERS

McCain currently operates four coal-fired boilers, each equipped with its own designated stack, and has four diesel generators installed on-site.

Stack parameters for each of the coal-fired boilers were obtained from the following stack emission testing reports. Additionally, this information was confirmed with McCain.

- C2 Boiler, Exco Stack Emissions Report No. G21.1385_AESM (v1.0) (2021)
- C2 Boiler, Yellow Tree Stack Emissions Report No. YTS3419AES (2025)
- C2 Boiler, Rayten Stack Emissions Report No. AES-02-106-012-01 (2023)
- C2 Boiler, Yellow Tree Stack Emissions Report No. YTS3419AES (2025)

Since the stack emissions reports only indicates Total Suspended Particulates (TSP), particulate matter in fractions of PM₁₀ was calculated as 92% of TSP and in fractions of PM_{2.5} was calculated as

82% of TSP. This was in line with the United States Environmental Protection Agency's (US EPA) AP42 particle size distribution factors Table B.2-18. Since no emission abatement equipment is installed, the emissions as presented are unmitigated.

Stack parameters for the four diesel generators were provided by McCain. Stack parameters for the proposed Gas Engine were based on assumptions.

A gas engine was chosen as the assumed equipment over a gas boiler, for the following reasons:

- A worst-case emissions scenario is required.
- Gas engines typically emit higher NO_x due to lean-burn operation and high combustion temperatures, whereas natural gas boilers with low-NO_x burners emit significantly less emissions (European Environment Agency (EEA), 2022; US EPA, 2023).
- Both equipment types using natural gas have negligible SO₂ emissions because of the fuel's low sulphur content (US EPA, 2023).
- Gas engines may consume slightly more fuel when compared to a boiler for the same thermal output unless combined heat and power is implemented (Intergovernmental Panel on Climate Change, 2021).
- Both equipment types produce very low PM emissions when firing natural gas, although gas engines can emit more ultrafine particles compared to boilers (EEA, 2022).

The locations and specifications of operational and proposed point sources are presented in **Table 5-1**. The emission rates utilised in the dispersion model, inclusive of the current operational stacks and diesel generator stacks, are presented in **Table 5-2**.

Table 5-1 – Point source parameters at McCain

Point source number	Point source name	Point source coordinates	Height of release above ground (m)	Height above nearby building (m)	Diameter at stack tip / vent exit (m)	Actual gas exit temperature (°C)	Actual gas volumetric flow (m³/s)	Actual gas exit velocity (m/s)	Type of emission (continuous / batch)
Existing									
1	C2 Boiler	-26.1262° S; 28.6797° E	24	7	1.0	159.6	4.5	5.4	Continuous
2	C3 Boiler	-26.1262° S; 28.6796° E	2	7	0.8	154.0	4.5	9.1	Continuous
3	C4 Boiler	-26.1266° S; 28.6798° E	24	7	1.0	173.8	5.8	8.2	Continuous
4	C5 Boiler	-26.1266° S; 28.6797° E	24	7	0.6	162.0	3.0	10.7	Continuous
5	Generator 1	-26.1272° S; 28.6779° E	6.3	1.3	0.5	400	6.8	33.9	Batch
6	Generator 2	-26.1272° S; 28.6779° E	6.3	1.3	0.5	400	6.8	33.9	Batch
7	Generator 3	-26.1272° S; 28.6779° E	6.3	1.3	0.5	400	6.8	33.9	Batch
8	Generator 4	-26.1269° S; 28.6793° E	1.4	n/a	0.2	505	279.4	6.7	Batch
Proposed									
9	Gas engine	-26.1243° S; 28.6822° E	6.31	1.3	0.5	407	6.6	33.8	Continuous
Notes: <ul style="list-style-type: none"> Stack height above buildings were assumed based on elevation profiles from Google Earth. The location for the Gas Engine was assumed. The stack height and diameter for the Gas Engine was assumed to be the same as Generator 1. The exist gas temperature of the Gas Engine was taken from the datasheet of a MTU 20V4000 genset. The gas exit velocity for the Gas Engine was calculated using assumptions made under the Ideal Gas Law-based Flow Conversion Equation. Details of the proposed flare and associated H₂S scrubber system are excluded as there is no design specification available. 									

Table 5-2 - Point source emission rates utilised in the dispersion model

Point source number	Point source name	PM ₁₀ emission rate (g/s)	PM _{2.5} emission rate (g/s)	SO ₂ emission rate (g/s)	NO ₂ emission rate (g/s)	CO emission rate (g/s)	TVOC emission rate (g/s)
1	C2 Boiler	8.2289E-07	7.3344E-07	1.8278E-06	1.8139E-06	2.9889E-06	N/A
2	C3 Boiler	4.7533E-07	4.2367E-07	1.9167E-06	7.4444E-07	5.0306E-06	N/A
3	C4 Boiler	2.5924E-07	2.3106E-07	2.7310E-06	1.3156E-06	5.7603E-06	N/A
4	C5 Boiler	4.2933E-07	3.8267E-07	9.5000E-07	3.6944E-07	1.0306E-06	N/A
5	Generator 1	5.7333E-01	5.6000E-01	1.6333E-03	2.0000E+01	4.4000E+00	5.0667E-01
6	Generator 2	5.7333E-01	5.6000E-01	1.6333E-03	2.0000E+01	4.4000E+00	5.0667E-01
7	Generator 3	5.7333E-01	5.6000E-01	1.6333E-03	2.0000E+01	4.4000E+00	5.0667E-01
8	Generator 4	4.0952E-02	4.0000E-02	1.1667E-04	1.4286E+00	3.1429E-01	3.6190E-02
9	Gas engine	1.2335E-04	1.2335E-04	9.4072E-04	6.5275E+00	5.0716E-01	1.7887E+00

5.2 POINT SOURCE MAXIMUM EMISSION RATES (NORMAL WORKING CONDITIONS)

Since the activities at McCain are not regulated by Section 21 of NEM:AQA, maximum emission rate determination is not applicable.

5.3 POINT SOURCE MAXIMUM EMISSIONS RATES (START-UP, MAINTENANCE AND/OR SHUT DOWN)

Since the activities at McCain are not regulated by Section 21 of NEM:AQA, maximum emission rate determination is not applicable.

5.4 FUGITIVE EMISISONS (AREA AND/OR LINE SOURCES)

Existing and proposed area and line and tank sources as identified in this AIR are presented in **Table 5-3**. The existing and proposed site layouts of major infrastructure at McCain are presented in **Figure 5-1**.

Table 5-3 – Area, line and tank sources at McCain

Area source number	Area source name	Point source coordinates	Type of emission (continuous/batch)
Existing			
01	Coal bunker	-26.1265° S; 28.6797° E	Batch
02	Clarifier	-26.1263° S; 28.6804° E	Continuous
03	Sunflower/Palm/Canola oil Tank 1	-26.1263° S; 28.6778° E	Continuous
04	Sunflower/Palm/Canola oil Tank 2	-26.1263° S; 28.6778° E	Continuous
05	Sunflower/Palm/Canola oil Tank 3	-26.1263° S; 28.6778° E	Continuous
06	Glycol Tank 1	-26.1260° S; 28.6781° E	Continuous
07	Glycol Tank 2	-26.1260° S; 28.6781° E	Continuous
08	Oily wastewater Tank 1	-26.1263° S; 28.6780° E	Continuous
09	Oily wastewater Tank 2	-26.1263° S; 28.6780° E	Continuous
10	Oily wastewater Tank 3	-26.1263° S; 28.6780° E	Continuous
11	Cooking Oil Tank 1	-26.1262° S; 28.6781° E	Continuous
12	Cooking Oil Tank 2	-26.1262° S; 28.6781° E	Continuous
13	Cooking Oil Tank 3	-26.1262° S; 28.6781° E	Continuous
14	Cooking Oil Tank 4	-26.1262° S; 28.6781° E	Continuous
15	Diesel Tank for Forklifts	-26.1268° S; 28.6798° E	Continuous
16	Diesel Tank for Generator 1	-26.1275° S; 28.6780° E	Continuous
17	Diesel Tank for Generator 2	-26.1275° S; 28.6780° E	Continuous
18	Diesel Tank for Generator 3	-26.1275° S; 28.6780° E	Continuous
19	Diesel Tank for Generator 4	-26.1269° S; 28.6793° E	Continuous
20	Diesel Tank for Firewater Pump 1	-26.1279° S; 28.6771° E	Continuous
21	Diesel Tank for Firewater Pump 2	-26.1279° S; 28.6771° E	Continuous
Proposed			
22	Aeration Basin	-26.1248° S; 28.6823° E	Continuous
23	New Diesel Tank	-26.1272° S; 28.6780° E	Continuous



Figure 5-1 – Current and proposed site layout

5.5 EMISSIONS INVENTORY

An emissions inventory is a list of air pollution sources, their physical and chemical parameters, as well as the quantification of emissions. Emissions are calculated using emission factors or mass balance approaches, requiring chemical and activity data inputs.

This emissions inventory was compiled using emission rate models and emission factors. Emission factors are used to estimate emissions where actual emission data is not available. In most cases, these factors are averages of available data of acceptable quality and are generally assumed to be representative of long-term averages for all facilities in the same source category. An emission factor is a value representing the relationship between an activity and the rate of emissions of a specified pollutant. Emission factors are always 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 (%)

The South African Regulations Regarding Air Dispersion Modelling (hereafter referred to as the *Modelling Regulations*) (GNR 533 in Government Gazette 37804, dated 11 July 2014), recommend the use of published emission factors for national consistency such as the United States Environmental Protection Agency (US EPA) AP-42 emission factors (US EPA, 1995), Australia's National Pollutant Inventory (NPI) Emission Estimation Technique Manuals (EETM) (National Pollutant Inventory, 1998) or similar. Unless otherwise stated, operational information and activity data (i.e. throughputs, etc.) required to calculate atmospheric emissions from the facility was provided by McCain. Any errors, limitations, or assumptions inherent in these datasets extend to this study.

All quantifiable emission sources associated with onsite operations, including proposed activities, have been considered for this assessment. Two emission scenarios were calculated, namely:

Scenario 1 - Existing Operations: Coal handling, boilers, diesel generators, storage tanks, vehicles on paved roads and clarifier.

Scenario 1 – Proposed Operations: Coal handling, boilers, diesel generators, storage tanks, vehicles on paved roads, clarifier and aeration basin, and the biogas engine.

The pollutants of focus include:

- PM₁₀ and PM_{2.5}.
- CO.
- SO₂.
- NO₂.
- TVOC represented by benzene.
- NH₃.
- H₂S.
- Odour.

5.5.1 POINT SOURCE EMISSIONS

Stacks, Diesel Generators and Gas Engine

The operational point sources at McCain have already been listed in **Table 5-1** with emission rates utilised in the dispersion model indicated in **Table 5-2**. As a worst case the boiler stacks were assumed to operate simultaneously for 24 hours a day, 365 days a year.

Emission estimates for the diesel generators and gas engine were based on the AP42 section 1.4: Natural Gas Combustion and the NPI Emission estimation technique manual for Combustion Engines v3.0 (June 2008). Calculations were applied to individual processes to obtain an emission to air estimate, based on operational information provided by McCain. The specific processes and emission rates are discussed in detail below.

The four diesel generators serve primarily as backup power to support existing operations. For this AIR, Generators 1 to 3 were assumed to operate from 08:00 to 14:00, one day per month over a twelve-month period. Generator 4 was assumed to operate from 08:00 to 10:30, also one day per month over twelve months. All generators run simultaneously during these operational windows.

Operation of the gas engine was assumed as continuous for 24 hours a day, 365 days a year. No additional operation for maintenance has been considered, and no abatement equipment is proposed for installation on the diesel generators or gas engine.

Table 5-2 (presented earlier) provides the point source emission rates for Scenario 1 and 2.

Storage Tanks

Emissions from the storage of organic liquids occur because of evaporative loss of the liquid during storage and changes in liquid levels. The emission mechanisms vary with tank design but in general these comprise breathing or standing losses and working losses. McCain's liquid storage comprises fixed roof tanks and underground tanks. Fixed roof tanks are either freely vented or equipped with a pressure vent and are considered the minimum acceptable equipment for storing organic liquids. The earth surrounding underground storage tanks limit the influence of diurnal temperature changes and thus mitigate evaporative losses better (US EPA, 2020).

The *Modelling Regulations* recommend the use of the US EPA and American Petroleum Industry (API) TANKS 4.0.9d model for estimating emissions from bulk liquid storage tanks. TANKS is Windows-based software created on the emission estimation procedures from the US EPA's AP-42 emission estimation manual. TANKS uses chemical, meteorological, roof fitting and rim seal data to generate breathing and working loss estimates for various types of storage tanks, including:

- Vertical and horizontal fixed roof tanks.
- Internal and external floating roof tanks.
- Domed external floating roof tanks.
- Underground tanks.

The US EPA TANKS 4.0.9d model requires local meteorological input at an annual and monthly resolution. Surface meteorology (ambient temperature, wind speed and humidity) from the Weather Research and Forecasting (WRF) meteorological data for 2022 - 2024. WRF data was used instead of local meteorological data from the Delmas monitoring station, as the station had poor data recovery for temperature (73.6%) and wind (67.4%). Annual and monthly average meteorological variables (in imperial units as required for TANKS input) are presented in **Table 5-4**.

Table 5-4 - Meteorological data input for TANKS model calculations

Month	Daily Average Ambient Temperature (F)	64.2	Atmospheric Pressure (PSIA)	12.2
	Daily Maximum Ambient Temperature (F)	Daily Minimum Ambient Temperature (F)	Solar Insulation Factor (Btu/ft ² /day)	Average Wind Speed (mph)
January	76.8	63.5	1,858.9	7.1
February	77.8	65.6	1,843.0	6.7
March	78.7	63.1	1,687.6	6.5
April	71.0	53.7	1,319.6	6.9
May	67.7	49.6	1,046.8	6.4
June	62.4	43.3	1,002.4	7.2
July	59.6	40.0	1,015.1	7.5
August	67.1	46.6	1,357.7	8.0
September	73.4	46.0	1,456.0	9.1
October	77.0	44.3	1,776.4	8.9
November	79.6	57.1	1,833.5	8.4
December	80.8	58.3	1,855.7	8.2
Annual Average	72.7	52.6	1,504.4	7.6

A broad spectrum of chemicals is preloaded into TANKS; Distillate Fuel Oil No. 2 is considered chemically representative of diesel, and TVOC emission rates for diesel were subsequently calculated.

Vegetable oils exhibit extremely low vapor pressures, which means they do not volatilize under normal storage conditions. As a result, they cannot produce measurable emissions when modelled using the U.S. EPA TANKS 4.09d program, which is designed for volatile organic compounds. Furthermore, vegetable oils are composed primarily of triglycerides and do not contain petroleum hydrocarbons. Consequently, oily wastewater derived from vegetable oils is not a petroleum-based material and falls outside the scope of TANKS modelling requirements.

The US EPA TANKS 4.09d software requires a minimum shell height of 1.5 m; therefore, Tanks 13–16 and 18 could not be modelled. To remain environmentally conservative, emissions from Tank 17 were used as a substitute for the tanks that could not be modelled, representing a worst-case emission scenario.

Tank specifications, material throughputs and calculated emission rates for tank emissions (working and breathing losses) are provided in **Table 5-5**.

Table 5-5 - Storage tanks specification and emission rates for Scenario 1 and 2

Tank ID	Tank 1	Tank 2	Tank 3	Tank 4	Tank 5	Tank 6	Tank 7	Tank 8	Tank 9	Tank 10	Tank 11	Tank 12	Tank 13	Tank 14	Tank 15	Tank 16	Tank 17	Tank 18	Tank 19	Tank 20
Contents	Sunflower/Palm/Cano la oil Tank 1	Sunflower/Palm/Cano la oil Tank 2	Sunflower/Palm/Cano la oil Tank 3	Glycol Tank 1	Glycol Tank 2	Oily wastewater tank 1	Oily wastewater tank 2	Oily wastewater tank 3	Cooking oil 1	Cooking oil 2	Cooking oil 3	Cooking oil 4	Diesel tank for Forklifts	Diesel tank for Generator 1	Diesel tank for Generator 2	Diesel tank for Generator 3	Diesel tank for Generator 4	Diesel tank for Firewater Pump	Diesel tank for Firewater Pump	Diesel
Horizontal / Vertical?	Vertical	Vertical	Vertical	Horizontal	Horizontal	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical	Vertical	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal
Floating or fixed roof	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
Situation (above or below ground)	Above	Above	Above	Above	Above	Above	Above	Above	Above	Above	Above	Above	Above	Above	Above	Above	Above	Above	Above	Above
Height (m)	11.4	11.4	11.4	2.0	2.0	9.4	6.2	11.4	7.1	7.1	7.1	7.1	1.1	0.5	0.5	0.5	1.7	1.2	1.8	2.8
Diameter (m)	3.3	3.3	3.3	-	-	3.3	2.3	3.6	2.2	2.2	2.2	2.2	-	-	-	-	-	-	-	12.1
Length (m)	3.3	3.3	3.3	-	-	3.3	2.3	3.6	2.2	2.2	2.2	2.2	-	-	-	-	-	-	-	2.4
Maximum liquid height (m)	10.2	10.2	10.2	1.8	1.8	8.4	5.5	10.2	6.4	6.4	6.4	6.4	0.9	0.4	0.4	0.4	1.5	1.0	1.6	2.6
Average liquid height (m)	5.1	5.1	5.1	0.9	0.9	4.2	2.7	5.1	3.2	3.2	3.2	3.2	0.4	0.2	0.2	0.2	0.7	0.5	0.8	1.3
Working volume (m³)	100.0	100.0	100.0	10.0	10.0	68.0	26.0	100.0	25.2	25.2	25.2	25.2	2.0	1.1	1.1	1.1	5.0	2.0	2.0	75.0
Turnovers per year	15.0	15.0	15.0	1.0	1.0	20.0	20.0	20.0	14.8	14.8	14.8	14.8	12.0	22.7	22.7	22.7	5.0	0.7	0.7	1.0
Net throughput (m³/annum)	1,500.0	1,500.0	1,500.0	10.0	10.0	1,360.0	520.0	2,000.0	375.0	375.0	375.0	375.0	24.0	25.0	25.0	25.0	25.0	1.5.0	1.5.0	80.0
Storage temperatur e (°C)	60-65	60-65	60-65	-	-	60-65	60-65	60-65	60-65	60-65	60-65	60-65	-	-	-	-	-	-	-	-
Colour of tank	Silver	Silver	Silver	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Silver	Black	Black	Black	Silver	Red	Red	White
Pressure setting	Atmospheric	Atmospheric	Atmospheric	Atmospheri c	Atmospheri c	Atmospheri c	Atmospheri c	Atmospheri c	Atmospheri c	Atmospheri c	Atmospheri c	Atmospheri c	Atmospheri c	Atmospheri c	Atmospheri c	Atmospheri c	Atmospheri c	Atmospheri c	Atmospheri c	Atmospheri c
TVOC represented by benzene (g/s)																				
Scenario	₋ (6)	₋ (6)	₋ (6)	1.0068E-06 ₋ (6)	1.0068E-06 ₋ (6)	₋ (6)	₋ (6)	₋ (6)	₋ (6)	₋ (6)	₋ (6)	₋ (6)	6.3288E-06 - (6)	6.3288E-06 - (6)	6.3288E-06 - (6)	6.3288E-06 - (6)	6.3288E-06 - (6)	6.3288E-06 - (6)	5.8973E-06 - (6)	7.6233E-06 - (7)
Notes: (1) Tank working volumes are calculated based on an assumed maximum liquid height of 90%. (2) Average liquid heights were assumed to be 50% of the maximum liquid height. (3) Where actual storage tank shell colours were not available options in TANKS 4.0.d, colour substitutes were applied. (4) A gas exit velocity of 0.001 m/s is assigned to all modelled tanks, in line with the <i>Modelling Regulations</i> . (5) Since throughputs for Tanks 1 – 19 under Scenarios 1 and 2 do not change, the emission rates remain the same. (6) Scenario 1. (7) Scenario 2.																				

5.5.2 AREA AND LINE SOURCE EMISSIONS

5.5.2.1 Coal Handling and Storage

Atmospheric dust arises from the mechanical disturbance of granular material exposed to the air. Dust generated from such open sources is termed "fugitive" because it is not discharged to the atmosphere in a confined flow stream. Common sources of fugitive dust include unpaved roads, agricultural tilling operations, aggregate storage piles, and heavy construction operations. The dust-generation process is caused by two basic physical phenomena (US EPA, 1995):

- Pulverization and abrasion of surface materials by the application of mechanical force through implements (wheels, blades, etc.).
- Entrainment of dust particles by the action of turbulent air currents, such as wind erosion of an exposed surface by wind speeds over 5.4 m/s.

Activities resulting in fugitive dust emissions at McCain include:

- Coal handling and transfer.
- Wind erosion of the stockpile surface.

The approach and input variables used to quantify these sources are presented in the sections that follow.

Materials Handling and Transfer

PM emissions from the handling of coal are calculated using **Equation 1** (US EPA, 2006):

$$E = k(0.0016) \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \quad \text{Equation 1}$$

Where:

- E = emission factor (kg/Mg)
- k = aerodynamic particle size multiplier (PM₁₀ = 0.35, PM_{2.5} = 0.053)
- U = mean wind speed (m/s)
- M = material moisture content (% by weight)

Wind Erosion

PM emissions from the wind erosion of the exposed surface of the coal stockpile is calculated by **Equation 2** (NPI, 2012):

$$EF_{TSP(kg/ha/yr)} = 1.9 \times \left(\frac{s(\%)}{1.5}\right) \times 365 \times \left(\frac{365-p}{235}\right) \times \left(\frac{f(\%)}{15}\right) \quad \text{Equation 2}$$

Where:

- s(%) = silt content (% by weight)
- p = number of days per year when rainfall is greater than 0.25 mm
- f(%) = percentage of time that wind speed is greater than 5.4 m/s at the mean height of the stockpile

In line with guidance provided by the NPI EET (NPI, 2012):

- 50% of TSP is assumed to be within the PM₁₀ particle size fraction. Similarly, 50% of PM₁₀ is assumed to be within the PM_{2.5} particle size fraction.
- A control efficiency of 30% is applied for "windbreaks" as the coal stored by McCain is located between buildings.

Source parameters and calculated emission rates are provided in **Table 5-6**.

Table 5-6 - Fugitive emission source parameters and calculated emission rates

Source name	Coal bunker	
Activity	Storage of coal	
Material type	Coal	
Material moisture content ^(a)	3.4 %	
Material silt content ^(b)	20 %	
Quantity of material handled / transferred / consumed (tons/annum)	17,000.0	
Height of stockpile (m) ^(c)	2.4	
Area of source (m ²)	331.5	
Emissions control	Windbreaks	
Control efficiency	30 %	
Emission interval	Continuous	
Emission rate (kg/annum)	PM ₁₀	PM _{2.5}
Handling	1.7623E-04	2.6686E-05
Wind erosion	9.9060E-04	4.9530E-04
^(a) The US EPA lower range value for typical moisture content of coal (US EPA, 2006).		
^(b) The US EPA upper range value for typical silt content of coal (US EPA, 2006).		
^(c) Assuming the height of the coal stockpile does not exceed 2.4 m (i.e., the height of the facility's perimeter fence)		

5.5.2.2 Paved Roads

Particulate matter emissions associated with trucks travelling on paved roads at McCain were calculated using emission factors from Chapter 13.2.1: Paved Roads of the USEPA AP42 (US EPA, 1995). Particulate matter emissions from paved roads are due to direct emissions from vehicles in the form of exhaust, brake wear, tyre wear emissions and the re-suspension of loose material on the road surface (USEPA, 2011). **Equation 3**, used to determine particulate emission rates from vehicles travelling on paved roads at Municipal Solid Waste Landfills (as a substitute since there is no direct relevant industry available in the documentation), is presented below:

$$E = k(sL)^{0.91} X (W)^{1.02} \quad g/VKT \quad \text{Equation 3}$$

Where:

k = particle size multiplier (PM₁₀ = 0.62; PM_{2.5} = 0.15)

sL = road surface silt loading (9.7 g/m² (USEPA, 2011))

W = average vehicle weight (23.98 tonnes for a 34-tonne truck, and 5.56 tonnes for an 8-tonne truck)

These emission factors relate the amount of particulate emissions (in grams) to the number of kilometres travelled by vehicles on site.

