REPORT

Draft Basic Assessment Report and Environmental Management Programme for the upgrading of the M3 and M4 Furnaces, PSP and associated abatement infrastructure and installation of pre-heaters.

Samancor Middelburg Ferrochrome

Submitted to:

Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA)

7 Government Boulevard
Building 6, Riverside Park
Mbombela
1200

Submitted by:

WSP Group Africa (Pty) Ltd

Building 1, Maxwell Office Park, Magwa Crescent West, Waterfall City, Midrand, 1685, South Africa

P.O. Box 6001, Halfway House, 1685

+27 11 254 4800

41105442-01

March 2023

Distribution List

1 Electronic copy to Samancor