The particulate matter emissions rates for truck movement on the various paved roads remain the same under Scenarios 1 and 2 (**Table 5-7**).

Truck type and loading parameters were provided by McCain. For the current site layout, paved roads are 4 m wide, one-way, with an onsite speed limit of 10 km/hour. No information on diesel trucks was provided; therefore, these vehicles are excluded from this AIR.

For the proposed operations, chemical delivery trucks (approximately three per month) and trucks removing dewatered solids (approximately two per day) will access the site. Given the low frequency and limited volumes associated with these activities, the resulting emissions, even when viewed cumulatively are considered negligible and have not been included in this AIR.

Calculations of emissions from light duty vehicles (LDVs) are not included in this assessment because of the relatively low number of LDVs operating on site and their negligible contribution to overall emissions compared to trucks.

Table 5-7 - Particulate matter emission rates on paved roads for Scenario 1 and 2

Truck type	No. of trucks/day	Vehicle kilometres travelled per day	Calculated emission rate (g/s)	
			PM ₁₀	PM _{2.5}
Food oil trucks	1	0.4	4.4719E-04	1.0819E-04
French fry trucks	14	17.31	1.4641E-02	3.5422E-03
Coal trucks	2	0.6	1.0605E-03	2.5657E-04

5.5.2.3 Odour and Wastewater Treatment

Volatile organic compounds (VOCs), H₂S and NH₃ are emitted from wastewater treatment, collection, and storage systems, through the evaporation of compound molecules at the liquid surface (Department of Agriculture, Water and Environment, 2011). Sources of atmospheric emissions from Wastewater Treatment Works (WWTW) include aeration during primary treatment, aerobic digestion, mechanical thickening of sludge, anaerobic digestion, sludge drying and flaring (as applicable). Odour problems associated with WWTW can be complex with odour originating from several components in the plant area which are commonly located outside.

According to Marquez, *et al.* (2022), biological treatment is an environmentally friendly method of transforming organic material into harmless by-products (e.g. carbon dioxide or mineral salts such as sulphates) and is also considered the most influential component of the wastewater treatment process in the elimination of soluble pollutants. The biodegradation of organic matter results in the generation of sewage sludge, liquid effluent, and malodorous gases. Volatile sulphur compounds (such as H₂S) are primarily responsible for the unpleasant odours associated with wastewater treatment and can account for up to 90% of the malodorous gas emissions (Marquez, *et al.*, 2022). The odour impact caused by WWTW on surrounding areas is closely related to the organic load of the wastewater influent as well as the quantity of sludge produced. Intrinsically, impacts can vary widely between individual facilities. Different chemical and biological processes and processing conditions, such as pH, temperature and retention time, also have a great effect on the odour character. Long retention times and low oxygen levels or even complete anaerobic conditions favour the generation of malodorous sulphur compounds (Belgiorno, Naddeo, & Zarra, 2013).

Marquez, *et al.* (2022) noted that odour emissions tend to decrease as the wastewater moves through the treatment process and the biological stability of the material increases; however, also highlighted sludge handling activities (which occur toward the end of the treatment process) as the major source of odour, regardless of the biological treatment process utilised.

Effluent Treatment

VOC and NH₃ emissions from the treatment of process effluent (industrial based) are calculated using NPI emission factors for Wastewater Treatment (NPI, 2011). Emissions are calculated using the applicable emission factors (**Table 5-8**) and **Equation 4**:

$$E_i = EF_i \times Q_{in} \quad \text{Equation 4}$$

where:

E_i = emission rate for compound (g/day)
 EF_i = emission factor for compound (g/m³)

Q_{in} = liquid volumetric flow rate (m^3/day)

Table 5-8 - Emission factors for wastewater treatment

Pollutant	Emission factors (g/m^3)
NH_3	2.2
TVOC	1.07

McCain currently produces 2,500 m^3 (Scenario 1) of process effluent per day and plans to increase effluent to 3,457 m^3 per day (Scenario 2). Calculated emission rates for effluent treatment are provided in **Table 5-9**.

Table 5-9 - Emission rates for effluent treatment

Pollutant	Emission rate (g/s)	
	Scenario 1	Scenario 2
NH_3	6.3657E-02	8.8025E-02
TVOC ⁽¹⁾	3.0961E-02	4.2812E-02

⁽¹⁾ Benzene is assumed to be representative of TVOCs in this AIR.

Odour

The odour emission factors used for this AIR were developed by Marquez, *et al.* (2022) and are based on odour measurements using dynamic olfactometry. Where the Marquez, *et al.* (2022) study does not account for facility components incorporated into the McCain WWTW design, emission factors developed by Capelli, *et al.* (2009) were substituted to ensure all potential emission sources are accounted for. The Marquez, *et al.* (2022) emission factors apply to each component's uncovered surface area, whereas the Capelli, *et al.* (2009) emission factors are based on total influent throughput. Only the open to air clarifier and aeration basin are considered in this AIR. Odour emission factors are presented in **Table 5-10**.

Table 5-10 - Odour emission factors considered for this assessment

Component Description	Emission Factor Reference	Emission Rate Unit	Emission Factor
Clarifier	Capelli, <i>et al.</i> (2009)	OU_E/m^3	13,100
Aeration basin	Marquez, <i>et al.</i> (2022)	$OU_E/m^2/s$	0.16

In the absence of an established emission factor for H_2S for wastewater treatment, emission rates were back calculated using quantified odour emission rates and an H_2S odour detection threshold (ODT) of 0.2 $\mu g/m^3$ (i.e. the lower range value documented by the WHO (2000)). This approach conservatively assumes that 1 OU_E is equivalent to an H_2S concentration of 0.2 $\mu g/m^3$ and that the odorous emission mixture comprises 100% H_2S .

Component dimensions and operational specifications are provided in **Table 5-11** and the quantified emission rates are presented in **Table 5-12**. In the absence of detailed information, the dimensions for the clarifier and aeration basin were assumed.

Table 5-11 - WWTW component specifications

Component Description	Subsection dimensions			
	Length (m)	Width (m)	Radius (m)	Area (m ²)
Clarifier	-	-	6	113.0
Aeration basin	10	10	-	100

Table 5-12 - Quantified emission rates

Component Description	Component emission rate	
	Odour (OU _E /s)	H ₂ S (g/s)
Scenario 1		
Clarifier	379.0	75.8
Scenario 2		
Clarifier	524.15	104.8
Aeration basin	16	3.2

5.6 EMERGENCY INCIDENTS

As confirmed by McCain, no emergency incidents resulting in atmospheric emissions have occurred at the facility in the past two years.

6 IMPACT OF THE ENTERPRISE ON THE RECEIVING ENVIRONMENT

This section presents the background, methodology and results of the AIR undertaken for McCain.

6.1 ANALYSIS OF EMISSIONS' IMPACT ON HUMAN HEALTH

6.1.1 ATMOSPHERIC EMISSIONS AND IMPACTS

KEY ATMOSPHERIC EMISSIONS

The key pollutant emissions at McCain include NH₃, CO, H₂S, NO_x, Odour, PM, SO₂, and TVOCs. Key emission sources for these pollutants include coal handling, boilers, diesel generators, storage tanks, vehicles on paved roads and WWTP processes.

HEALTH IMPACTS

Ammonia

NH₃ is a colourless gas with a strong, pungent odour, commonly associated with agricultural activities, industrial processes, and the decomposition of organic matter. It is highly soluble in water and can form ammonium compounds. At elevated concentrations, ammonia is irritating to the eyes, skin, and respiratory tract, and prolonged exposure can lead to serious health effects. Inhalation of high levels may cause coughing, chest pain, and pulmonary oedema, posing significant risks to individuals with pre-existing respiratory conditions. Extremely high concentrations can be immediately dangerous to life and health, although such levels typically occur only in confined or poorly ventilated environments (ATSDR, 2004; US EPA, 2011; OEHHA, 2000).

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. Really 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).

Hydrogen Sulphide

H₂S has both natural and anthropogenic origins. It is a colourless, flammable gas that has a distinctive rotten egg smell which is detectable even at low concentrations. Long term exposure to H₂S at low concentrations results in eye irritation, headache, fatigue, respiratory irritation, dizziness, nausea and vomiting. Exposure to higher concentrations can lead to convulsions, inability to breathe, coma and even death (OSHA, 2005; ATSDR, 2006).

Nitrogen Oxides

Under high temperature conditions nitrogen and oxygen atoms in the air react to form nitric oxide (NO). NO is a colourless gas that is non-toxic but is transformed into NO₂ when it is oxidised in the atmosphere. Elevated NO₂ concentrations may lead to asthma, emphysema, bronchitis, damage to lung tissue and even premature death. NO_x may lead to biological imbalances and mutations in vegetation, limits visibility and contributes to the formation of acid rain via the production of nitric acid. Further oxidation of NO₂ may lead to the formation of nitrate aerosols, which further limit visibility and affect the natural environment. Most importantly, however, NO_x contributes to the formation of tropospheric O₃, an important atmospheric oxidant, a major air pollutant and a key greenhouse gas (Seinfeld and Pandis, 1998; Fenger, 2002; US EPA, 2011).

Odour

The complex and dynamic nature of odour, the variability of the constituent gases over time, the influence of meteorological conditions and the subjectivity of olfactory perception, complicates the effective regulation of odour (Belgiorno, Naddeo, & Zarra, 2013). Environmental odour can have a negative impact on both quality of life and economic activity even if the constituent gases at ambient concentrations pose little threat to human health (in the generally accepted meaning of the term). According to the World Health Organisation (WHO), health is not only the absence of disease but includes physical, mental, and social well-being. In general, the regulation of odour internationally is framed around a nuisance impact, either under air quality or nuisance regulations. In South Africa, odour regulations have not been promulgated.

Particulate Matter

PM refers to solid or liquid particles suspended in the air. PM varies in size from particles that are only visible under an electron microscope to soot or smoke particles that are visible to the human eye. PM contributes greatly to deteriorations in visibility, as well as posing major health risks, as small particles (PM₁₀) can penetrate deep into lungs, while even smaller particle sizes (PM_{2.5}) can enter the bloodstream via capillaries in the lungs, with the potential to be laid down as plaques in the cardiovascular system or brain. Health effects include respiratory problems, lung tissue damage, cardiovascular problems, cancer, and premature death. Acidic particles may damage buildings, vegetation and acidify water sources (US EPA, 2011).

Sulphur Dioxide

SO₂ is produced via the combustion of sulphur rich fuel. SO₂ is a major respiratory irritant, resulting in respiratory illnesses, alterations in pulmonary defences and aggravation of existing cardiovascular disease. SO₂ may also create sulphuric acid because of its water solubility, producing acid rain. Once emitted, SO₂ may oxidize in the atmosphere to produce sulphate aerosols, which are harmful

to human health, limit visibility and in the long-term influence global climate (Seinfeld and Pandis, 1998; Fenger, 2002; US EPA, 2011).

VOC

VOCs are organic compounds that easily vaporize from the solid or liquid phase into a gas. VOCs are released during fuel combustion (wood, coal, petrol or natural gas) and are released from solvents, paints, glues and other chemicals. They consist of a variety of chemicals that have both long term and short-term health effects. Many VOCs are hazardous air pollutants with their 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 nitrogen oxides, 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; US EPA, 2011).

Benzene

Benzene in its purest form is a colourless liquid with an aromatic odour. Crude oil is the largest natural source of benzene, with benzene being used in many products, including plastics, synthetic rubber, glues, paints, furniture wax, lubricants, dyes, detergents, pesticides and some pharmaceuticals (Government of South Australia, 2008). Inhaling very large amounts of benzene over a short period (5 – 10min) can result in death. Exposure to lower concentrations can result in drowsiness, dizziness, headaches, tremors, confusion and unconsciousness. Long-term exposure can result in harmful effects of the tissues that form blood cells, especially bone marrow. Benzene has been identified as a human carcinogen (Government of South Australia, 2011).

Ethylbenzene

Ethylbenzene is a clear, colourless, volatile liquid under standard conditions. It is flammable and combustible at room temperature and standard atmospheric pressure. Ethylbenzene is a naturally occurring component of crude oil and is also formed during the combustion of organic materials. Ethylbenzene is primarily used as a precursor in the production of styrene and cellulose acetate, as well as being found in many industrial, commercial and consumer products. Acute ethyl-benzene exposure following inhalation includes respiratory tract irritation, chest constrictions, dizziness, vertigo and minor haematological changes. Ethylbenzene is thought to be a carcinogen, although research is ongoing (Alberta Environment, 2004).

Toluene

Toluene is a clear, colourless, volatile and flammable liquid under standard conditions. It is naturally occurring in crude oil and petroleum, as well as being formed during the combustion of organic materials. Toluene is widely used as a solvent in paints, varnishes, pesticide formulations, printing inks, dyes, adhesives, sealants, cleaning agents, nail polish and for chemical extractions. After inhalation exposure, toluene is rapidly absorbed from the lungs and distributed to highly vascular tissues such as the brain. Symptoms of acute exposure progress from fatigue, headache and decreased manual dexterity to narcosis as exposure increases. Research has indicated that at concentrations of below 50ppm observable effects are few, although above 50ppm neurological impairment has been observed (Alberta Environment, 2004).

Xylene

Xylenes are monocyclic aromatic compounds with two methyl groups attached to a benzene ring. Xylenes are a naturally occurring component of all petroleum products and are also formed during the combustion of organic materials. Xylenes are predominantly used as an additive to petrol during blending to enhance the fuels octane rating, as well as being used as a solvent in paints, varnishes, pesticide formulations, vitamins, pharmaceuticals, printing inks, dyes, adhesives, cleaning agents and paint removers. Acute poisoning and death have been reported after overexposure or ingestion

of substantial amounts, with an exposure level required for loss of consciousness approximately 10,000 ppm (WHO, 1997). The major symptoms of acute human exposure include irritation of the nasal cavity, throat and eyes, and effects on the central nervous system including headaches, nausea, dizziness, difficulty in concentrating, impaired memory, slurred speech, fatigue, confusion and difficulties in breathing (Alberta Environment, 2004).

6.2 THE REGULATORY FRAMEWORK FOR AIR QUALITY

6.2.1 SECTION 28 – DUTY OF CARE

The Duty of Care obligations set out in Section 28 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (Republic of South Africa, 1998), hereafter referred to as “NEMA”, stipulates that ‘every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment’.

As such, any person or organisation must undertake the following necessary measures, set out by NEMA, to minimize or contain atmospheric emissions:

- Investigate, assess and evaluate the impact on the environment.
- Inform and educate employees about environmental risks of their work and the way their tasks must be performed to avoid causing significant pollution or degradation of the environment.
- Cease, modify or control any act, activity or process causing the pollution or degradation.
- Eliminate any source of the pollution or degradation.
- Remedy the effects of the pollution or degradation.

Failure to comply with the stated conditions or directives constitutes a breach of the Duty of Care under NEMA and exposes the responsible party to sanctions in terms of Section 28. Non-compliance may prompt the competent authority to intervene, take remedial measures, and recover associated costs from multiple parties, including landowners, persons in control of the activity, or those who negligently failed to act.

In the event of prosecution, offenders may face severe penalties under Section 34 of NEMA, including fines of up to R10 million, imprisonment for up to 10 years, or both, as well as additional penalties.

6.2.2 THE NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT, 2004

The objectives of the NEM: AQA (Republic of South Africa, 2005) are to:

- Protect the environment by providing reasonable measures for:
 - The protection and enhancement of air quality.
 - The prevention of air pollution and ecological degradation.
 - Securing ecologically sustainable development while promoting justifiable economic and social development.
 - Give effect to everyone’s right “to an environment that is not harmful to their health and well-being” (Republic of South Africa, 1996).

Significant functions detailed in NEM: AQA include:

- The National Framework for Air Quality Management (Department of Environmental Affairs, 2018).
- Institutional planning matters

- The establishment of a National Air Quality Advisory Committee.
- The appointment of Air Quality Officers (AQO) at each level of government.
- The development, implementation, and reporting of Air Quality Management Plans (AQMP) at national, provincial, and municipal levels.
- Air quality management measures
 - The declaration of Priority Areas where ambient air quality standards are being, or may be, exceeded.
 - The listing of activities that result in atmospheric emissions and which have the potential to impact negatively on the environment and the licensing thereof through an AEL.
 - The declaration of Controlled Emitters.
 - The declaration of Controlled Fuels.
 - Procedures to enforce Pollution Prevention Plans or Atmospheric Impact Reporting for the control and inventory of atmospheric pollutants of concern.
 - Requirements for addressing dust and offensive odours.

With respect to odour control, Section 35 of NEM: AQA (under Part 6: Control measures in respect of dust, noise, and offensive odours) states the following:

- The minister or Member of the Executive Council may prescribe measures for the control of offensive² odours emanating from the specified activities.
- The occupier of any premises must take all reasonable steps to prevent the emission of any offensive odour caused by any activity on such premises.

6.2.3 SECTION 21 OF THE NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT – LISTING OF ACTIVITIES

Section 21 of NEM:AQA tasks the Minister with the responsibility of publishing a list of activities which result in atmospheric emissions, and which he/she reasonably believes have or may have a significant detrimental effect on the environment, including health, social conditions, economic conditions, ecological conditions, or cultural heritage. This list applies nationally.

The current operations or proposed by McCain do not trigger any of the Listed Activities under Section 21 of NEM:AQA, as amended (Department of Environmental Affairs, 2013; Department of Environmental Affairs, 2015; Department of Environmental Affairs, 2015). As such, McCain is not required to comply to any MES stipulated by these regulations nor hold an AEL.

6.2.4 SMALL BOILERS AS A CONTROLLED EMITTER

Since each boiler is below 10 MW and as indicated in the stack emission reports, the boilers at McCain fall below the limits for regulation under Section 21 of NEM:AQA and the Declaration for Small Boilers as Controlled Pollutants and Establishment of Emission Standards of 2013 (Government Gazette 36973 Notice 831).

² 'Offensive odour' is defined by NEM:AQA as any smell which is considered to be malodorous or a nuisance to a reasonable person.

6.2.5 SECTION 30 OF THE NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT – ATMOSPHERIC IMPACT REPORTS

An AQO may require any person to submit to the air quality officer an AIR if s/he reasonably suspects that the person has on one or more occasion contravened or failed to comply with NEM:AQA or any conditions of a license and that such contravention or failure has had, or may have a detrimental effect on the environment (including health, social and economic conditions or cultural heritage) or has contributed to the degradation of ambient air quality.

Any person required to submit an AIR must do so in the prescribed format published under Government Notice 747 in Government Gazette 36904 dated 11 October 2013; as amended by Government Notice R284 in Government Gazette 38633 dated 2 April 2015 (Department of Environmental Affairs, 2013; Department of Environmental Affairs, 2015).

6.2.6 HIGHVELD PRIORITY AREA AIR QUALITY MANAGEMENT PLAN

McCain is located in the Mpumalanga Province that falls within the Highveld Priority Area (HPA). 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; Department of Environmental Affairs and Tourism (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 Plans (first generation) (HPA AQMP) is to achieve and maintain compliance with the National Ambient Air Quality Standard (NAAQS) across the HPA, using the constitutional principal of progressive realisation of air quality improvements. 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).

The second generation HPA AQMP published on 26 March 2025 by the Department of Forestry, Fisheries, and the Environment (DFFE) aims to establish emission reduction targets by enhancing the understanding of how various interventions impact ambient air quality in the HPA, thereby supporting continued improvement and eventual compliance within the priority area.

The McCain operation is located within the HPA and thus required to operate within the air quality requirements of the HPA AQMPs and related regulations.

6.2.7 LOCAL BY-LAWS

The Nkangala District Municipality (NDM) adopted the Air Quality Management By-law of 2015. Under the by-law air pollution is defined as any change in air composition caused by smoke, soot, dust (including fly ash), cinders, solid particles of any type, gases, fumes, aerosols, or substances that produce odour.

In respect of small boilers, no person may install, modify, extend, or replace a small boiler without prior written approval from the Municipality. Authorisation will only be granted if:

- The application is submitted in the prescribed municipal format.
- All required information is provided and reviewed.
- The boiler can comply with applicable emission standards under the NEM:AQA.

For dust emissions anyone carrying out an activity or operating a facility that typically generates dust emissions harmful to health or causing a nuisance must implement effective control measures to prevent dust from entering the atmosphere.

Regarding emissions that cause a nuisance, the by-law states that regardless of other provisions in the by-law, no person may create, cause, or permit emissions, including odours that result in a nuisance.

“Nuisance” refers to any unreasonable or likely interference from air pollution that affects:

- The health or well-being of people or living organisms.
- The use or enjoyment of property or the environment.
- Ordinary comfort, convenience, or peace.

Penalties for a person convicted of an offence include but are not limited to a fine not exceeding ten million rands or imprisonment not exceeding thirty days. Should the person convicted persist with the activity, they are further liable to a fine not exceeding ten thousand rands or imprisonment not exceeding twenty days.

6.2.8 SECTION 9 OF THE NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT – NATIONAL STANDARDS

Section 9 of NEM:AQA tasks the Minister of the DFFE with the responsibility of identifying substances or mixtures of substances in the ambient air which, through ambient concentrations, bioaccumulation, deposition or in any other way, present a threat to health or well-being and the subsequent establishment of national standards for ambient air quality for these substances.

Ambient air quality standards are defined as “targets for air quality management which establish the permissible concentration of a particular substance in, or property of, discharges to air, based on what a particular receiving environment can tolerate without significant deterioration” (Department of Environmental Affairs, 2000). The aim of these standards is to provide a benchmark for air quality management and governance. Ambient air quality criteria apply to areas where the Occupational Health and Safety regulations (Republic of South Africa, 1993) do not apply, which is generally outside the property or lease area.

The South African NAAQS for the pollutants that have been considered in this study are presented in **Table 6-1** and became applicable for air quality management from their promulgation in 2009 (Department of Environmental Affairs, 2009) and 2012 (Department of Environmental Affairs, 2012). The NAAQS generally have specific averaging periods, compliance timeframes, permissible frequencies of exceedance and measurement reference methods.

Table 6-1 - South African National Ambient Air Quality Standards

Pollutant	Averaging Period	Concentration (µg/m ³)	Permissible Frequency of Exceedance ⁽²⁾
PM ₁₀	24-hour	75	4
	1-year	40	0
PM _{2.5}	24-hour	40	4
		25 ⁽¹⁾	4
	1-year	20	0
		15 ⁽¹⁾	0
Benzene	1-year	5	0
SO ₂	10-minute	500	526

	1-hour	350	88
	24-hour	125	4
	1-year	50	0
NO ₂	1-hour	200	88
	1-year	40	0
CO	1-hour	30 000	88
	8-hour	10 000	11
O ₃	8-hour	120	11
Lead	1-year	0.5	0
⁽¹⁾ Effective date is 01 January 2030.			
⁽²⁾ This exceedance is applicable to a calendar year			

6.2.8.1 Criteria for Hydrocarbon Exposure

TVOCs is the term used for a class of several hundred carbon based chemical compounds that evaporate easily into air. Some VOCs have no known human health effects while the toxicity and carcinogenicity of others is well established. Little is known about how VOCs combine in the atmosphere or what the potential cumulative impacts might be on the human body, making analysis, risk assessment and guideline setting difficult.

No local standards or international guidelines have been set for the assessment of cumulative ambient TVOC concentrations. Benzene is the only VOC with an established NAAQS in South Africa. For the purposes of this assessment, TVOC has been conservatively treated as equivalent to benzene. Therefore, if the benzene NAAQS is not exceeded, it can be considered a safe estimate for the overall impact of TVOCs.

6.2.9 INTERNATIONAL GUIDANCE

In the absence of local guidelines and standards for H₂S, NH₃ and odour international guidance is sought from recognised environmental bodies.

6.2.9.1 World Health Organisation

The WHO provide guidelines for protecting public health from the adverse effects of air pollutants and to eliminate or reduce exposure to those pollutants that are known or likely to be hazardous to human health or well-being. The guidelines are based on expert evaluation of current scientific evidence and are intended to inform policy makers and to provide targets for air quality management. In establishing pollutant levels below which exposure does not constitute a significant public health risk over a specified period, the guidelines provide a basis for setting standards or limit values for air pollutants. In general, the guidelines address single pollutants (identified to be of special environmental and health significance to countries of the European Region) whereas in reality, exposure to mixtures of chemicals occurs, with potentially additive, synergistic or antagonistic effects. In dealing with practical situations or standard-setting procedures, therefore, consideration should be given to the interrelationships between the various air pollutants. In setting legally binding standards, considerations such as prevailing exposure levels, technical feasibility, source control measures, abatement strategies, and social, economic and cultural conditions also should be considered (World Health Organisation, 2000).

6.2.9.2 Texas Commission on Environmental Quality

The Texas Commission on Environmental Quality (TCEQ) is the environmental agency for the state of Texas in the United States. TCEQ have developed Effects Screening Levels (ESLs) to evaluate impacts from pollutant concentrations predicted by dispersion modelling simulations. ESLs, which

include both short- (1-hour) and long-term (annual) limit values, are chemical-specific concentration limits set to protect human health and welfare. They are not ambient air quality standards but rather a guideline as to whether airborne contaminants present adverse risk. Short-term ESLs are based on data concerning acute health effects, the potential for nuisance odour and effects on vegetation, while long-term ESLs are based on data concerning chronic health and vegetation effects. Welfare ESLs (i.e., odour and vegetation effects) are based on effect thresholds while health ESLs are based on toxicity factors and dose responses relevant to humans (Texas Commission on Environmental Quality, 2006).

6.2.9.3 California Office of Environmental Health Hazard Assessment

The California Office of Environmental Health Hazard Assessment (OEHHA) is the lead agency for the assessment of health risks posed by environmental contaminants in the state of California, United States. OEHHA have developed risk assessment guidelines with defined Reference Exposure Levels (RELs) for airborne contaminants. An REL is the concentration level at or below which no adverse non-cancer health effects are anticipated for the specified exposure duration (i.e., acute 1-hour and chronic annual exposure). RELs are designed to protect the most sensitive individuals in the population by the inclusion of factors that account for uncertainties as well as individual differences in human susceptibility to chemical exposures. The factors used err on the side of public health protection to avoid underestimation of non-cancer hazards and as such, exceeding the REL does not automatically indicate an adverse health impact. Increasing concentrations above the REL value increases the likelihood that the health effect will occur (California Office of Environmental Health Hazard Assessment, 2015).

Guidelines for health impacts from airborne exposure to H₂S, NH₃ and odour established by the organisations summarised below, is provided in **Table 6-2**.

Table 6-2 - International health-based guidelines for pollutants or averaging periods not regulated by NAAQS

Pollutant	Averaging period	TCEQ ESL (µg/m ³)	OEHHA REL (µg/m ³)	WHO (µg/m ³)
NH ₃	1-hour	180	3,200	-
	1-year	92	200	-
H ₂ S	1-hour	-	42	-
Odour	30-minute	-	-	7
Red	The most stringent of the 1-hour and 1-year guideline values recommended by the international bodies referenced above, are used in this study to assess impacts.			

6.3 NUISANCE

The complex and dynamic nature of odour, the variability of the constituent gases over time, the influence of meteorological conditions and the subjectivity of olfactory perception, complicates the effective regulation of odour (Belgiorno, Naddeo, & Zarra, 2013). Environmental odour can have a negative impact on both quality of life and economic activity even if the constituent gases at ambient concentrations pose little threat to human health (in the generally accepted meaning of the term). According to the WHO, health is not only the absence of disease but includes physical, mental, and social well-being as well. In general, the regulation of odour internationally is framed around a nuisance impact, either under air quality or nuisance regulations. In South Africa, odour regulations have not been promulgated, and until such time that they are, the general application of nuisance common law applies.

Common law entitles everyone to the undisturbed use and enjoyment of his or her land if s/he complies with legislation and if that use poses no threat to anyone or their property. Conversely,

common law imposes duties on neighbours to tolerate and to endure to a certain extent their neighbour's reasonable exercise of ownership powers or rights. If one neighbour exceeds the regulatory demarcation of tolerance; however, s/he has exceeded the legal limit of reasonable exercise of his or her ownership rights and this constitutes a nuisance.

If the issue cannot be addressed between the neighbours, a written complaint can be made to the Local Authority before the Court is approached. Should this prove unsuccessful, the offended neighbour can approach the court for an interdict to prevent the nuisance. Not all forms of nuisance are actionable. An actionable nuisance occurs when the actions of the offending property are outside of what is proper, befitting and socially adequate in the light of the convictions of the society – *secundum bonos mores* (Regal v African Superslate (Pty) Ltd 1963 (1) SA 102 (AD)).

If the application for an interdict is successful, but the offending neighbour persists with his or her unlawful actions, s/he may be found guilty of contempt of court, in which case the court may impose a fine or imprisonment. In addition, such conduct may constitute a breach of the general Duty of Care under Section 28 of the NEMA, which may be enforced through the issuing of a compliance or remedial directive by the competent authority. An affected neighbour may also seek to compel such enforcement in terms of section 28(12) of NEMA. Continued non-compliance may further expose the offending party to civil liability, private prosecution, and/or criminal sanctions, including fines, imprisonment, and claims for damages under Section 34 of NEMA.

6.3.1 INTERNATIONAL ODOUR ASSESSMENT CRITERIA

While South Africa's odour legislation is limited to the prevention of unreasonable nuisance, nations of the European Union, North America and Australasia have well established odour regulations, many of which incorporate odour standards or impact criteria. Assessment tools such as dynamic olfactometry and dispersion modelling are applied to determine nuisance potential. Complaints are also investigated by trained inspectors, who use a checklist to characterise the odour based on hedonic tone, frequency and intensity (Minnesota Pollution Control Agency, 2004). When an offense has been committed (including failure to comply with permit conditions), the regulator has reasonable grounds to suspend the activity or take enforcement action.

Odour impact criteria guidelines assist with the assessment of model simulated nuisance impacts. By definition, the limit of detection of an odour by an average human nose under laboratory conditions is 1.0 European odour unit per metre cubed of air (OU_E/m^3) (Bull, *et al.*, 2018).

Criteria limits for acceptable odour exposure have been established for an array of international jurisdictions although with significant variation in application (**Table 6-3**).

Table 6-3 - Criteria limits for acceptable odour exposure

Region	Limit value (OU/m^3)	Percentile	Averaging period	Applicability
New South Wales (Australia)	2 (urban) - 7 (rural)	99 th	1-second	Limit value dependent on population density surrounding the odour source (i.e., rural vs urban population densities)
Germany	1	90 th	1-second	Residential areas
Hong Kong	5	100 th	5-second	Nearest sensitive receptor
Ontario (Canada)	1	99.5 th	10-min	At sensitive receptors
Tasmania	2	99.5 th	1-hour	-
New Zealand	5	99.5 th	1-hour	Moderate sensitivity (all conditions)

Norway	1	99 th	1-hour	Nearest residential receptor
France	5	98 th	1-hour	Bio-stabilisation plants
Catalonia (Spain)	5	98 th	1-hour	Moderately offensive odour (e.g., WWTW).
Colombia	3	98 th	1-hour	Treatment and disposal of non-hazardous wastes, transfer plants, wastewater treatment plants
Netherlands	1	98 th	1-hour	WWTW built after 1996, (outside urban areas)
United Kingdom	1.5	98 th	1-hour	Highly offensive odour (e.g., septic effluent, biological landfill, etc.).
	3			Moderately offensive odour (e.g., fat frying, livestock rearing, etc.)
	6			Less offensive odour (e.g., brewery, confectionery, etc.)
Ireland	1.5	98 th	1-hour	Target value for all situation (excl. pig production)
Belgium	0.5	98 th	1-hour	Target for very unpleasant odours in high sensitivity areas
	2			Limit for very unpleasant odours in high sensitivity areas

The odour impact criteria established by the United Kingdom (UK) is proposed as an appropriate guideline to evaluate the degree of odour nuisance impact for this assessment. Expressed as the 98th percentile of the hourly mean odour concentrations, a value of 6.0 OU_E/m³ is suggested as appropriate for 'less offensive' odours, 3.0 OU_E/m³ for 'moderately offensive' odours and 1.5 OU_E/m³ for the 'most offensive' odours.

The impact is based on predicted odour concentrations at identified sensitive receptors in line with the UK Institute of Air Quality Management (IAQM) guidance (Bull, *et al.*, 2018). The IAQM classifies sensitive receptors into low, medium, or high sensitivity as described in **Table 6-4**.

Table 6-4 - Receptor sensitivity to odour classification

High Sensitivity Receptor	<p>Surrounding land where:</p> <ul style="list-style-type: none"> Users can reasonably expect enjoyment of a high level of amenity. People would reasonably be expected to be present here continuously, or at least regularly for extended periods, as part of the normal pattern of use of land. <p>Examples may include residential dwellings, hospitals, schools/education, tourist/cultural and food retail/processing.</p>
Medium Sensitivity Receptor	<p>Surrounding land where:</p> <ul style="list-style-type: none"> Users can reasonably expect enjoyment of a high level of amenity. People wouldn't reasonably be expected to be present here continuously, or at least regularly for extended periods, as part of the normal pattern of use of land. <p>Examples may include places of work, commercial/retail premises and sports/recreation fields.</p>
Low Sensitivity Receptor	<p>Surrounding land where:</p> <ul style="list-style-type: none"> The enjoyment of amenity would not reasonably be expected. There is transient exposure, where the people would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of land. <p>Examples may include industrial use, farms, footpaths and roads.</p>

The sensitivity classification of the receptor, as well as the predicted odour concentration at the receptor in question is then used to establish the impact significance at that specific receptor (**Table 6-5**). For example, a predicted 98th percentile concentration of 6 OU_E/m³ at a low sensitivity receptor would result in a moderate significance.

Table 6-5: Odour effect descriptors for impacts predicted by modelling

Odour concentration (OU _E /m ³)	Receptor Sensitivity		
	Low	Medium	High
≥10	Moderate	Substantial	Substantial
5 - 10	Moderate	Moderate	Substantial
3 - 5	Slight	Moderate	Moderate
1.5 - 3	Negligible	Slight	Moderate
0.5 – 1.5	Negligible	Negligible	Slight
<0.5	Negligible	Negligible	Negligible

6.4 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 influenced by wind speed in combination with surface roughness.

Parameters that need to be considered 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, site-specific meteorological data is required. As site-specific meteorological data is unavailable for McCain Delmas, data from the Delmas Air Quality Monitoring Station (AQMS), operated by the Mpumalanga Province, was used. Located approximately 2.2 km southeast of the Project site (26.1403°S, 28.6970°E), the Delmas AQMS is the closest representative station. Meteorological data for the period 2022 to 2024 was obtained from the South African Air Quality Information System (SAAQIS).

The overall data recovery of the meteorological parameters (temperature, relative humidity, rain and wind) for the Delmas AQMS was 71%, below the minimum requirement of 90%, as stipulated by the South African National Accreditation System (SANAS) TR 07-03 standards (SANAS, 2012); therefore, the data should be viewed with caution. Despite the low data recovery, the dataset is included as it is considered sufficient to provide a meteorological overview.

Data recovery statistics from this station are provided in **Table 6-6**.

Table 6-6 - Details of the surface meteorological stations near McCain

Station Name	Period	Latitude (°S)	Longitude (°E)	Altitude (mamsl)	Data Recovery (%)		
					Temperature	Rainfall	Wind
Delmas	2022 - 2024	26.1403	28.6970	1,545	73.6	77.7	67.4

In addition, modelled meteorological data from the Weather Research and Forecasting (WRF) model was purchased from Lakes Environmental Software for the period 2022 – 2024 for comparative analysis. The data coverage is centred over the McCain site (Latitude: 26.1267 S; Longitude: 28.6799 E) with a grid cell dimension of 4 km x 4 km over a 50 km x 50 km domain. The

data is assumed and expected to be representative of the actual experienced meteorological conditions onsite and is further recommended in terms of the *Modelling Regulations*. The percentage recovery for parameters recorded is 100%; therefore, considered reliable for use in this assessment. The AERMET meteorological model contains a diagnostic wind field module that includes parameterized treatments of terrain effects.

6.4.1 TEMPERATURE AND RAINFALL

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 especially in the case of particulate matter. **Figure 6-1** presents the average temperature and monthly rainfall recorded at the Delmas AQMS for the period 2022 - 2024.

Clear seasonal variations are evident in the temperature and rainfall values for the area from both datasets. The region typically receives higher levels of rainfall during the summer months (December, January, and February), with drier conditions on average during the cooler, winter months (June, July, and August). The Delmas AQMS received an average rainfall of 23 mm, 11.5 mm and 24.5 mm of rainfall for 2022, 2023 and 2024, respectively, with approximately 38.9% received during summer and 3.2% during winter. Summer temperatures for the region average 20.6°C while winter temperatures average 10.0°C.

The WRF (**Figure 6-2**) average summer temperature is 1.2°C higher than the Delmas AQMS, and the WRF average winter temperature is 2.4°C higher than the Delmas AQMS. Overall, these temperatures fall within range of each other, as such the WRF temperature data is considered site-representative.

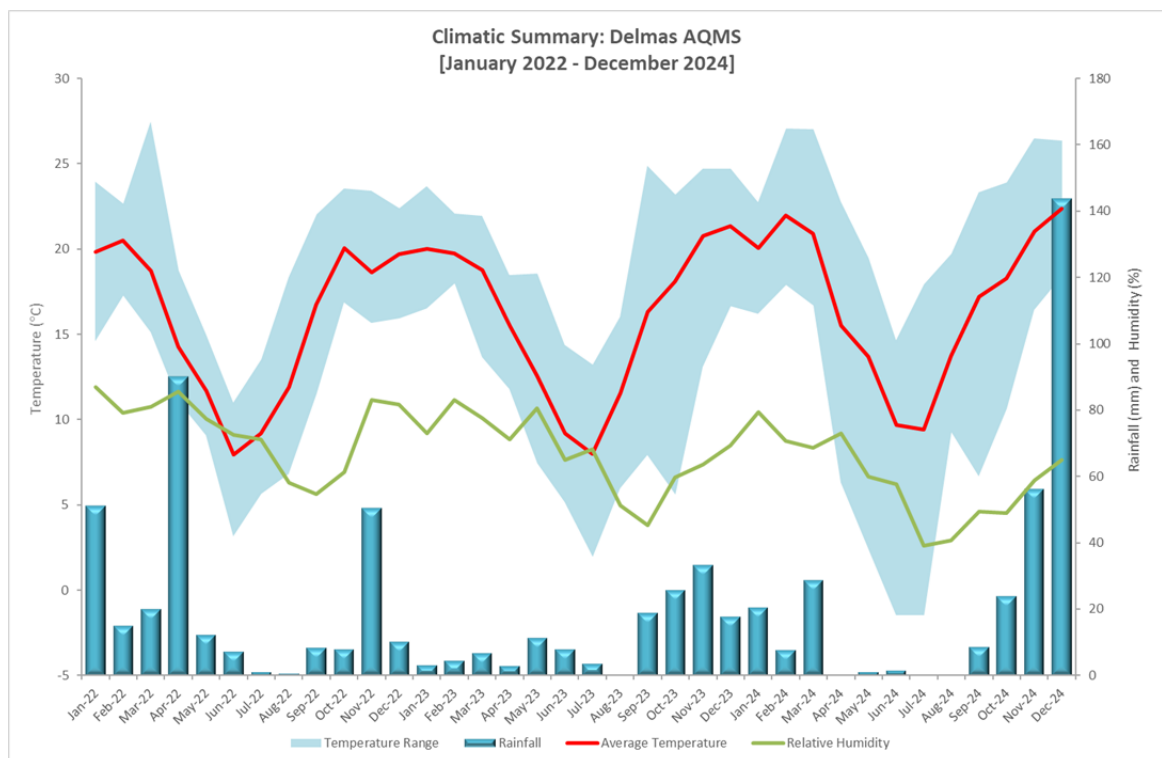


Figure 6-1 - Climatic summary using the Delmas AQMS data (2022 – 2024)

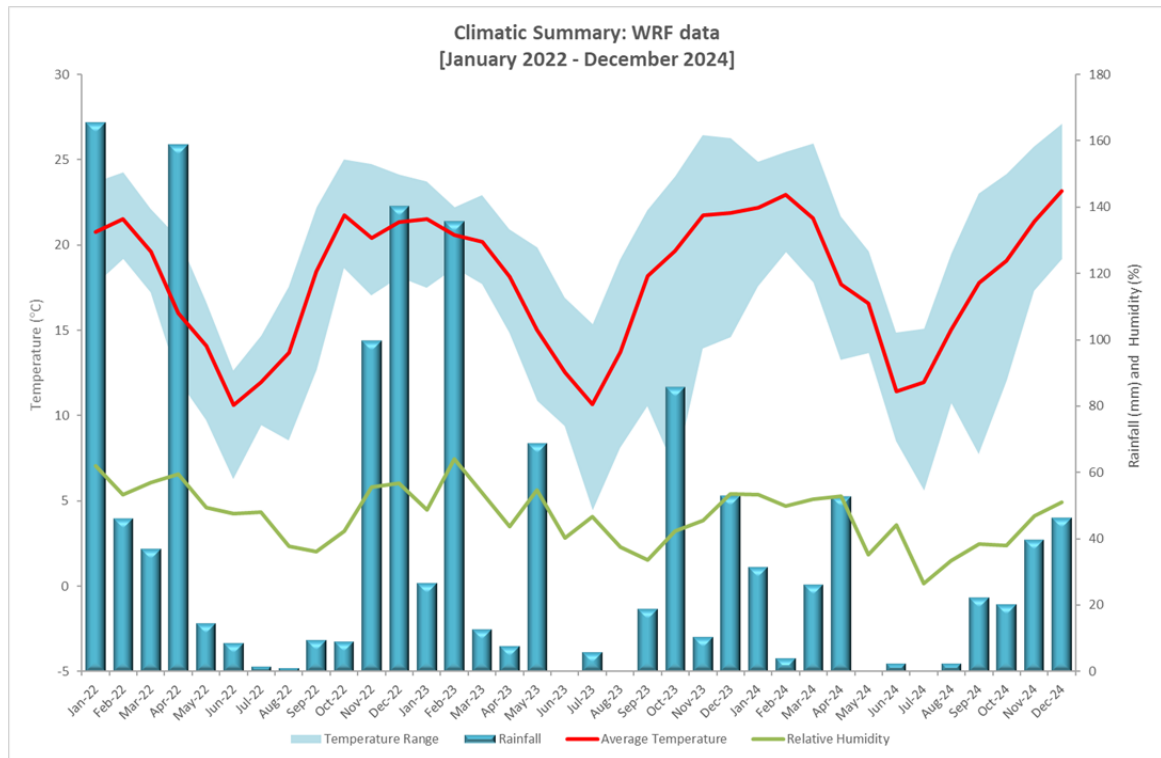


Figure 6-2 - Climatic summary using the WRF data (2022 – 2024)

6.4.2 WINDFIELD

Wind roses are useful for illustrating the prevailing meteorological conditions of an area, indicating wind speeds and directional frequency distributions. In the following wind roses, the colour of the bar indicates the wind speed whilst the length of the bar represents the frequency of winds blowing from a certain direction (as a percentage). Calm conditions are defined as wind speeds less than 0.5 m/s, although it is noted the SAWS wind sensor only records winds from 1 m/s.

Period, seasonal, and diurnal wind roses for the data from the Delmas AQMS are presented in **Figure 6-3**. Period, seasonal, and diurnal wind roses for the AERMET-ready WRF dataset are also presented in **Figure 6-4** for comparative purposes. The following key items are highlighted:

- Calm conditions for the period 2022 – 2024 occurred 9.7% of the time at the Delmas AQMS.
- Predominant winds originated from the northwest, south, northeast and west-northwest for the period. A maximum wind speed of 12.7 m/s and an average wind speed of 2.9 m/s was recorded. Wind speeds greater than 8 m/s occurred for 1% of the time for the period.
- Early morning winds (00:00 – 06:00) originated predominantly from the south. During the morning (06:00 – 12:00), when convective mixing is initiated, winds from the northeast dominated, with smaller components notable from the east, northwest, and south. Winds during the afternoon hours (12:00 – 18:00) dominated from the northwest and west-northwest. At night (18:00 – 24:00) winds from the northwest remained dominant, with an increase in winds from the northeast, north-northeast and south.
- During summer and spring, winds were predominant from the northwest, northeast and west-northwest. In autumn, the northwest and northeast components diminish in frequency, with the introduction of a dominant wind from the south. In winter the wind from the south remains dominant with smaller components from the south-southwest and northwest also notable.

- In comparison, the AERMET-ready WRF dataset exhibited predominant winds from the north and north-northwest for the period 2022 - 2024. The percentage of calm conditions were lower in the WRF dataset when compared to the Delmas AQMS data set (5.3% and 9.7% respectively).
- In the WRF dataset early morning winds (00:00 – 06:00) originated predominantly from the north and north-northeast. During the morning (06:00 – 12:00), when convective mixing is initiated, winds from the north-northwest and north dominated. Winds during the afternoon hours (12:00 – 18:00) dominated from the northwest, west-northwest, north-northwest and north. At night (18:00 – 24:00) winds from the north-northwest remained dominant, with the other components diminishing in intensity.
- In the WRF dataset winds from the north and north-northwest dominate in summer and spring, whereas winds from the west-northwest and north dominate in autumn and winter. Smaller components from the northwest and west-northwest are also notable in winter.
- The WRF and Delmas AQMS illustrate notable temporal differences in wind patterns. This is likely to the poor data recovery from the Delmas AQMS (67.4%), where winds during the period are underrepresented.

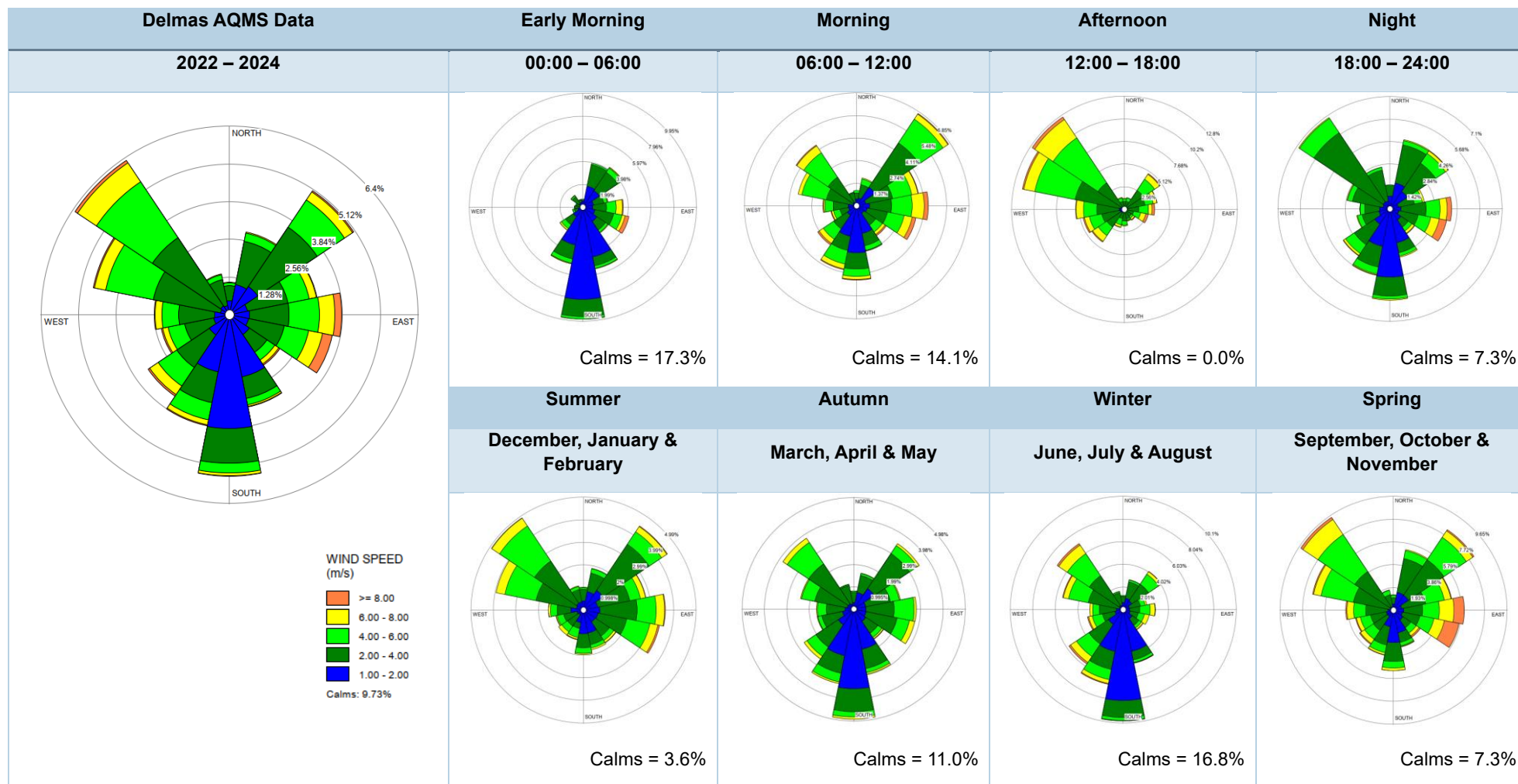


Figure 6-3 - Wind conditions using the Delmas AQMS data for the period 2022 to 2024

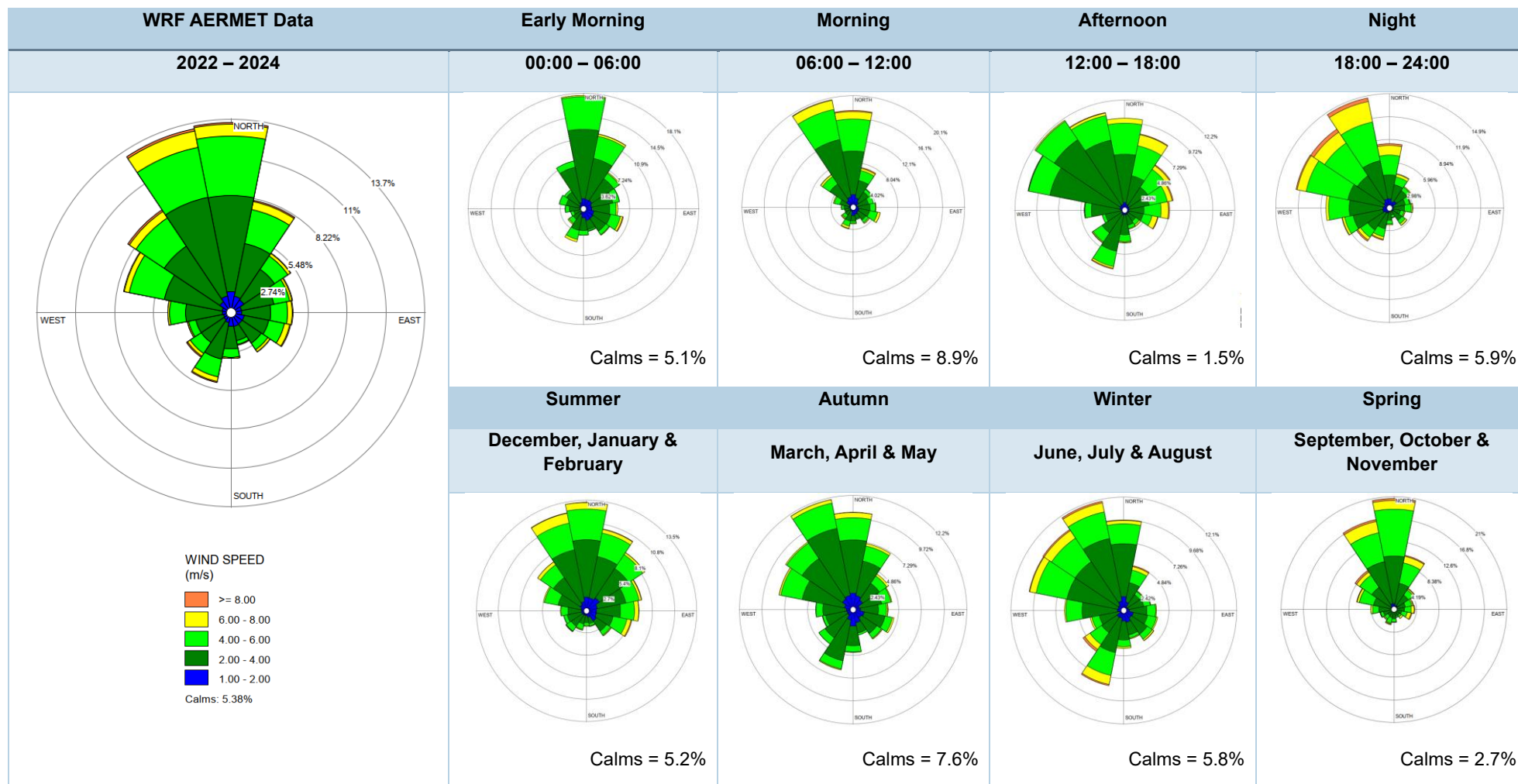


Figure 6-4 - Wind conditions using the WRF data for the period 2022 to 2024

6.5 LOCAL AMBIENT AIR QUALITY

6.5.1 DESCRIPTION OF SOURCES OF EMISSIONS WITHIN THE REGION

Within the Delmas area, several existing sources contribute to atmospheric emissions. These include the Thando Tech Botleng Colliery (~1.4 km west) and the Sephaku Cement Plant (~ 3.3 km south-southeast). Agricultural activities dominate the landscape surrounding McCain. In addition, vehicle exhaust emissions and domestic fuel burning within nearby communities further contribute to local air pollution.

6.5.2 LOCAL MEASUREMENTS

6.5.2.1 Delmas AQMS

The nearest AQMS to McCain is the Delmas AQMS (~2.2 km southeast; 26.1403°S, 28.6970°E). Pollutants monitored by the AQMS include PM₁₀, SO₂, NO₂ and CO. Where hourly concentrations were provided in parts per billion (ppb), these were converted to micrograms per cubic meter (µg/m³) using ambient temperature and pressure as monitored by the station. The AQMS does not monitor PM_{2.5}, benzene, H₂S and NH₃, and no baseline data for these pollutants is otherwise available for this AIR. As such, PM_{2.5}, benzene, H₂S and NH₃ data is not presented.

Data recovery for the Delmas AQMS was below 90% for all pollutants during all years (2022, 2023 and 2024 respectively), below the minimum requirement of 90% as stipulated by the SANAS TR 07-03 (SANAS, 2012). Data recovery for SO₂ (2022) and CO (2022 and 2023) was between 57.6% and 77.2%, which is below the minimum requirement of 90% and although discussed in this section, must be viewed with caution.

Pollutants with a data recovery below 50% in a single year were not considered in this baseline discussion as the data is not representative, highlighted in bold in **Table 6-7**.

Table 6-7 - Data recovery at the Delmas AQMS from 2022 - 2024

Year	Data recovery (%)			
	PM ₁₀	SO ₂	NO ₂	CO
2022	46.4	62.2	12.0	77.2
2023	44.0	43.9	0	57.6
2024	40.7	5.0	0	0

6.5.2.2 Sulphur Dioxide

- The 1-hour average (**Figure 6-5**) SO₂ concentrations remained below the 1-hour (350 µg/m³) NAAQS in 2022 with no exceedances recorded, thus compliant with the respective NAAQS.
- The 24-hour average (**Figure 6-6**) SO₂ concentrations exceeded the 24-hour (125 µg/m³) NAAQS in 2022 one time; however, remaining compliant as four exceedances of the 24-hour NAAQS are permitted per calendar year.
- The annual average SO₂ concentrations for 2022 (15.0 µg/m³) remained below the annual average NAAQS (50 µg/m³), thus compliant with the respective NAAQS.

6.5.2.3 Carbon Monoxide

- The 1-hour average (**Figure 6-7**) CO concentrations remained below the 1-hour (10,000 $\mu\text{g}/\text{m}^3$) NAAQS in 2022 and 2023 with no exceedances recorded, thus compliant with the respective NAAQS.
- The 8-hour average (**Figure 6-8**) CO concentrations remained below the 8-hour (30,000 $\mu\text{g}/\text{m}^3$) NAAQS in 2022 and 2023 with no exceedances recorded, thus compliant with the respective NAAQS
- The annual average CO concentrations were 456.1 $\mu\text{g}/\text{m}^3$ and 557.6 $\mu\text{g}/\text{m}^3$ for 2022 and 2023 respectively. Notably there is no annual average NAAQS for CO.

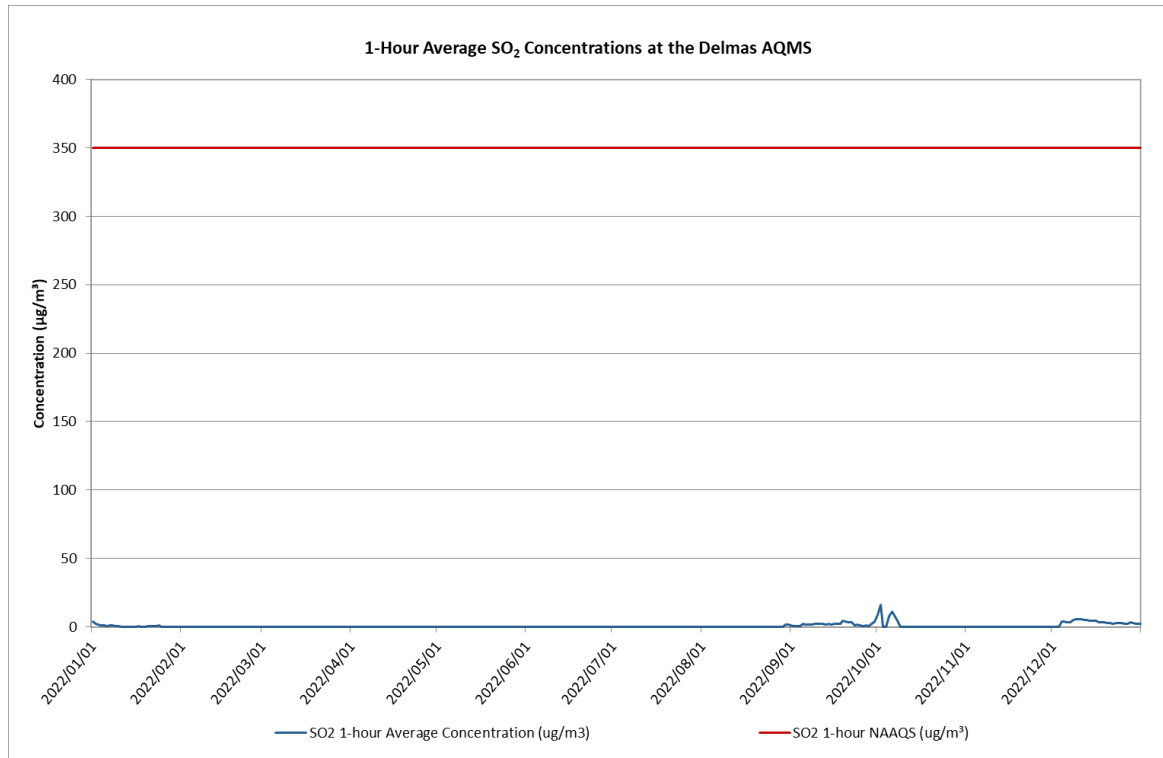


Figure 6-5 - 1-hour average SO₂ concentrations at the Delmas AQMS for 2022

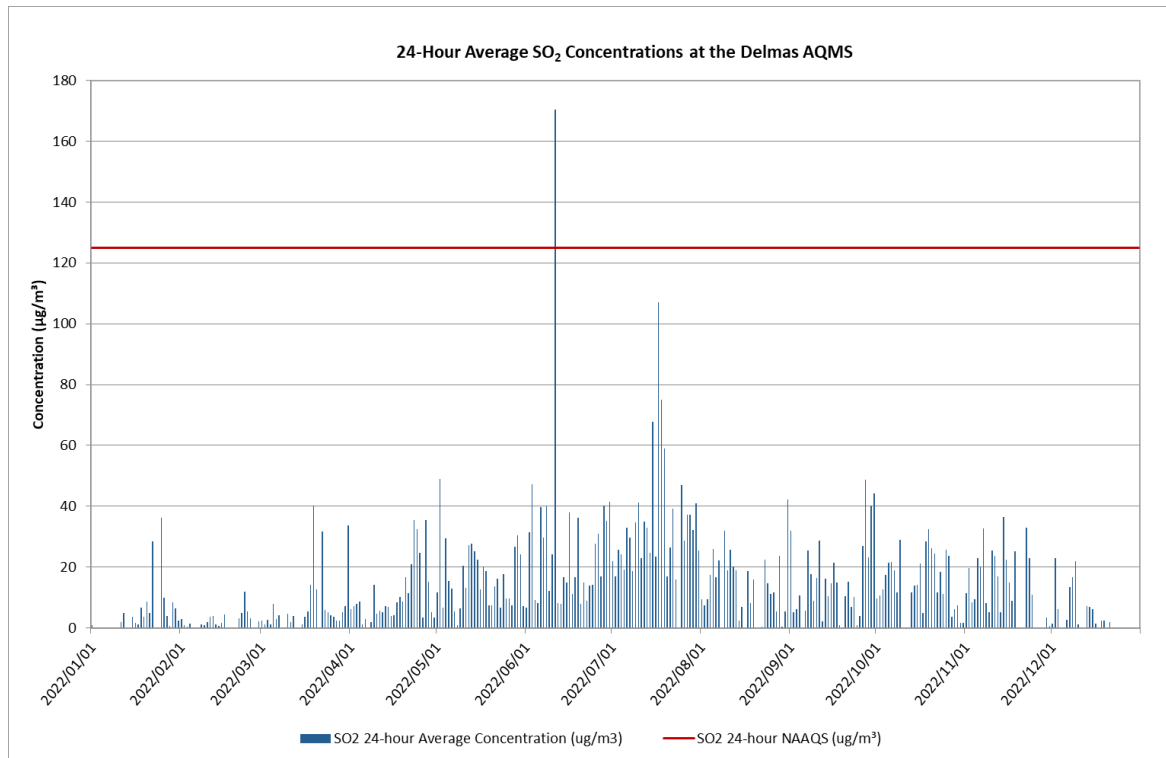


Figure 6-6 - 24-hour average SO₂ concentrations at the Delmas AQMS for 2022

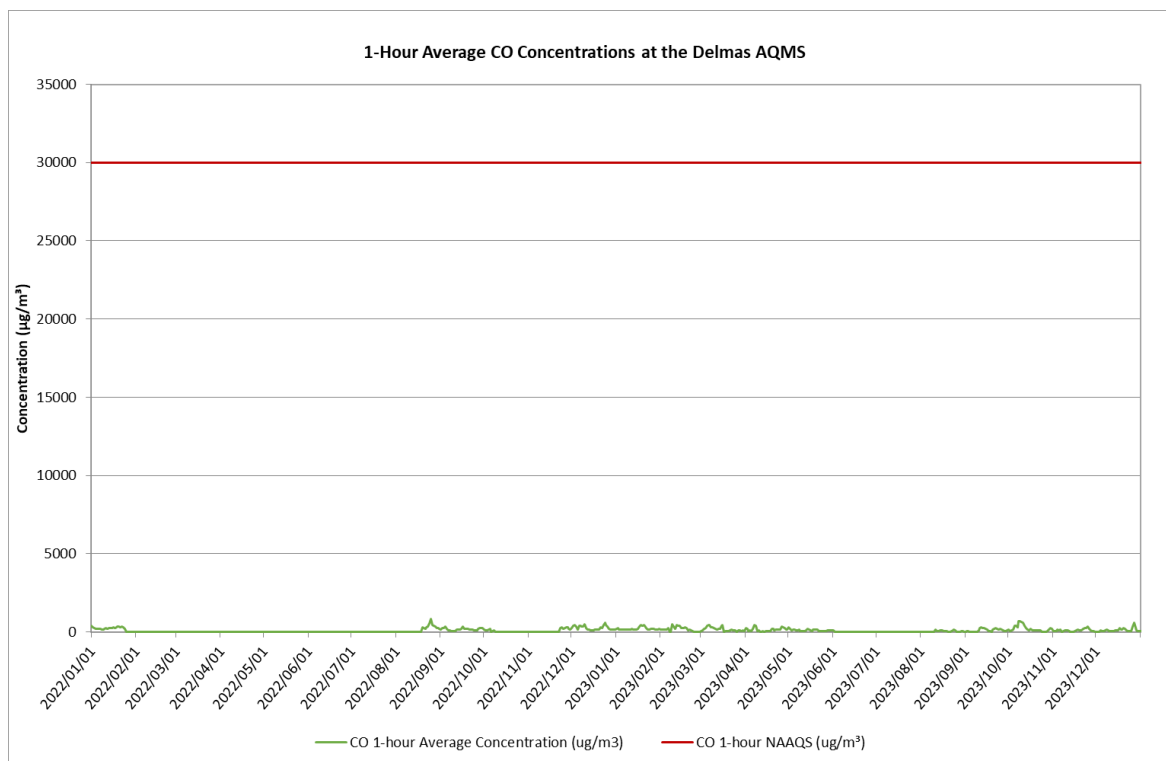


Figure 6-7 - 1-hour average CO concentrations at the Delmas AQMS for 2022 and 2023

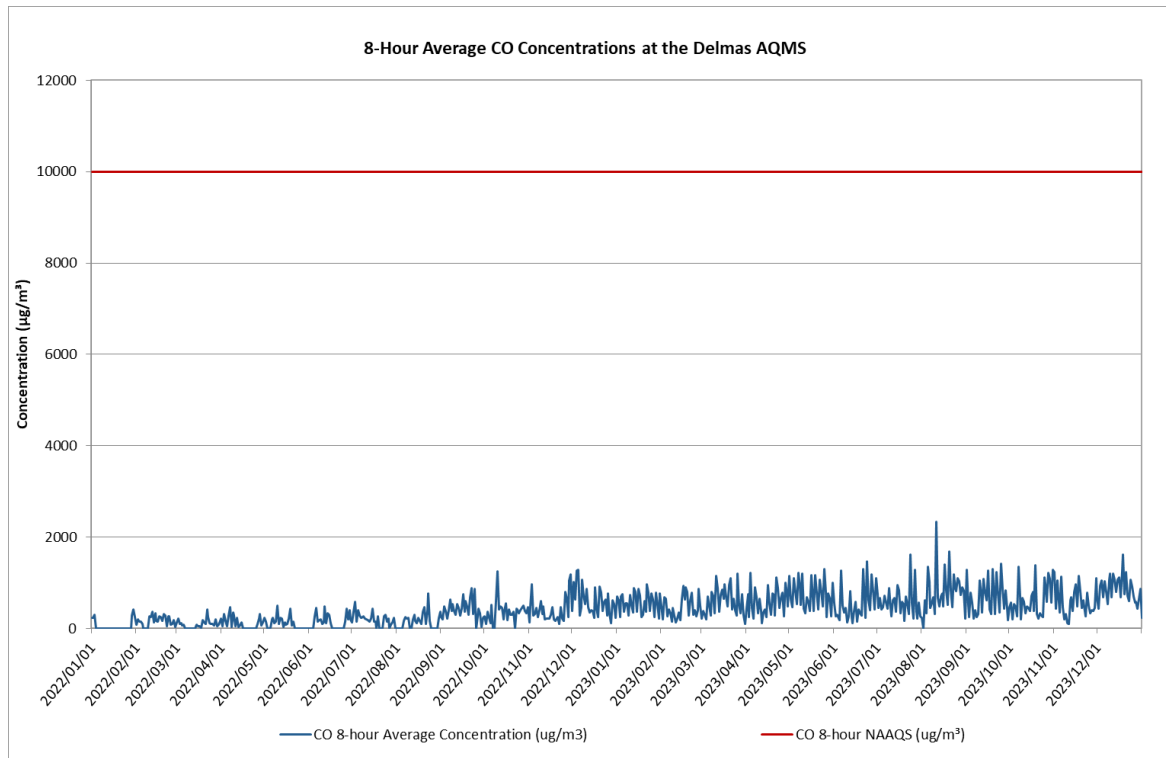


Figure 6-8 - 8-hour average CO concentrations at the Delmas AQMS for 2022 and 2023

7 DISPERSION MODELLING

7.1 DISPERSION MODELLING METHODOLOGY

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 by the Modelling Regulations, was utilised for this assessment to predict ground level downwind concentrations of pollutants emitted from McCain during the existing and proposed operations.

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 NAAQS and international guidelines 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.

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.

7.1.1 MODELLING SCENARIOS

Two dispersion modelling simulations were undertaken for McCain:

Scenario 1 - Existing Operations: Coal handling, boilers, diesel generators, storage tanks, vehicles on paved roads and clarifier.

Scenario 2 - Proposed Operations: Coal handling, boilers, diesel generators, storage tanks, vehicles on paved roads, clarifier and aeration basin, and the biogas engine.

7.1.2 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 2022 – December 2024, with a 100% data recovery on all variables. A meteorological computational modelling domain of 10 km x 10 km was used with a spatial resolution of 4 km.

7.1.3 TERRAIN

Terrain influences dispersion of pollutants, especially during periods of stable conditions. The National Aeronautics and Space Administration (NASA) Shuttle Radar Topographic Mission (SRTM) digital elevation model 1-arc data (resolution 30 m x 30 m) was extracted for input into the model to account for terrain influences on dispersion.

7.1.4 GRID RESOLUTION

According to the Modelling Regulations, the selected size and extent of the model domain is influenced by factors such as source buoyancy, terrain features (i.e. mountains) and the location of contributing sources. Larger domains are recommended for elevated, buoyant sources (e.g. stacks) while smaller domains are considered sufficient for lower release heights, particularly if emissions are at or near ambient temperature. The modelling domain for this study was defined as 10 km x 10 km, centred over the McCain operations. The Modelling Regulations specify the use of a multi-tier grid and recommend specific tier resolutions, namely 50 m for general area (property boundary) of maximum impact, 100 m for 5 km from the facility of interest, 250 m for 10 km from the facility of

interest and 1,000 m exceeding 10 km from the facility of interest. Given this, the tiered grid resolution applied in the model comprised:

- 100 m grid spacing up to 5 km from the facility of interest.
- 250 m grid spacing up to 10 km from the facility of interest.
- 1,000 m grid spacing of 15 km from the facility of interest.

7.1.5 MODEL INPUT PARAMETERS

Table 7-1 lists the key parameters used in the Level 2 dispersion model for McCain.

Table 7-1 - Key model inputs used in the assessment

Parameter		Model Input
Model		
Assessment Level		Level 2
Dispersion Model		AERMOD View 13.0.0
Supporting Models		AERMET and AERMAP
Emissions		
Pollutants modelled		PM ₁₀ , PM _{2.5} , CO, SO ₂ , NO ₂ , benzene, NH ₃ , H ₂ S and Odour
Scenarios		Existing and proposed operating conditions
Chemical transformation		Total conversion method
Exponential decay		Half-life of four hours
Settings		
Terrain setting		Flat
Terrain data		SRTM1/STRM3
Terrain data resolution (m)		Global ~ 30
Land characteristics		Urban
Grid Receptors		
Modelling domain (km)		20 x 20
Grid resolution	Tier I	100 m
	Tier II	250 m
	Tier III	1000 m

7.1.6 MODEL OUTPUTS

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

- Long-term scenario
 - The long-term outputs comprise annual average concentrations, which are calculated by averaging all hourly concentrations over one year or over the three-year meteorological period as specified. The calculation is conducted for each grid point within the modelling domain. The long-term concentrations for each receptor point are presented as isopleth plots and in a results table.
- Short-term scenario
 - 98th percentile (P98) concentrations were calculated for the comparison of short-term term (i.e., 1-hour) odour concentrations with the UK odour impact criteria guideline. This translates

to 98% of hourly concentrations at each grid point falling below the P98 concentration calculated for that grid point. P98 hourly outputs are specified for comparison with the selected guideline.

- The short-term scenario refers to the 99th percentile (P99) concentration in accordance with the NAAQS. For example, the P99 for the PM₁₀ daily average standard allows for four exceedances per annum. This means that the fourth highest concentration (P99) is presented and compared against the daily average standard.
 - The P99 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 P99 percentile results (24-hour) 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).
- 100th percentile (P100) concentrations were calculated for pollutants that are not regulated by NAAQS. These are for the comparison with international assessment criteria guidelines (unless a lower percentile threshold is specified by the guidance documentation). This is considered environmentally conservative.

As defined in the *Modelling Regulations*, ambient air quality standards and guidelines are applied to areas outside the facility fenceline (i.e. beyond the facility boundary). Within the facility boundary, environmental conditions are prescribed by occupational health and safety criteria. As such, tabular model outputs in this assessment are presented for each sensitive receptor, the maximum concentration on the facility boundary and the maximum concentration off-site (i.e. beyond the facility boundary).

7.2 DISPERSION MODEL RESULTS

Simulated pollutant concentrations for 1-hour, 24-hour and annual averaging periods at each discrete receptor are presented in **Table 7-2**. Isopleth maps showing pollutant dispersion across the study area are presented in **Figure 7-5** to **Figure 7-19**. Simulated concentrations have been evaluated against their respective NAAQS and international guidelines. Key findings are as follows:

- PM₁₀ concentrations:
 - All predicted concentrations at sensitive receptors under Scenarios 1 and 2 do not result in exceedances of the ambient PM₁₀ 24-hour (75 µg/m³) or annual (40 µg/m³) NAAQS.
 - The isopleths for Scenarios 1 and 2 do not show any changes, this is due to the minimal contribution from the gas engine under Scenario 2.
- PM_{2.5} concentrations:
 - All predicted concentrations at sensitive receptors under Scenarios 1 and 2 do not result in exceedances of the ambient PM_{2.5} 24-hour (40 µg/m³) or annual (20 µg/m³) NAAQS.
- CO concentrations:
 - All predicted concentrations at sensitive receptors under Scenarios 1 and 2 do not result in exceedances of the ambient CO 1-hour (30,000 µg/m³) or 8-hour (10,000 µg/m³) NAAQS.

- SO₂ concentrations:
 - All predicted concentrations at sensitive receptors under Scenarios 1 and 2 do not result in exceedances of the ambient SO₂ 1-hour (350 µg/m³), 24-hour (125 µg/m³) or annual (50 µg/m³) NAAQS.
- NO₂ concentrations:
 - All predicted concentrations at sensitive receptors under Scenarios 1 and 2 do not result in exceedances of the ambient NO₂ 1-hour (200 µg/m³) or annual (40 µg/m³) NAAQS.
- Benzene concentrations:
 - All predicted concentrations at sensitive receptors under Scenarios 1 and 2 do not result in exceedances of the ambient benzene annual NAAQS (5 µg/m³).
 - In Scenario 2 two offsite exceedances (7.0 µg/m³ and 6.1 µg/m³ respectively) of the benzene NAAQS are predicted to occur ~53.8 m and 14.2 m from the eastern boundary of McCain, near the proposed WWTP expansion.
 - Notably, these exceedances occur near the public road, where no residential occupancy is present.
- NH₃ concentrations:
 - All predicted concentrations at sensitive receptors under Scenarios 1 and 2 do not result in exceedances of the ambient TCEQ ESL NH₃ 1-hour guideline (180 µg/m³) and annual guideline (92 µg/m³).
- H₂S concentrations:
 - All predicted concentrations at sensitive receptors under Scenarios 1 and 2 do not result in exceedances of the ambient 1-hour H₂S OEHHA REL 1-hour guideline (42.0 µg/m³).
- Odour:
 - P98 1-hour odour concentrations at sensitive receptors under Scenarios 1 and 2 fall well below the 1-hour UK odour criteria limit (1.5 OUE/m³). In line with the UK IAQM guidance (**Table 6-5**), the impact significance for sensitive receptors is determined to be 'negligible'.

With the inclusion of the biogas engine, aeration basin and the one diesel tank, predicted concentrations for all pollutants are unlikely to significantly affect the surrounding environment. Peak concentrations across all pollutants occur either within the operational boundary or adjacent to the facility's fenceline.

Table 7-2 - Simulated pollutant concentrations at sensitive receptors

				Predicted concentrations (µg/m³ or OUE/m³)																															
Polluta nt	Averaging period	Standard/guideline (µg/m³)	Reference	Sensitive receptor																															
				Peak	Fenceli ne peak	Rec 01	Rec 02	Rec 03	Rec 04	Rec 05	Rec 06	Rec 07	Rec 08	Rec 09	Rec 10	Rec 11	Rec 12	Rec 13	Rec 14	Rec 15	Rec 16	Rec 17	Rec 18	Rec 19	Rec 20	Rec 21	Rec 22	Rec 23	Rec 24	Rec 25	Rec 26	Rec 27	Rec 28		
						Scenario1																													
PM ₁₀	24-hour	75	NAAQS	7.8E+00	7.1E-01	9.2E-03	8.0E-03	5.2E-03	8.2E-03	3.3E-02	2.0E-02	1.3E-02	9.8E-03	1.0E-02	2.6E-02	8.0E-03	1.3E-02	7.1E-03	9.5E-03	1.9E-02	1.2E-02	2.3E-02	1.8E-01	1.9E-02	2.2E-02	3.4E-02	2.3E-01	8.4E-01	7.0E-02	2.6E-02	1.5E-02	4.2E-02	4.8E-02		
	Period	40	NAAQS	3.2E+00	1.5E-01	7.8E-04	5.8E-04	4.3E-04	8.1E-04	3.2E-03	1.5E-03	1.2E-03	6.5E-04	7.0E-04	2.2E-03	4.7E-04	1.1E-03	9.1E-04	9.7E-04	3.1E-03	6.2E-04	1.5E-03	1.7E-02	1.4E-03	1.4E-03	3.7E-03	2.8E-02	2.5E-01	1.4E-02	2.3E-03	1.3E-03	4.1E-03	3.6E-03		
PM _{2.5}	24-hour	40	NAAQS	3.0E+00	3.5E-01	3.4E-03	3.0E-03	2.2E-03	3.2E-03	1.3E-02	7.7E-03	4.6E-03	3.5E-03	3.9E-03	9.7E-03	2.9E-03	4.8E-03	3.1E-03	3.5E-03	7.7E-03	4.2E-03	8.4E-03	7.6E-02	7.4E-03	8.1E-03	1.1E-02	8.9E-02	5.2E-01	3.0E-02	8.4E-03	5.9E-03	1.5E-02	1.8E-02		
	Period	20	NAAQS	1.4E+00	5.0E-02	3.0E-04	2.2E-04	1.7E-04	3.2E-04	1.2E-03	5.7E-04	4.6E-04	2.6E-04	2.8E-04	9.1E-04	2.0E-04	4.5E-04	3.8E-04	3.8E-04	1.2E-03	2.4E-04	5.8E-04	6.6E-03	5.6E-04	6.0E-04	1.4E-03	1.3E-02	9.1E-02	5.6E-03	9.5E-04	5.4E-04	1.7E-03	1.6E-03		
CO	1-hour	30,000	NAAQS	2.6E+01	4.4E+00	1.8E-05	1.3E-05	1.3E-05	2.8E-05	5.2E-05	2.5E-05	1.2E-02	2.1E-05	4.2E-05	4.8E-02	1.0E-02	2.1E-02	2.3E-02	1.3E-02	7.3E-02	1.2E-05	3.3E-05	1.7E-04	5.2E-05	3.3E-02	4.4E-02	7.6E-01	1.0E+01	4.3E-01	5.9E-02	2.6E-02	1.0E-01	1.1E-01		
	8-hour	10,000	NAAQS	2.9E+01	4.1E+00	1.1E-02	8.2E-03	7.1E-03	1.4E-02	4.8E-02	7.7E-03	1.9E-02	7.2E-03	1.1E-02	4.6E-02	1.3E-02	2.2E-02	2.2E-02	1.8E-02	6.4E-02	2.5E-03	1.2E-02	2.8E-01	1.7E-02	3.9E-02	6.3E-02	5.9E-01	7.6E+00	3.4E-01	5.0E-02	2.8E-02	8.9E-02	1.1E-01		
SO ₂	1-hour	350	NAAQS	1.0E-02	1.8E-03	6.9E-06	5.2E-06	4.2E-06	9.3E-06	2.5E-05	9.8E-06	1.5E-05	5.0E-06	6.4E-06	2.2E-05	5.7E-06	1.3E-05	1.3E-05	3.8E-05	4.1E-06	1.1E-05	7.4E-05	1.1E-05	1.5E-05	3.8E-05	1.5E-04	3.3E-03	1.7E-04	2.8E-05	1.5E-05	4.1E-05	3.8E-05			
	24-hour	125	NAAQS	1.68E-03	3.3E-04	3.6E-06	2.5E-06	2.0E-06	3.4E-06	9.2E-06	4.7E-06	4.1E-06	2.8E-06	3.2E-06	7.3E-06	2.8E-06	4.0E-06	2.8E-06	3.3E-06	6.2E-06	2.9E-06	5.7E-06	3.7E-05	5.2E-06	6.3E-06	8.0E-06	4.9E-05	2.4E-04	2.3E-05	7.3E-06	5.0E-06	1.1E-05	1.1E-05		
NO ₂	Period	50	NAAQS	3.2E-04	6.0E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+05	1.0E-04	1.0E-04	1.0E-05	0.0E+00	0.0E+00	0.0E+00		
	1-hour	200	NAAQS	1.8E+02	4.9E-02	2.1E-27	8.5E-28	8.8E-28	4.0E-26	1.1E-18	2.7E-23	2.2E-23	1.8E-27	1.5E-24	1.3E-18	9.6E-24	2.2E-23	2.0E-23	1.4E-23	7.8E-21	8.5E-28	3.4E-23	3.8E-10	3.4E-23	2.8E-19	7.5E-17	1.1E-06	9.9E-02	6.6E-11	2.7E-20	4.4E-23	2.5E-16	4.2E-14		
Benzene	Period	40	NAAQS	6.5E+02	3.7E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+03	3.5E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00		
	Annual	5	NAAQS	3.0E+00	6.8E-02	1.3E-03	9.4E-04	6.9E-04	1.3E-03	4.7E-03	2.7E-03	1.9E-03	1.2E-03	1.3E-03	4.3E-03	8.6E-04	1.9E-03	1.5E-03	1.5E-03	5.0E-03	1.1E-03	2.6E-03	3.3E-02	2.7E-03	2.7E-03	5.2E-03	9.4E-02	1.3E-01	1.8E-02	3.9E-03	2.4E-03	7.1E-03	8.0E-03		
NH ₃	1-hour	180	TCEQ	4.3E+02	3.1E+01	2.2E+00	1.7E+00	1.8E+00	2.3E+00	5.9E+00	2.3E+00	1.6E+00	1.3E+00	1.2E+00	3.3E+00	1.4E+00	1.4E+00	8.1E-01	1.3E+00	2.1E+00	1.9E+00	2.5E+00	2.0E+01	1.9E+00	3.8E+00	3.2E+00	3.5E+01	5.5E+00	3.2E+00	1.9E+00	4.0E+00	8.0E+00			
	Annual	92	TCEQ	6.1E+00	1.4E-01	2.6E-03	1.9E-03	1.4E-03	2.6E-03	9.0E-03	5.4E-03	3.7E-03	2.3E-03	2.6E-03	8.4E-03	1.7E-03	3.7E-03	3.0E-03	3.0E-03	9.8E-03	2.2E-03	5.2E-03	6.7E-02	5.3E-03	5.3E-03	1.0E-02	1.9E-01	2.2E-01	3.4E-02	7.6E-03	4.8E-03	1.4E-02	1.6E-02		
H ₂ S	1-hour	42	OEHHAREL	5.1E-01	3.7E-02	2.6E-03	2.0E-03	2.2E-03	2.7E-03	7.0E-03	2.7E-03	2.0E-03	1.5E-03	1.4E-03	4.0E-03	1.7E-03	1.7E-03	9.6E-04	1.6E-03	2.5E-03	2.2E-03	3.0E-03	2.3E-02	2.2E-03	4.5E-03	3.8E-03	4.1E-02	4.4E-02	6.5E-03	3.8E-03	2.3E-03	4.8E-03	9.5E-03		
Odour	1-hour	1.5	UK	1.7E-01	6.9E-03	1.8E-04	1.3E-04	6.9E-05	1.8E-04	6.3E-04	2.9E-04	1.6E-04	1.1E-04	1.6E-04	4.0E-04	1.2E-04	1.4E-04	9.1E-05	1.2E-04	2.6E-04	8.6E-05	2.6E-04	3.3E-03	2.6E-04	4.7E-04	4.3E-04	7.1E-03	8.0E-03	9.9E-04	2.8E-04	2.0E-04	5.0E-04	1.0E-03		
Scenario 2																																			
PM ₁₀	24-hour	75	NAAQS	7.8E+00	7.1E-01	9.2E-03	8.0E-03	5.2E-03	8.2E-03	3.3E-02	2.0E-02	1.3E-02	9.9E-03	1.0E-02	2.6E-02	8.0E-03	1.3E-02	7.1E-03	9.5E-03	1.9E-02	1.2E-02	2.3E-02	1.8E-01	1.9E-02	2.2E-02	3.4E-02	2.3E-01	8.4E-01	7.0E-02	2.6E-02	1.5E-02	4.2E-02	4.8E-02		
	Period	40	NAAQS	3.2E+00	1.5E-01	7.9E-04	5.8E-04	4.3E-04	8.2E-04	3.2E-03	1.5E-03	1.2E-03	6.6E-04	7.0E-04	2.2E-03	4.8E-04	1.1E-03	9.2E-04	9.8E-04	3.1E-03	6.3E-04	1.5E-03	1.7E-02	1.4E-03	1.4E-03	3.7E-03	2.9E-02	2.5E-01	1.4E-02	2.3E-03	1.3E-03	4.1E-03	3.6E-03		
PM _{2.5}	24-hour	40	NAAQS	3.0E+00	3.5E-01	3.4E-03	3.0E-03	2.2E-03	3.2E-03	1.3E-02	7.7E-03	4.6E-03	3.6E-03	3.9E-03	9.8E-03	2.9E-03	4.8E-03	3.1E-03	3.5E-03	7.7E-03	4.2E-03	8.4E-03	7.6E-02	7.5E-03	8.1E-03	1.1E-02	9.0E-02	5.2E-01	3.0E-02	8.4E-03	5.9E-03	1.5E-02	1.9E-02		
	Period	20	NAAQS	1.4E+00	5.0E-02	3.1E-04	2.3E-04	1.7E-04	3.2E-04	1.2E-03	5.7E-04	4.7E-04	2.6E-04	2.9E-04	9.2E-04	2.0E-04	4.5E-04	3.8E-04	3.9E-04	1.3E-03	2.4E-04	5.8E-04	6.7E-03	5.6E-04	6.1E-04	1.4E-03	1.3E-02	9.1E-02	5.6E-03	9.6E-04	5.5E-04	1.7E-03	1.6E-03		
CO	1-hour	30,000	NAAQS	4.2E+01	3.1E+00	2.9E-01	2.2E-01	1.7E-01	3.1E-01	7.6E-01	4.6E-01	4.3E-01	2.5E-01	3.2E-01	9.5E-01	2.4E-01	4.3E-01	3.1E-01	3.8E-01	7.1E-01	1.8E-01	4.6E-01	4.0E+00	5.9E-01	7.3E-01	7.4E-01	6.7E+00	1.0E+01	1.5E+00	8.3E-01	5.3E-01	1.3E+00	1.9E+00		
	8-hour	10,000	NAAQS	3.1E+01	2.5E+00	1.7E-01	1.3E-01	9.4E-02	1.7E-01	4.3E-01	2.8E-01	2.1E-01	1.8E-01	2.1E-01	6.0E-01	1.5E-01	2.4E-01	1.7E-01	1.9E-01	4.1E-01	1.3E-01	2.9E-01	2.5E+00	4.2E-01	4.5E-01	4.0E-01	4.6E+00	7.8E+00	8.1E-01	4.5E-01	3.2E-01	7.0E-01	1.2E+00		
SO ₂	1-hour	350	NAAQS	7.8E-02	5.8E-02	5.1E-04	3.7E-04	2.9E-04	5.4E-04	1.4E-03																									



Figure 7-1 - Scenario 1 and 2 P99 24-hour average PM₁₀ concentrations





Figure 7-3 - Scenario 1 and 2 P99 24-hour average PM_{2.5} concentrations



Figure 7-4 - Scenario 1 and 2 annual average $PM_{2.5}$ concentrations



Figure 7-5 - Scenario 1 P99 1-hour average CO concentrations

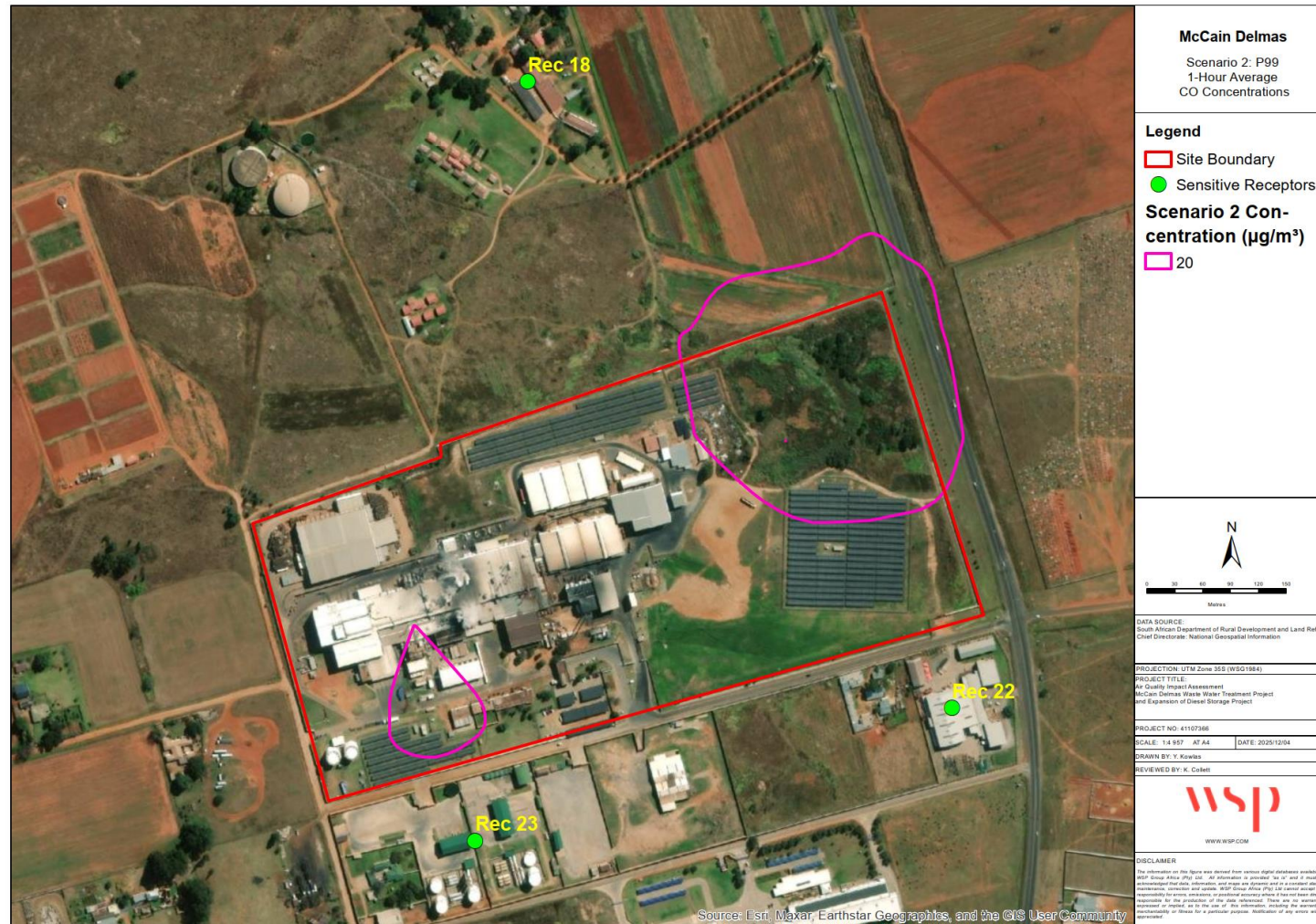


Figure 7-6 - Scenario 2 P99 1-hour average CO concentrations



Figure 7-7 - Scenario 1 P99 8-hour average CO concentrations

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Figure 7-9 - Scenario 1 and 2 P99 1-hour average SO₂ concentrations

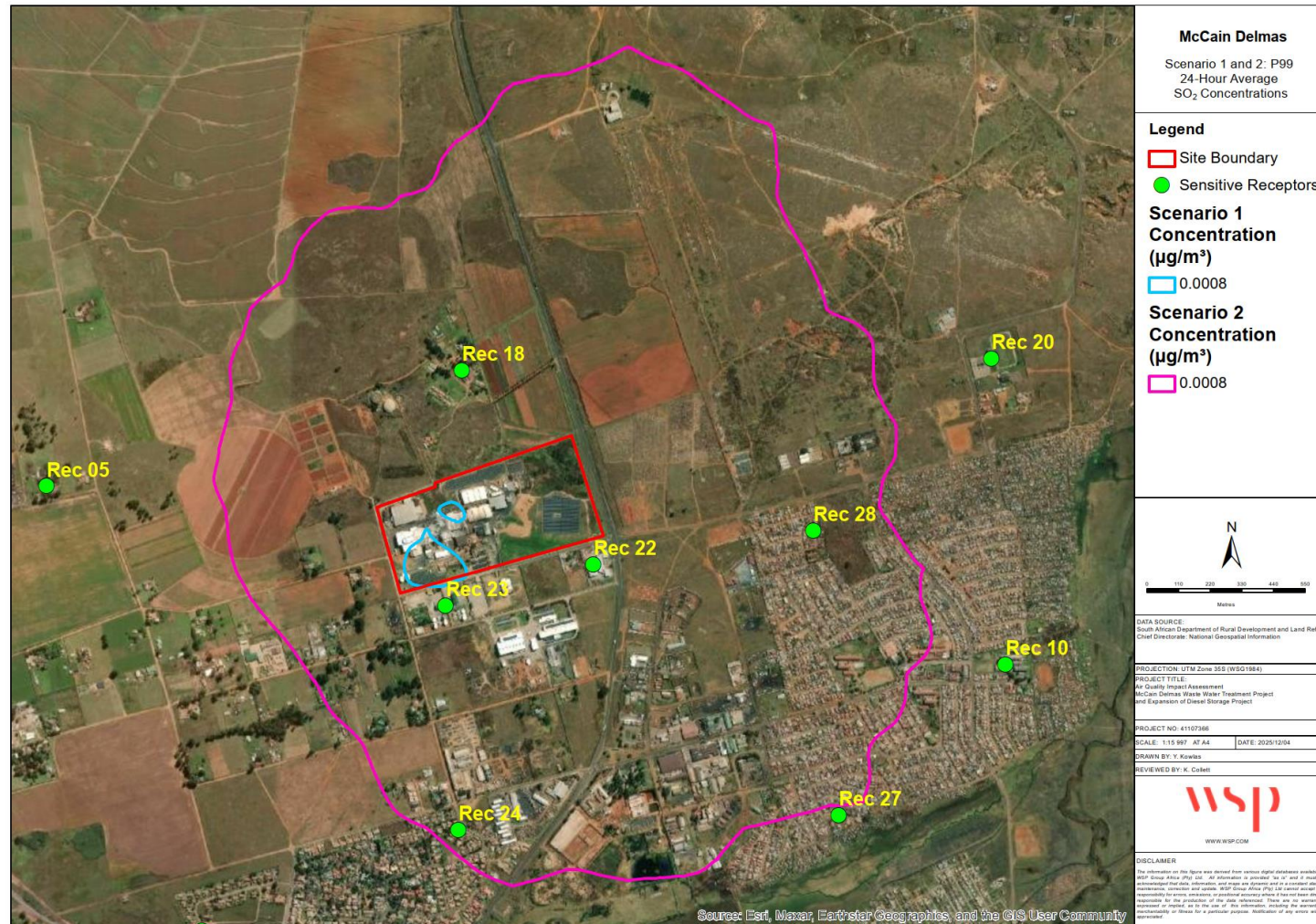


Figure 7-10 - Scenario 1 and 2 P99 24-hour average SO₂ concentrations

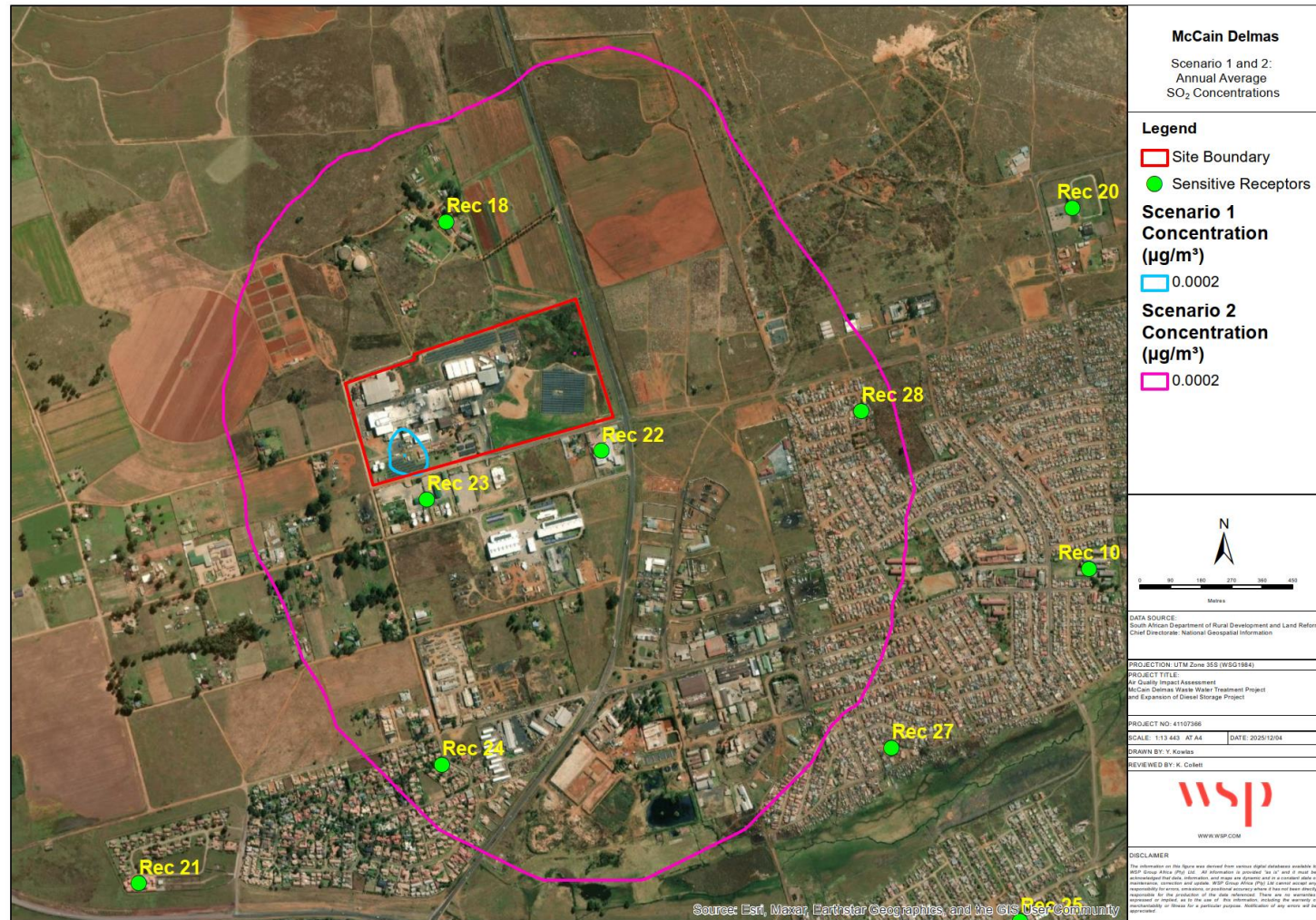


Figure 7-11 - Scenario 1 and 2 annual average SO₂ concentrations



Figure 7-12 - Scenario 1 P99 1-hour average NO₂ concentrations



Figure 7-13 - Scenario 2 P99 1-hour average NO₂ concentrations



Figure 7-14 - Scenario 1 and 2 annual average NO₂ concentrations

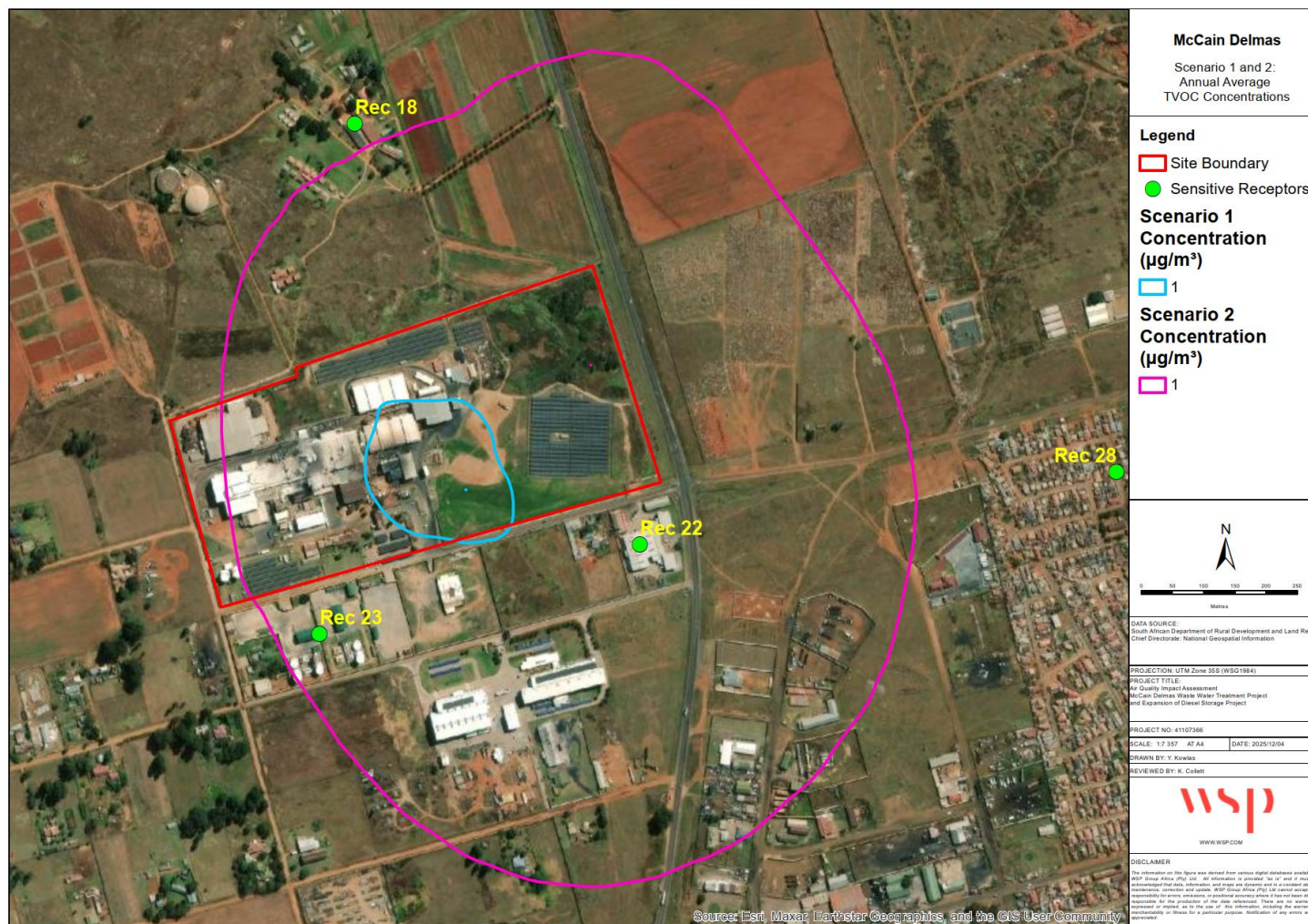


Figure 7-15 - Scenario 1 and 2 annual average benzene concentrations



Figure 7-16 - Scenario 1 and 2 P100 1-hour average NH₃ concentrations

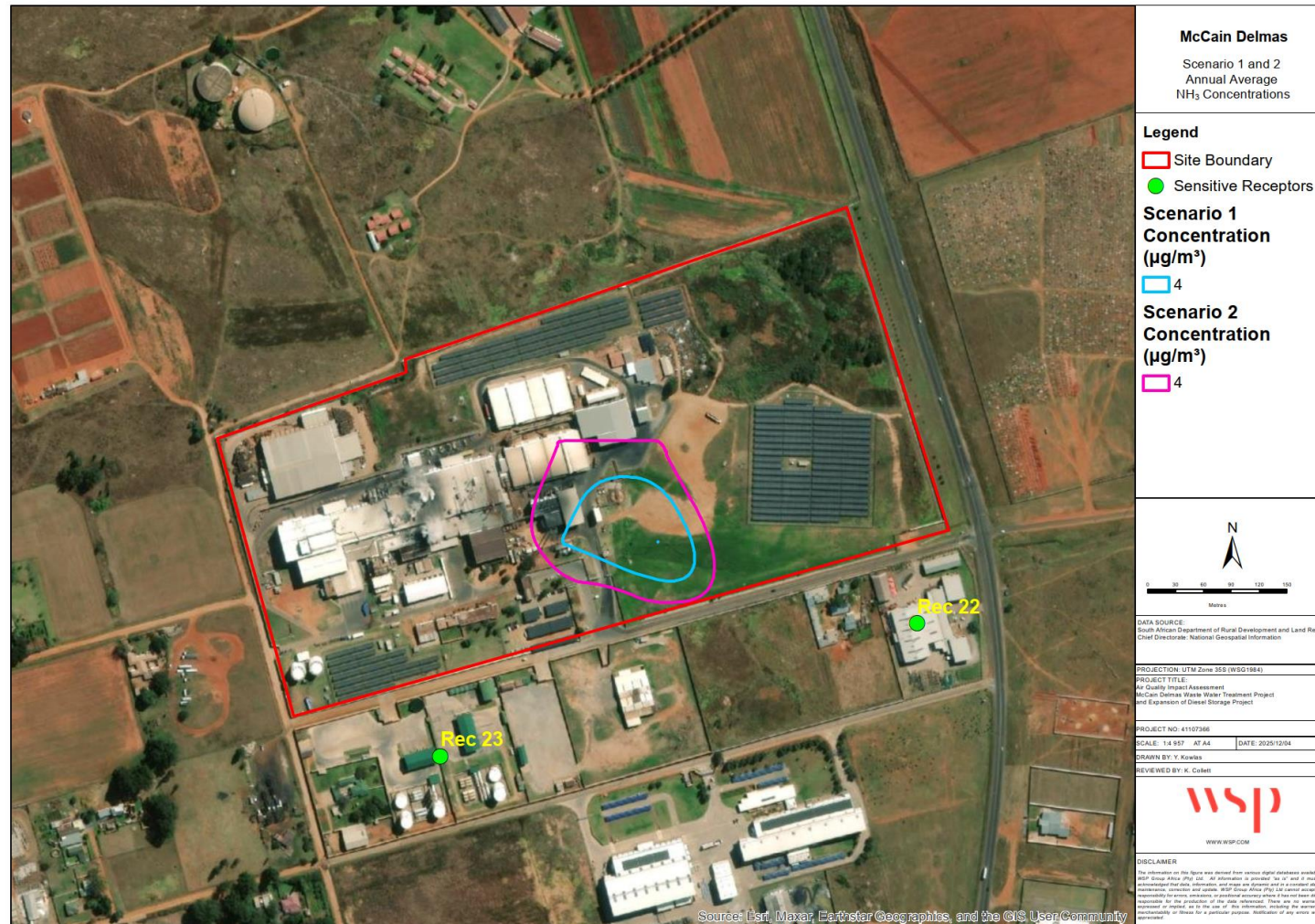


Figure 7-17 - Scenario 1 and 2 annual average NH₃ concentrations

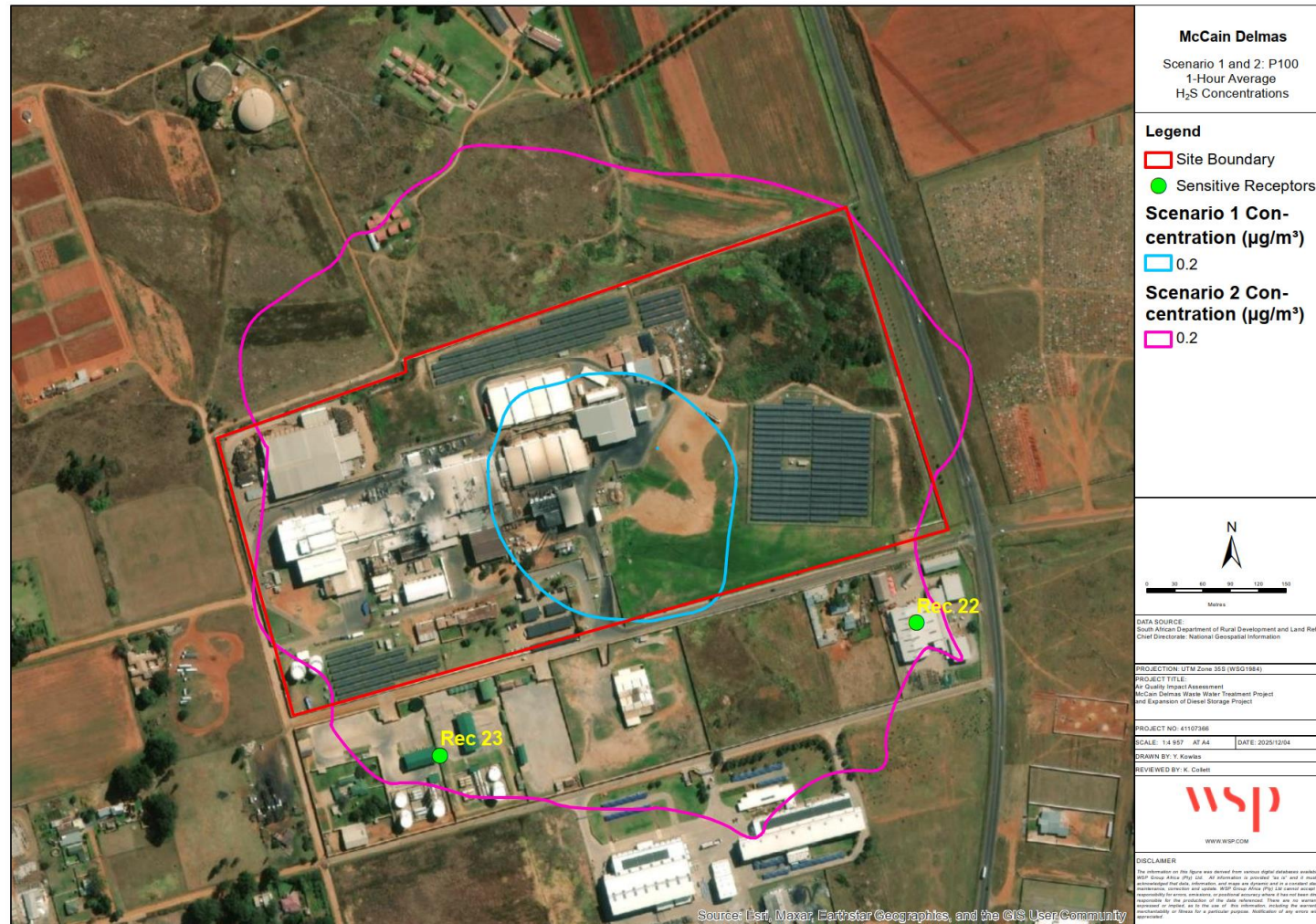


Figure 7-18 - Scenario 1 and 2 P100 average H₂S concentrations

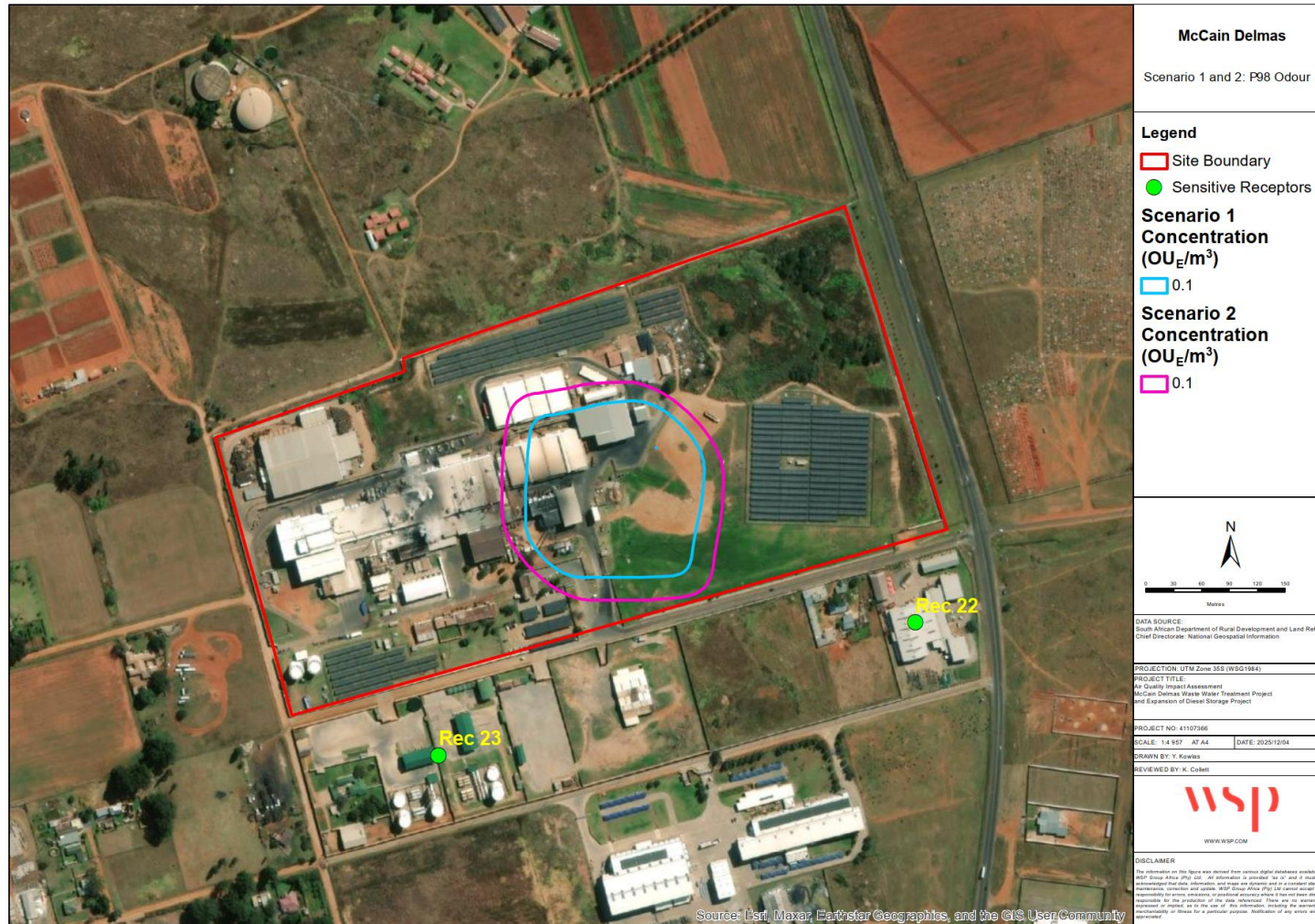


Figure 7-19 - Scenario 1 and 2 P98 average odour concentrations

7.3 CUMULATIVE ASSESSMENT

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 7-3**.

Table 7-3: 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 ⁽¹⁾ .	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 than the NAAQS, no exceedances allowed.	Sum of the 99th percentile concentrations and background C_B must be less than the NAAQS. Wherever one year is modelled, the highest concentrations shall be considered.
Notes: ⁽¹⁾ For an isolated facility influenced by regional background pollution C_B must be considered.		

The cumulative impacts were assessed under Scenario 2, which accounted for the existing and proposed facility operations, and have been presented in **Section 7.2**. Background concentrations were not added to these concentrations to assess McCain's contribution to ambient conditions due to the lack of representative monitoring data for the area.

8 ASSESSMENT OF IMPACTS

The purpose of this AIR is to identify the potential impacts and associated risks posed by the operation of the proposed Project on the air quality of the area. The outcomes of the impact assessment will provide a basis to identify the key risk drivers and make informed decisions on the way forward to ensure that these risks do not result in unacceptable social or environmental risk.

All impacts of the operation of the proposed Project were evaluated using a risk matrix, which is a semi-quantitative risk assessment methodology. This system derives an environmental impact level based on the magnitude, extent, reversibility, duration and probability of occurrence. The overall risk level is determined using professional judgement based on a clear understanding of the nature of the impact, potential mitigatory measures that can be implemented and changes in risk profile because of implementation of these mitigatory measures. A full description of the risk rating methodology is presented in **Appendix B**.

Key localised air quality impacts associated with the Project include the future operational phase impacts of air pollution on residential receptors. Outcomes of the AIR are presented in **Table 8-1**, outlining the impact of each parameter and the resulting risk level.

Without mitigation, the risks for this Project are considered low, with moderate magnitude, limited extent, and partial reversibility over the medium term. With mitigation measures in place, both the magnitude and likelihood of occurrence are reduced, resulting in a very low residual risk

Table 8-1 - Impact assessment of risks associated with the proposed Project

Description	Without Mitigation						With Mitigation							
	Magnitude	Extent	Reversibility	Duration	Probability of Occurrence	Significance	Risk Level	Magnitude	Extent	Reversibility	Duration	Probability of Occurrence	Significance	Risk Level
Operational phase impacts of air pollution on sensitive receptors	2	2	1	4	2	18	Low	1	1	1	4	1	7	Very Low

9 PROJECT ALTERNATIVES

The EIA Regulations, 2014 (GNR 326) (as amended) require that the BA process must identify and describe alternatives to the proposed activity that were considered, or the motivation for not considering alternatives. Different types or categories of alternatives could be considered, including different site locations, technology types, and project layouts. It is not always possible to provide alternatives to various categories, as project designs and locations may already be located strategically or may be too costly for the project to proceed.

9.1 SITE ALTERNATIVES

The proposed project will be located within the current footprint of the McCain facility. No site alternatives for the WWTP or the diesel storage expansion can be provided or considered, due to the following reasons:

- McCain Delmas is an existing facility.
- Limited available land provides no alternative for the location of the WWTP on the McCain Delmas property, and this infrastructure needs to be constructed within proximity to the existing McCain facility; and
- Existing facility infrastructure will tie into the proposed expansion infrastructure, allowing for easy integration.

9.2 TECHNOLOGY ALTERNATIVES

Several technology alternatives for the WWTP were considered, as relevant to the various phases of the treatment process. The alternatives are presented in **Table 9-1**, including the key advantages and disadvantages as well as the motivation for selecting the preferred alternative. The alternatives considered are:

- **Primary treatment:** Two technology options have been identified as either Covered Anaerobic Lagoons or UASB Reactors.
- **Phosphorous removal:** Two technology options for removal include use of iron/aluminium or use of specialised bacteria (biological).
- **Activated sludge process:** Two technology options have been considered for the control of the mass of biomass in the treatment systems, namely gravity settling in a secondary clarifier and applying a MBR.
- **Biogas handling:** Two options have been considered for the use of the biogas generated at the plant, namely, to generate power (in a gas engine at the WWTP) or displace coal in the McCain's facility's existing boilers.

Table 9-1 - WWTP technology alternative

WWTP Component	Alternative technologies	Advantage	Disadvantage	Preferred Option
Primary anaerobic treatment alternatives	Covered Anaerobic Lagoons	<ul style="list-style-type: none"> ■ Produces renewable energy (biogas). ■ Reduces odour and greenhouse gas emissions. ■ Lower operating cost compared to mechanical systems. ■ Suitable for large volumes of high-strength wastewater. 	<ul style="list-style-type: none"> ■ Requires large land area. ■ Not suitable for low-strength or highly diluted wastewater. ■ May need post-treatment for nutrient removal or pathogen control. ■ Temperature-sensitive (microbial activity slows in cold climates unless heated). 	-
	UASB	<ul style="list-style-type: none"> ■ Compact design – requires much less space than lagoons. ■ Energy-efficient – no need for aeration. ■ Produces biogas – can be captured and used. ■ Low sludge production. ■ Can handle high organic loads. 	<ul style="list-style-type: none"> ■ Sensitive to temperature (less effective in cold climates). ■ Needs skilled monitoring and maintenance. ■ Start-up period can be slow (several weeks/months to develop good sludge granules). ■ Does not remove nutrients or pathogens and often needs post-treatment. 	USAB preferred compared to covered anaerobic lagoons, as the latter with be a large open to air emission source.
Phosphorus removal	Iron or Aluminium	<ul style="list-style-type: none"> ■ Aluminium is advantageous in low-alkalinity water because it raises alkalinity and requires lower dosages, producing less chemical sludge. ■ Iron is cost effective and readily available. 	<ul style="list-style-type: none"> ■ Sludge production that requires dewatering. ■ Need for careful chemical dosing. 	-
	Biological	<ul style="list-style-type: none"> ■ Reduced chemical costs. ■ Lower sludge production. 	<ul style="list-style-type: none"> ■ Uses specialised bacteria. ■ Risk of poor performance. 	-

WWTP Component	Alternative technologies	Advantage	Disadvantage	Preferred Option
Activated sludge process	Gravity settling in a secondary clarifier	<ul style="list-style-type: none"> Lower initial capital costs. Lower energy consumption. 	<ul style="list-style-type: none"> Requires larger development footprint. Operates at lower mixed liquor suspended solids concentration. Performance can be impacted by variable flow rates or poor sludge settling characteristics. Produces great quantity of excess sludge. Effluent quality may not meet environmental discharge or plant requirements and therefore may require additional treatment. 	-
	Membrane bioreactor system	<ul style="list-style-type: none"> Provides a positive barrier to solids, eliminating the possibility of upset conditions due to variable flow or changes in bacteria growth in the activated sludge system. Allows for a significantly higher influent mixed liquor suspended solids concentration, reducing the required size of the activated sludge system. Effluent quality would allow for environmental discharge or direct feed into a water recycle system with no modifications. 	<ul style="list-style-type: none"> More operationally complex and requires additional infrastructure, such as backpulse pumps and air scour blowers. Relies on vendor-supplied membranes, which will need to be periodically maintained and replaced. Cannot operate in low- or no-power conditions; untreated effluent from the activated sludge system would discharge by gravity to a containment tank. 	MBR preferred compared to a secondary clarifier, as a clarifier will be an open to air emission source.
Biogas handling	Power generation	<ul style="list-style-type: none"> Reduced electricity consumption for the plant. 	<ul style="list-style-type: none"> Gas engine will generate air emissions. Higher operational costs. 	-
	Replacement fuel for on-site boilers	<ul style="list-style-type: none"> Limited additional infrastructure required. Reduced dependence on coal. Replacement of coal as a fuel source for the boilers will reduce greenhouse gas emissions and air pollution. Lower operational costs. 	<ul style="list-style-type: none"> May lead to corrosion of boilers, if H₂S scrubber system for desulfurization is not optimally operating 	The environmental benefits of replacing coal at the McCain facility make this option the preferred.

9.3 NO-GO ALTERNATIVE

The “do-nothing” alternative will be the status quo. The project activities, i.e. the expansion of the fuel storage tank and the WWTP will not occur, should the No-Go alternative be implemented, and no potential negative or positive impacts from such proposed activities will arise. The fuel storage expansion is an operational requirement to allow for sustainable business continuation and will negatively impact the McCain Delmas operation if it does not proceed.

As per the Need and Desirability, benefit will arise from the WWTP as aligned with and contributing to McCain’s Sustainability Pillars of resource efficient operations. This includes treatment of wastewater

to a standard suitable for plant use or discharge, and generation of biogas (a renewable energy source to be used within the McCain Delmas plant operation) through conversion of high COD waste material.

From an air quality perspective, should the proposed Project not go ahead, the status quo will remain the same.

10 RECOMMENDATIONS

Although air quality impacts from McCain's proposed diesel tank and WWTP are assessed to be very low (or negligible for sensitive receptors), WSP proposes the following mitigation measures for consideration:

General:

- Maintain appropriate operational controls and adhere to manufacturer stipulated repair and maintenance requirements for all equipment.
- Conduct training of the workforce at all levels (i.e. workers, foremen, managers) in awareness of air emissions. This can be included in site induction courses and should focus on promoting understanding as to why operational controls are in place and should be adhered to.

Storage tanks:

- Maintain appropriate operational controls (e.g. appropriate temperature and pressure settings for storage vessels and loading operations).
- Conduct regular equipment inspections for visible/audible/odorous leaks.
- Conduct regular checks and periodic replacement of components including pump seals, compressor seals, pipeline valves, open-ended valves, flanges, and other connections (as applicable) in line with manufacturer specifications.
- Maintain meticulous record keeping of all inputs, throughputs, and production rates, including loading and dispatch quantities for each tank to allow for a more accurate accounting of evaporative losses and emission inventory updates going forward.

Coal handling and storage:

- General housekeeping, including the regular cleaning of machinery and the areas around the coal bunker to remove deposited particles to minimise the load available for entrainment during high wind speed events.

WWTP:

- Develop a Vegetative Environmental Buffer (VEB) along the eastern boundary of the proposed development site. A VEB will ameliorate odours by slowing wind and allowing dilution of odour, encouraging particulate and aerosol deposition, physical interception of dust and aerosols onto which odorous compounds can adhere, and offering a sink for the chemical constituents of odour. WSP recommends the use of indigenous leafy trees that maintain their leaves throughout the year. Multiple rows of trees (with taller and shorter but bushier species alternating) will increase effectiveness of the barrier. Additional value of the VEB is protection from bioaerosols, noise mitigation and improved visual aesthetics.
- Masking agents offer an additional odour neutralisation option should complaints arise despite the above recommendation. The efficacy of commercial additives varies widely, and local options can be investigated.

- Complaints and any actions arising from a complaint must be recorded in complaints register maintained by site management. If required, fenceline measurements of H₂S can be initiated if complaints arise, which will provide a real-time indicator of odour impact.
- Warning communities to expect potential odour events during upset conditions (e.g. during desludging or when extended maintenance is scheduled) will generate increased trust and facilitate communication between parties.
- Maintenance/desludging should be scheduled (where possible) for periods with dry and cool conditions, particularly when prolonged repair work or sludge drying is anticipated. Drier conditions will accelerate sludge drying, shortening the duration in which peak impacts may occur. Odorous emissions are generally higher in warmer months due to increased gas volatility.

11 ASSUMPTIONS AND LIMITATIONS

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

GENERAL

- Unless otherwise stated, operational information for the McCain facility was provided by McCain. Any errors, limitations or assumptions inherent in these datasets extend to this AIR.
- The raw materials, energy sources and production rates are based data provided by McCain.
- Due to the limited dust fallout monitoring data received, this data was not included in the AIR. Additionally, TSP is not a pollutant of interest.
- Construction activity and emissions are excluded from this AIR. Due to the nature of construction, impacts are of a limited duration.
- As indicated in the stack emission reports, the boilers at McCain fall below the limits for regulation under Section 21 of NEM:AQA and the Declaration for Small Boilers as Controlled Pollutants and Establishment of Emission Standards of 2013 (Government Gazette 36973 Notice 831).

EMISSIONS INVENTORY

- The emissions inventory, calculated from the US EPA AP42 and NPI emission factors, is assumed to be representative of reality.
- The latest stack emissions testing reports as provided by McCain were used.
- PM₁₀ taken as 92% of PM as per US EPA AP-42, B.2-18.
- PM_{2.5} taken as 82% of PM as per US EPA AP-42, B.2-18.
- Emission rates for bulk storage tanks were simulated using the USEPA TANKS 4.0.d emissions estimation model as recommended by the *Modelling Regulations*.
- Caustic soda has a low volatility and cannot be simulated in TANKS 4.09d.
- Ammonia tanks are pressurized and do not have working and breathing losses under normal operations, as such were not considered in this assessment.
- Tank working volumes are calculated based on an assumed maximum liquid height of 90%.
- Average liquid heights were assumed to be 50% of the maximum liquid height.
- Where actual storage tank shell colours were not available options in TANKS 4.0.d, colour substitutes were applied.
- A gas exit velocity of 0.001 m/s is assigned to all modelled tanks, in line with the *Modelling Regulations*.
- As confirmed by McCain, no emissions control equipment is used, as such no emission reduction factors were applied to the emissions inventory.

- Length (m) of the various roads based on the measurement of the line (route) drawn in Google Earth™.
- The silt content of all roads was assumed to be 8.4% as per generic data from US EPA AP-42, 13.2.2 Unpaved Roads, Table 13.2.2-1.
- It is assumed that no road wetting occurs.
- The lower range value for typical moisture content of coal provided by the US EPA reference guideline was applied. The lower range moisture value will result in higher emission rates and is therefore considered environmentally conservative.
- The upper range value for typical silt content of coal provided by the US EPA reference guideline was applied. The upper range silt value will result in higher emission rates and is therefore considered environmentally conservative.
- The existing clarifier are assumed to be used in both Scenarios 1 and 2.
- The vapour space within covered or enclosed components of the proposed WWTW are assumed to reach a state of equilibrium and thus were not assessed as potential odour sources.
- The area of the clarifier was assumed using Google Earth™.
- The length and width of the aeration basin was assumed as 10 m x 10 m.

DISPERSION MODEL

- Building downwash effects have been accounted for in the dispersion model using building location, shape and height visible on Google Earth™.
- The building height of the proposed Biogas Plant was assumed to be 5 m.
- Variable emission rates have been applied as follows:
 - Coal handling, one hour per day, over 365 days.
 - Diesel generators:
 - Generator 1-3, six hours per month, one day per month over twelve months.
 - Generator 4, 2.5 hours per month, one day per month over twelve months.

12 COMPLAINTS

As confirmed by McCain, no air quality related complaints have been received in the last five years.

13 CURRENT OR PLANNED AIR QUALITY INTERVENTIONS

As confirmed by McCain, no specific air quality interventions are scheduled over the next five years.

14 COMPLIANCE AND ENFORCEMENT ACTIONS

As confirmed by McCain, there have been no air quality compliance and enforcement actions undertaken against the facility in the last five years.

15 ADDITIONAL INFORMATION

There is no additional information to supply in relation to this AIR.

16 FORMAL DECLARATIONS

16.1 ANNEXURE A: DECLARATION OF ACCURACY OF INFORMATION

Name of Enterprise: McCain Foods South Africa

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

Name of Practitioner: Yakeen Kowlas

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

Professional Registration No: 115605

Declaration of independence and accuracy of information provided:

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

I, Yakeen Kowlas, 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 Midrand on this 18 day of February 2026.

Kowlas,
Yakeen
(ZAYK03125)

Kowlas, Yakeen (ZAYK03125)
cn=Kowlas, Yakeen (ZAYK03125),
ou=WSPObjects,
email=Yakeen.Kowlas@wsp.com
CN=Kowlas, Yakeen (ZAYK03125),
OU=WSPObjects, OU=ZA,
OU=Users, OU=Active,
E=Yakeen.Kowlas@wsp.com,
DC=net, DC=ptwan, DC=corp

SIGNATURE

Principal Consultant at WSP

CAPACITY OF SIGNATORY

17 REFERENCES

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Appendix A

CURRICULUM VITAE



Yakeen Kowlas

Earth & Environment - Air Quality & Climate Change, Principal Consultant

CAREER SUMMARY

Yakeen Kowlas is a Principal Consultant in the Air Quality & Climate Change division at WSP, with over ten years of experience in the environmental industry. He holds a B.Sc. H. in Environmental Management from the University of South Africa and is currently pursuing an MSc at the University of Witwatersrand.

He is a registered Professional Natural Scientist (Pr.Nat.Sci.) with the South African Council for Natural Scientific Professions (SACNASP). He has extensive expertise in South Africa's air quality legislation and regulatory requirements, specializing in ambient air quality and noise monitoring, air quality management, and dispersion modelling. His work spans various sectors, including petrochemical, mining, metallurgical, manufacturing, and local government, with project experience in South Africa, Botswana, and Guinea.

His responsibilities encompass infield monitoring, data collection, emission inventories, air emission license applications, auditing, and scientific reporting, supporting a range of clients from the mining to oil and gas industries.



>9 years with WSP

>10 years of experience

Area of expertise

Air Quality Impact Assessments
Air Quality Management
Ambient Air Quality and Acoustic Monitoring
Environmental Compliance Auditing

Language

English – Fluent
Afrikaans

EDUCATION

Master of Science, University of Witwatersrand, South Africa	Current
Bachelor of Science (Honours) Environmental Management, UNISA, South Africa	2013
Bachelor of Science Environmental Management, University of Zululand, South Africa	2009

ADDITIONAL TRAINING

AERMOD Air Dispersion Modelling	2023
Scientific Report Writing for Professionals	2023
First Aid Level 1	2019
Fundamentals of Project Management	2018
Report Writing Fundamentals for Consulting Engineers	2018
Risk Assessment – HIRA	2018
Snake Awareness Training	2016

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Yakeen Kowlas

Earth & Environment - Air Quality & Climate Change, Principal Consultant

Advance Driving – Defensive Driving and Traffic Psychology	2016
Climate Reality Leadership Corporation	2013

PROFESSIONAL MEMBERSHIPS

SACNASP – South African Council for Natural Scientific Professionals – Registration No. 155605	2024
--	------

PROFESSIONAL HISTORY

WSP Group Africa (Pty) Ltd.	October 2015 – present
Department of Economic Development, Tourism and Environmental Affairs	April 2015 – September 2015
ALS Inspection	October 2013 – March 2015
SGS	August 2010 – July 2011

PROFESSIONAL EXPERIENCE

Air Quality Management

Bidvest Tank Terminals, Air Quality Management, Various Locations, South Africa
2024 – 2025

Consultant and Project Manager
NAIES reporting for 2023 and 2024.

Xintong Steel, Air Quality Management, Atlantis, Western Cape, South Africa
2020 - present

Consultant and Project Manager
Air quality management inclusive of NAEIS and GHG reporting, AEL applications and audits, annual reporting, and the development of a fugitive emissions management plan.

Dekro Paints, Air Quality Management, Kuils River, Western Cape, South Africa
2018 - present

Consultant and Project Manager
Air quality management inclusive of dust fallout, TVOC and LDAR monitoring, biannual reports, AEL audits, and the development of an odour management plan.

Safripol, Air Quality Management, Jacobs, Kwa-Zulu Natal, South Africa
2023 - present

Consultant and Project Manager
Air quality management inclusive of NAIES, AEL application, annual reporting, and the development of an odour management plan.

Enaex Africa, Air Quality Management, Secunda, Mpumalanga, South Africa
2020 - 2024

Consultant and Project Manager
Annual AEL audits.

Richards Bay Coal Terminal, Air Quality Management, Richards Bay, South Africa
2022

Consultant and Project Manager
NAIES reporting for 2022.

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Yakeen Kowlas

Earth & Environment - Air Quality & Climate Change, Principal Consultant

Air Quality Impact Assessments

Atlantis Foundries, Air Quality Management, Atlantis, Western Cape, South Africa
2024

Consultant and Project Manager

Development of an AIR including dispersion modelling for a Diesel Generator Project.

Seriti, KLX Pit 1 Project, Mpumalanga, South Africa
2024

Consultant

Development of an AQIA including dispersion modelling for an in-pit disposal, a Destoning Plant and a Secondary Feeder operation.

Safripol, Microgrid Project, Jacobs, Kwa-Zulu Natal, South Africa
2024

Consultant and Project Manager

Development of an AIR including dispersion modelling for a Microgrid Project.

Loci, Kanye Mine, Botswana
2023

Consultant

Development of an AQIA including dispersion modelling for a proposed manganese mine.

Loci, Nolens Mine, Botswana
2022

Consultant

Development of an AQIA including dispersion modelling for a proposed coal mine.

Seriti, New Denmark Colliery, Mpumalanga, South Africa
2022

Consultant

Development of an AQMP including dispersion modelling and a dust management plan for the Seriti New Denmark coal mine.

Flaura Pets, Pet Crematorium, Strand, Western Cape, South Africa
2021

Consultant

Development of an AIR including dispersion modelling for a proposed pet crematorium.

Air Quality Monitoring

NATREF, TVOC Monitoring, Free State, South Africa
2016 - present

Consultant and Project Manager

Maintenance and management of the passive monitoring network, including reporting and annual presentations.

Omnia Group, Dust Fallout Monitoring - Sasolburg, South Africa
2015- 2023

Consultant and Project Manager

Maintenance and management of the dust fallout network, including reporting at each of the Omnia sites inclusive of Sasolburg, Dryden and Rustenburg.

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Yakeen Kowlas

Earth & Environment - Air Quality & Climate Change, Principal Consultant

**Thungela, South African Coal Estates, Dust Fallout, Particulate Matter and Noise Monitoring, Mpumalanga, South Africa
2020 - 2023**

Consultant and Project Manager

Maintenance and management of the dust fallout and particulate network, and a noise monitor, including reporting and the development of a dust management plan at the proposed SACE collieries.

**Thungela, Dust Fallout and Particulate Matter Monitoring for nine Collieries, Mpumalanga, South Africa
2015 - 2022**

Consultant and Project Manager

Maintenance and management of the dust fallout and particulate network, including reporting at the different Thungela collieries.

**Foskor, Dust Fallout and Particulate Matter Monitoring for a Phosphate Mine, Phalaborwa, Limpopo, South Africa
2016 - 2020**

Consultant and Project Manager

Maintenance and management of the dust fallout and particulate network, including reporting and the development of a dust management plan.

**Seriti, Dust Fallout and Particulate Matter Monitoring (multiple collieries), Various Locations, South Africa
2015 - 2021**

Consultant

Maintenance and management of the dust fallout and particulate network, including reporting at the different Seriti collieries.

**Eskom, Dust Fallout Monitoring, Lethabo Power Station, South Africa
2019**

Consultant and Project Manager

Maintenance and management of the dust fallout network, including reporting.

**Alliance Mining Commodities, Air Quality and Noise Monitoring, Koumbia Bauxite Project, Guinea.
2018**

Consultant

Assisting the environmental team with an air quality network establishment and management, and noise monitoring.

**Transnet, Dust Fallout Monitoring, Pendergry, Brits, South Africa
2017**

Consultant

Maintenance and management of the dust fallout network, including reporting and the development of a dust management plan.

**Eskom, Dust Fallout Monitoring, Kendal Power Station, South Africa
2016**

Consultant

Maintenance and management of the dust fallout network, including reporting.

**Eskom, Dust Fallout Monitoring, Majuba Power Station, South Africa
2015 - 2016**

Consultant

Maintenance and management of the dust fallout network, including reporting.

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Yakeen Kowlas

Earth & Environment - Air Quality & Climate Change, Principal Consultant

EVRAZ Highveld Steel, Fallout Monitoring, eMalahleni, Gauteng, South Africa

2015

Consultant

Maintenance and management of the dust fallout network, including reporting.

Richards Bay Minerals, Air Quality Monitoring, Kwa-Zulu-Natal, South Africa

2011

Air Quality Technician

Maintenance and management of the dust fallout network, particulate matter sampling and passive sampling.

Tata Steel, Dust Fallout Monitoring, Kwa-Zulu-Natal, South Africa

2011

Air Quality Technician

Maintenance and management of the dust fallout network.

Tronox, Dust Fallout Monitoring, Kwa-Zulu-Natal, South Africa

2011

Air Quality Technician

Maintenance and management of the dust fallout network.

Mondi, Dust Fallout Monitoring, Kwa-Zulu-Natal, South Africa

2011

Air Quality Technician

Maintenance and management of the dust fallout network.

Tendele Coal Mine, Dust Fallout Monitoring, Kwa-Zulu-Natal, South Africa

2011

Air Quality Technician

Maintenance and management of the dust fallout network.

Acoustic Monitoring

Rainbow Rare Earths, Environmental Authorisation, Phalaborwa, South Africa

2023

Consultant

WSP was appointed to undertake an environmental acoustic impact assessment for the proposed rare earths phosphogypsum plant. Yakeen was responsible for environmental noise monitoring.

National Petroleum Refiners of South Africa (Pty) Ltd, Environmental Acoustic Impact Assessment for the Hybrid Clean Fuels II Project, Sasolburg, Free State, South Africa

2013

Consultant

WSP was appointed to undertake an environmental acoustic impact assessment for the proposed Hybrid CFII upgrade project at the refinery. Yakeen was responsible for environmental noise monitoring.

Xintong Steel, Noise Monitoring, Atlantis, South Africa

2019

Consultant

Environmental noise monitoring was conducted during the daytime and night-time at the Xintong steel foundry.

Abland, Environmental Acoustic Impact Assessment for the development of a Casino, Somerset west, Cape Town, South Africa

2016

Consultant

WSP

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Yakeen Kowlas

Earth & Environment - Air Quality & Climate Change, Principal Consultant

WSP was appointed to undertake an environmental acoustic impact assessment for the development of a proposed Casino. Yakeen was responsible for environmental noise monitoring.

**Sonae Novobord, Noise Monitoring, Mpumalanga, South Africa
2016**

Consultant

Environmental noise monitoring was conducted during the daytime and night-time at the Sonae Panbult Plant.

Stack Monitoring

**Mondi, Stack Emission Testing, Kwa-Zulu-Natal, South Africa
2011**

Air Quality Technician

Isokinetic sampling using methods 1-5.

**Assmang Chrome, Emission Testing, Kwa-Zulu-Natal, South Africa
2011**

Air Quality Technician

Isokinetic sampling using methods 1-5.

**Assmang Manganese, Stack Emission Testing, Kwa-Zulu-Natal, South Africa
2011**

Air Quality Technician

Isokinetic sampling using methods 1-5.

Environmental Audits

**uMhlatuze Municipality, Environmental Compliance Inspection, Kwa-Zulu-Natal, South Africa
2015**

Environmental Officer

Waste transfer station audits.

**Government, Private Hospitals and Clinics, Compliance Inspection, Kwa-Zulu-Natal, South Africa
2015**

Environmental Officer

Health care risk waste audits of various hospitals and clinics in Northern Kwa-Zulu Natal.

**South32, Aluminium, Environmental Compliance Inspection, Kwa-Zulu-Natal, South Africa
2015**

Environmental Officer

Environmental compliance audit of facility permits, air quality, waste management and water quality.

**Tronox CPC Plant, Environmental Compliance Inspection, Kwa-Zulu-Natal, South Africa
2015**

Environmental Officer

Environmental compliance audit of facility permits, air quality, waste management and water quality.

**Tonga Sugar Mill, Environmental Compliance Inspection, Kwa-Zulu-Natal, South Africa
2015**

Environmental Officer

Environmental compliance audit of facility permits, air quality, waste management and water quality.

**Richards Bay Coal Terminal, Environmental Compliance Inspection, Kwa-Zulu-Natal, South Africa
2015**

Environmental Officer

Environmental compliance audit of facility permits, air quality, waste management and water quality.

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Yakeen Kowlas

Earth & Environment - Air Quality & Climate Change, Principal Consultant

**Amatikulu Mill, Environmental Compliance Inspection, Kwa-Zulu-Natal, South Africa
2015**

Environmental Officer

Environmental compliance audit of facility permits, air quality, waste management and water quality.

**MPACT, Environmental Compliance Inspection, Kwa-Zulu-Natal, South Africa
2015**

Environmental Officer

Environmental compliance audit of facility permits, air quality, waste management and water quality.

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Appendix B

IMPACT ASSESSMENT METHODOLOGY



The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation.

The key objectives of the risk assessment methodology are to identify any additional potential environmental issues and associated impacts likely to arise from the proposed Project, and to propose a significance ranking. Issues / aspects will be reviewed and ranked against a series of significance criteria to identify and record interactions between activities and aspects, and resources and receptors to provide a detailed discussion of impacts.

A standard risk assessment methodology is used for the ranking of the identified environmental impacts pre-and post-mitigation (i.e. residual impact). The significance of environmental aspects is determined and ranked by considering the criteria³ presented in **Figure B-1**.

Table B-1 - Impact Assessment Criteria and Scoring System

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries
Impact Reversibility (R) The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change	Reversible: Recovery without rehabilitation		Recoverable: Recovery with rehabilitation		Irreversible: Not possible despite action
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probability	Definite

³ The definitions given are for guidance only, and not all the definitions will apply to all the environmental receptors and resources being assessed. Impact significance was assessed with and without mitigation measures in place.

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (M + E + R + D) \times P]$ <i>Significance = (Magnitude + Extent + Reversibility + Duration) × Probability</i>				
IMPACT SIGNIFICANCE RATING					
Total Score	4 to 15	16 to 30	31 to 60	61 to 80	81 to 100
Environmental Significance Rating (Negative (-))	Very low	Low	Moderate	High	Very High
Environmental Significance Rating (Positive (+))	Very low	Low	Moderate	High	Very High

17.1.1 IMPACT MITIGATION

The impact significance without mitigation measures will be assessed with the design controls in place. Impacts without mitigation measures in place are not representative of the proposed development's actual extent of impact and are included to facilitate understanding of how and why mitigation measures were identified. The residual impact is what remains following the application of mitigation and management measures and is thus the final level of impact associated with the development. Residual impacts also serve as the focus of management and monitoring activities during Project implementation to verify that actual impacts are the same as those predicted in this report.

The mitigation measures chosen are based on the mitigation sequence/hierarchy which allows for consideration of five (5) different levels, which include avoid/prevent, minimise, rehabilitate/restore, offset and no-go in that order. The idea is that when Project impacts are considered, the first option should be to avoid or prevent the impacts from occurring in the first place if possible, however, this is not always feasible. If this is not attainable, the impacts can be allowed, however they must be minimised as far as possible by considering reducing the footprint of the development for example so that little damage is encountered. If impacts are unavoidable, the next goal is to rehabilitate or restore the areas impacted back to their original form after Project completion. Offsets are then considered if all the other measures described above fail to remedy high/significant residual negative impacts. If no offsets can be achieved on a potential impact, which results in full destruction of any ecosystem for example, the no-go option is considered so that another activity or location is considered in place of the original plan.

The mitigation sequence/hierarchy is shown in **Figure B-1** below.

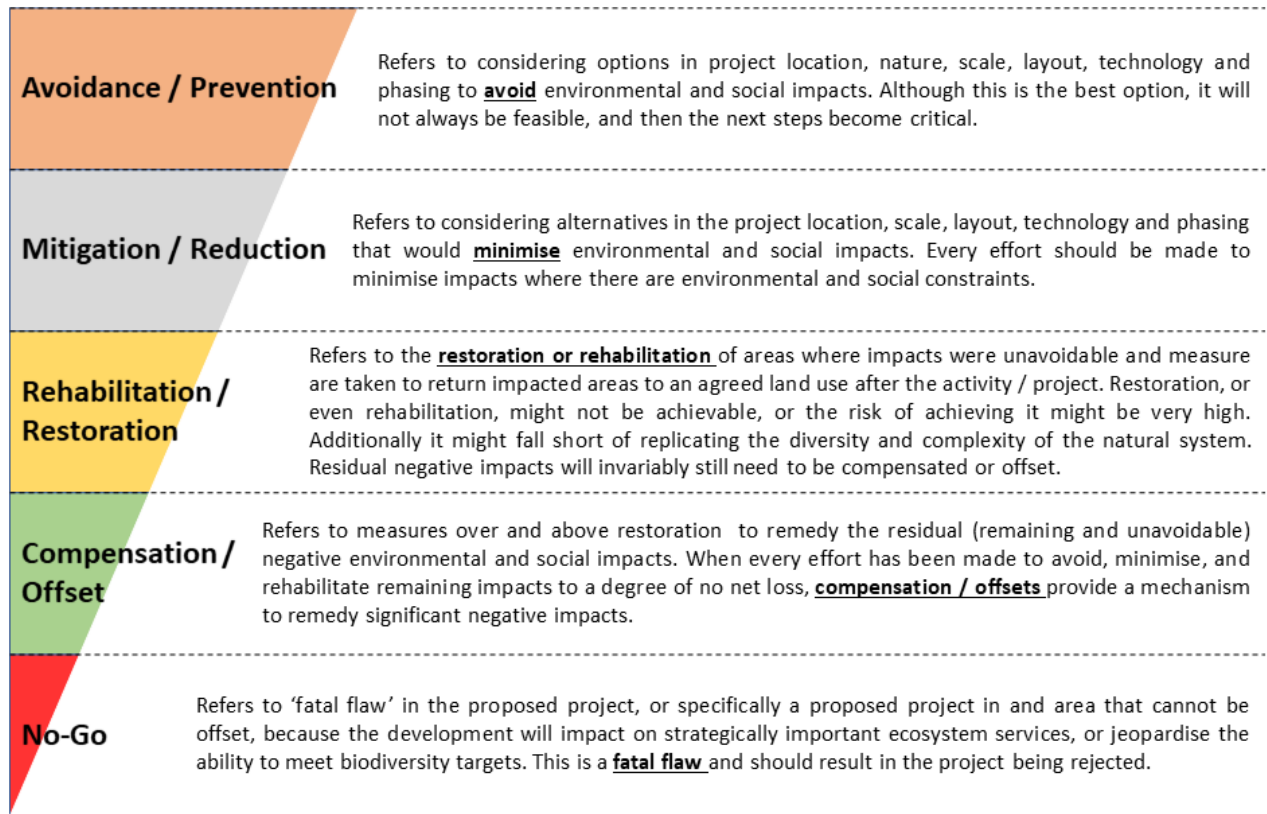


Figure B-1 - Mitigation Sequence/Hierarchy

Appendix C

TANKS MODEL RESULTS

TANKS 4.0.9d
Emissions Report - Detail Format
Tank Identification and Physical Characteristics

Identification

User Identification:	Tank 17
City:	Delmas
State:	Mpumalanga
Company:	McCain
Type of Tank:	Horizontal Tank
Description:	Diesel tank for Generator 4

Tank Dimensions

Shell Length (ft):	5.74
Diameter (ft):	6.23
Volume (gallons):	1,320.86
Turnovers:	5.00
Net Throughput(gal/yr):	6,604.30
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition	Good

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Delmas, Mpumalanga (Avg Atmospheric Pressure = 12.28 psia)

TANKS 4.0.9d
Emissions Report - Detail Format
Liquid Contents of Storage Tank

Tank 17 - Horizontal Tank
Delmas, Mpumalanga

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F)			Liquid Bulk Temp (deg F)	Vapor Pressure (psia)			Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
		Avg.	Min.	Max.		Avg.	Min.	Max.					
Distillate fuel oil no. 2	All	66.25	60.84	71.66	64.24	0.0081	0.0067	0.0095	130.0000			188.00	Option 1: VP60 = .0065 VP70 = .009

TANKS 4.0.9d
Emissions Report - Detail Format
Detail Calculations (AP-42)

Tank 17 - Horizontal Tank
Delmas, Mpumalanga

Annual Emission Calculations	
Standing Losses (lb):	0.2752
Vapor Space Volume (cu ft):	111.4495
Vapor Density (lb/cu ft):	0.0002
Vapor Space Expansion Factor:	0.0365
Vented Vapor Saturation Factor:	0.9987
Tank Vapor Space Volume:	
Vapor Space Volume (cu ft):	111.4495
Tank Diameter (ft):	6.2300
Effective Diameter (ft):	6.7494
Vapor Space Outage (ft):	3.1150
Tank Shell Length (ft):	5.7400
Vapor Density	
Vapor Density (lb/cu ft):	0.0002
Vapor Molecular Weight (lb/lb-mole):	130.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0081
Daily Avg. Liquid Surface Temp. (deg. R):	525.9220
Daily Average Ambient Temp. (deg. F):	64.2200
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	523.9100
Tank Paint Solar Absorptance (Shell):	0.1700
Daily Total Solar Insulation Factor (Btu/sqft day):	1,504.6800
Vapor Space Expansion Factor	
Vapor Space Expansion Factor:	0.0365
Daily Vapor Temperature Range (deg. R):	21.6343
Daily Vapor Pressure Range (psia):	0.0028
Breather Vent Press. Setting Range(psia):	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0081
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	0.0067
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	0.0095
Daily Avg. Liquid Surface Temp. (deg R):	525.9220
Daily Min. Liquid Surface Temp. (deg R):	520.5134
Daily Max. Liquid Surface Temp. (deg R):	531.3306
Daily Ambient Temp. Range (deg. R):	20.1000
Vented Vapor Saturation Factor	
Vented Vapor Saturation Factor:	0.9987
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0081
Vapor Space Outage (ft):	3.1150
Working Losses (lb):	
Vapor Molecular Weight (lb/lb-mole):	130.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0081
Annual Net Throughput (gal/yr.):	6,604.3000
Annual Turnovers:	5.0000
Turnover Factor:	1.0000
Tank Diameter (ft):	6.2300
Working Loss Product Factor:	1.0000
Total Losses (lb):	
	0.4400

TANKS 4.0.9d
Emissions Report - Detail Format
Individual Tank Emission Totals

Emissions Report for: Annual

Tank 17 - Horizontal Tank
Delmas, Mpumalanga

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Distillate fuel oil no. 2	0.16	0.28	0.44

TANKS 4.0.9d
Emissions Report - Detail Format
Tank Identification and Physical Characteristics

Identification

User Identification:	Tank 19
City:	Delmas
State:	Mpumalanga
Company:	McCain
Type of Tank:	Horizontal Tank
Description:	Diesel tank for Firewater Pump

Tank Dimensions

Shell Length (ft):	5.94
Diameter (ft):	3.94
Volume (gallons):	528.35
Turnovers:	0.75
Net Throughput(gal/yr):	396.26
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	Red/Primer
Shell Condition	Good

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Delmas, Mpumalanga (Avg Atmospheric Pressure = 12.28 psia)

TANKS 4.0.9d
Emissions Report - Detail Format
Liquid Contents of Storage Tank

Tank 19 - Horizontal Tank
Delmas, Mpumalanga

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F)			Liquid Bulk Temp (deg F)	Vapor Pressure (psia)			Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
		Avg.	Min.	Max.		Avg.	Min.	Max.					
Distillate fuel oil no. 2	All	77.23	64.24	90.22	68.56	0.0112	0.0076	0.0161	130.0000			188.00	Option 1: VP70 = .009 VP80 = .012

TANKS 4.0.9d
Emissions Report - Detail Format
Detail Calculations (AP-42)

Tank 19 - Horizontal Tank
Delmas, Mpumalanga

Annual Emission Calculations	
Standing Losses (lb):	0.3925
Vapor Space Volume (cu ft):	46.1285
Vapor Density (lb/cu ft):	0.0003
Vapor Space Expansion Factor:	0.0926
Vented Vapor Saturation Factor:	0.9988
Tank Vapor Space Volume:	
Vapor Space Volume (cu ft):	46.1285
Tank Diameter (ft):	3.9400
Effective Diameter (ft):	5.4602
Vapor Space Outage (ft):	1.9700
Tank Shell Length (ft):	5.9400
Vapor Density	
Vapor Density (lb/cu ft):	0.0003
Vapor Molecular Weight (lb/lb-mole):	130.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0112
Daily Avg. Liquid Surface Temp. (deg. R):	536.8998
Daily Average Ambient Temp. (deg. F):	64.2200
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	528.2300
Tank Paint Solar Absorptance (Shell):	0.8900
Daily Total Solar Insulation Factor (Btu/sqft day):	1,504.6800
Vapor Space Expansion Factor	
Vapor Space Expansion Factor:	0.0926
Daily Vapor Temperature Range (deg. R):	51.9686
Daily Vapor Pressure Range (psia):	0.0086
Breather Vent Press. Setting Range(psia):	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0112
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	0.0076
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	0.0161
Daily Avg. Liquid Surface Temp. (deg R):	536.8998
Daily Min. Liquid Surface Temp. (deg R):	523.9076
Daily Max. Liquid Surface Temp. (deg R):	549.8920
Daily Ambient Temp. Range (deg. R):	20.1000
Vented Vapor Saturation Factor	
Vented Vapor Saturation Factor:	0.9988
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0112
Vapor Space Outage (ft):	1.9700
Working Losses (lb):	
Vapor Molecular Weight (lb/lb-mole):	0.0137
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	130.0000
Annual Net Throughput (gal/yr.):	0.0112
Annual Turnovers:	396.2600
Turnover Factor:	0.7500
Tank Diameter (ft):	1.0000
Working Loss Product Factor:	3.9400
	1.0000
Total Losses (lb):	
	0.4062

TANKS 4.0.9d
Emissions Report - Detail Format
Individual Tank Emission Totals

Emissions Report for: Annual

Tank 19 - Horizontal Tank
Delmas, Mpumalanga

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Distillate fuel oil no. 2	0.01	0.39	0.41

TANKS 4.0.9d
Emissions Report - Detail Format
Tank Identification and Physical Characteristics

Identification

User Identification:	Tank 20
City:	Delmas
State:	Mpumalanga
Company:	McCain
Type of Tank:	Horizontal Tank
Description:	New Tank

Tank Dimensions

Shell Length (ft):	9.50
Diameter (ft):	0.00
Volume (gallons):	19,751.18
Turnovers:	1.07
Net Throughput(gal/yr):	21,133.76
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	White/White
Shell Condition	Good

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Delmas, Mpumalanga (Avg Atmospheric Pressure = 12.28 psia)

TANKS 4.0.9d

Emissions Report - Detail Format

Liquid Contents of Storage Tank

Tank 20 - Horizontal Tank

Delmas, Mpumalanga

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F)			Liquid Bulk Temp (deg F)	Vapor Pressure (psia)			Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
		Avg.	Min.	Max.		Avg.	Min.	Max.					
Distillate fuel oil no. 2	All	66.25	60.84	71.66	64.24	0.0081	0.0067	0.0095	130.0000			188.00	Option 1: VP60 = .0065 VP70 = .009

TANKS 4.0.9d
Emissions Report - Detail Format
Detail Calculations (AP-42)

Tank 20 - Horizontal Tank
Delmas, Mpumalanga

Annual Emission Calculations	
Standing Losses (lb):	0.0000
Vapor Space Volume (cu ft):	0.0000
Vapor Density (lb/cu ft):	0.0002
Vapor Space Expansion Factor:	0.0365
Vented Vapor Saturation Factor:	1.0000
Tank Vapor Space Volume:	
Vapor Space Volume (cu ft):	0.0000
Tank Diameter (ft):	0.0000
Effective Diameter (ft):	0.0000
Vapor Space Outage (ft):	0.0000
Tank Shell Length (ft):	9.5000
Vapor Density	
Vapor Density (lb/cu ft):	0.0002
Vapor Molecular Weight (lb/lb-mole):	130.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0081
Daily Avg. Liquid Surface Temp. (deg. R):	525.9220
Daily Average Ambient Temp. (deg. F):	64.2200
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	523.9100
Tank Paint Solar Absorptance (Shell):	0.1700
Daily Total Solar Insulation Factor (Btu/sqft day):	1,504.6800
Vapor Space Expansion Factor	
Vapor Space Expansion Factor:	0.0365
Daily Vapor Temperature Range (deg. R):	21.6343
Daily Vapor Pressure Range (psia):	0.0028
Breather Vent Press. Setting Range(psia):	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0081
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	0.0067
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	0.0095
Daily Avg. Liquid Surface Temp. (deg R):	525.9220
Daily Min. Liquid Surface Temp. (deg R):	520.5134
Daily Max. Liquid Surface Temp. (deg R):	531.3306
Daily Ambient Temp. Range (deg. R):	20.1000
Vented Vapor Saturation Factor	
Vented Vapor Saturation Factor:	1.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0081
Vapor Space Outage (ft):	0.0000
Working Losses (lb):	
Vapor Molecular Weight (lb/lb-mole):	0.5274
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	130.0000
Annual Net Throughput (gal/yr.):	0.0081
Annual Turnovers:	21,133.7600
Turnover Factor:	1.0700
Tank Diameter (ft):	1.0000
Working Loss Product Factor:	0.0000
	1.0000
Total Losses (lb):	0.5274

TANKS 4.0.9d
Emissions Report - Detail Format
Individual Tank Emission Totals

Emissions Report for: Annual

Tank 20 - Horizontal Tank
Delmas, Mpumalanga

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Distillate fuel oil no. 2	0.53	0.00	0.53

TANKS 4.0.9d
Emissions Report - Detail Format
Tank Identification and Physical Characteristics

Identification

User Identification:	Tank 4
City:	Delmas
State:	Mpumalanga
Company:	McCain
Type of Tank:	Horizontal Tank
Description:	Glycol Tank 4

Tank Dimensions

Shell Length (ft):	6.69
Diameter (ft):	5.91
Volume (gallons):	1,233.60
Turnovers:	1.00
Net Throughput(gal/yr):	1,233.60
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	Gray/Light
Shell Condition	Good

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Delmas, Mpumalanga (Avg Atmospheric Pressure = 12.28 psia)

TANKS 4.0.9d
Emissions Report - Detail Format
Liquid Contents of Storage Tank

Tank 4 - Horizontal Tank
Delmas, Mpumalanga

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F)			Liquid Bulk Temp (deg F)	Vapor Pressure (psia)			Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
		Avg.	Min.	Max.		Avg.	Min.	Max.					
Propylene glycol	All	71.89	62.59	81.20	66.46	0.0018	0.0011	0.0029	76.1100			76.11	Option 2: A=8.2082, B=2085.9, C=203.54

TANKS 4.0.9d
Emissions Report - Detail Format
Detail Calculations (AP-42)

Tank 4 - Horizontal Tank
Delmas, Mpumalanga

Annual Emission Calculations	
Standing Losses (lb):	0.0665
Vapor Space Volume (cu ft):	116.8938
Vapor Density (lb/cu ft):	0.0000
Vapor Space Expansion Factor:	0.0653
Vented Vapor Saturation Factor:	0.9997
Tank Vapor Space Volume:	
Vapor Space Volume (cu ft):	116.8938
Tank Diameter (ft):	5.9100
Effective Diameter (ft):	7.0970
Vapor Space Outage (ft):	2.9550
Tank Shell Length (ft):	6.6900
Vapor Density	
Vapor Density (lb/cu ft):	0.0000
Vapor Molecular Weight (lb/lb-mole):	76.1100
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0018
Daily Avg. Liquid Surface Temp. (deg. R):	531.5634
Daily Average Ambient Temp. (deg. F):	64.2200
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	526.1300
Tank Paint Solar Absorptance (Shell):	0.5400
Daily Total Solar Insulation Factor (Btu/sqft day):	1,504.6800
Vapor Space Expansion Factor	
Vapor Space Expansion Factor:	0.0653
Daily Vapor Temperature Range (deg. R):	37.2228
Daily Vapor Pressure Range (psia):	0.0018
Breather Vent Press. Setting Range(psia):	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0018
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	0.0011
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	0.0029
Daily Avg. Liquid Surface Temp. (deg R):	531.5634
Daily Min. Liquid Surface Temp. (deg R):	522.2577
Daily Max. Liquid Surface Temp. (deg R):	540.8691
Daily Ambient Temp. Range (deg. R):	20.1000
Vented Vapor Saturation Factor	
Vented Vapor Saturation Factor:	0.9997
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0018
Vapor Space Outage (ft):	2.9550
Working Losses (lb):	
Vapor Molecular Weight (lb/lb-mole):	0.0040
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	76.1100
Annual Net Throughput (gal/yr.):	0.0018
Annual Turnovers:	1,233.5990
Turnover Factor:	1.0000
Tank Diameter (ft):	1.0000
Working Loss Product Factor:	5.9100
	1.0000
Total Losses (lb):	
	0.0705

TANKS 4.0.9d
Emissions Report - Detail Format
Individual Tank Emission Totals

Emissions Report for: Annual

Tank 4 - Horizontal Tank
Delmas, Mpumalanga

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Propylene glycol	0.00	0.07	0.07

TANKS 4.0.9d
Emissions Report - Detail Format
Tank Identification and Physical Characteristics

Identification

User Identification:	Tank 5
City:	Delmas
State:	Mpumalanga
Company:	McCain
Type of Tank:	Horizontal Tank
Description:	Glycol Tank 5

Tank Dimensions

Shell Length (ft):	6.69
Diameter (ft):	5.91
Volume (gallons):	1,233.60
Turnovers:	1.00
Net Throughput(gal/yr):	1,233.60
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	Gray/Light
Shell Condition	Good

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meterological Data used in Emissions Calculations: Delmas, Mpumalanga (Avg Atmospheric Pressure = 12.28 psia)

TANKS 4.0.9d
Emissions Report - Detail Format
Liquid Contents of Storage Tank

Tank 5 - Horizontal Tank
Delmas, Mpumalanga

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F)			Liquid Bulk Temp (deg F)	Vapor Pressure (psia)			Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
		Avg.	Min.	Max.		Avg.	Min.	Max.					
Propylene glycol	All	71.89	62.59	81.20	66.46	0.0018	0.0011	0.0029	76.1100			76.11	Option 2: A=8.2082, B=2085.9, C=203.54

TANKS 4.0.9d
Emissions Report - Detail Format
Detail Calculations (AP-42)

Tank 5 - Horizontal Tank
Delmas, Mpumalanga

Annual Emission Calculations	
Standing Losses (lb):	0.0665
Vapor Space Volume (cu ft):	116.8938
Vapor Density (lb/cu ft):	0.0000
Vapor Space Expansion Factor:	0.0653
Vented Vapor Saturation Factor:	0.9997
Tank Vapor Space Volume:	
Vapor Space Volume (cu ft):	116.8938
Tank Diameter (ft):	5.9100
Effective Diameter (ft):	7.0970
Vapor Space Outage (ft):	2.9550
Tank Shell Length (ft):	6.6900
Vapor Density	
Vapor Density (lb/cu ft):	0.0000
Vapor Molecular Weight (lb/lb-mole):	76.1100
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0018
Daily Avg. Liquid Surface Temp. (deg. R):	531.5634
Daily Average Ambient Temp. (deg. F):	64.2200
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	526.1300
Tank Paint Solar Absorptance (Shell):	0.5400
Daily Total Solar Insulation Factor (Btu/sqft day):	1,504.6800
Vapor Space Expansion Factor	
Vapor Space Expansion Factor:	0.0653
Daily Vapor Temperature Range (deg. R):	37.2228
Daily Vapor Pressure Range (psia):	0.0018
Breather Vent Press. Setting Range(psia):	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0018
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	0.0011
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	0.0029
Daily Avg. Liquid Surface Temp. (deg R):	531.5634
Daily Min. Liquid Surface Temp. (deg R):	522.2577
Daily Max. Liquid Surface Temp. (deg R):	540.8691
Daily Ambient Temp. Range (deg. R):	20.1000
Vented Vapor Saturation Factor	
Vented Vapor Saturation Factor:	0.9997
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0018
Vapor Space Outage (ft):	2.9550
Working Losses (lb):	
Vapor Molecular Weight (lb/lb-mole):	0.0040
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	76.1100
Annual Net Throughput (gal/yr.):	0.0018
Annual Turnovers:	1,233.5990
Turnover Factor:	1.0000
Tank Diameter (ft):	1.0000
Working Loss Product Factor:	5.9100
	1.0000
Total Losses (lb):	0.0705

TANKS 4.0.9d
Emissions Report - Detail Format
Individual Tank Emission Totals

Emissions Report for: Annual

Tank 5 - Horizontal Tank
Delmas, Mpumalanga

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Propylene glycol	0.00	0.07	0.07

TANKS 4.0.9d
Emissions Report - Detail Format
Total Emissions Summaries - All Tanks in Report

Emissions Report for: Annual

Tank Identification				Losses (lbs)
Tank 17	McCain	Horizontal Tank	Delmas, Mpumalanga	0.44
Tank 19	McCain	Horizontal Tank	Delmas, Mpumalanga	0.41
Tank 20	McCain	Horizontal Tank	Delmas, Mpumalanga	0.53
Tank 4	McCain	Horizontal Tank	Delmas, Mpumalanga	0.07
Tank 5	McCain	Horizontal Tank	Delmas, Mpumalanga	0.07
Total Emissions for all Tanks:				1.51



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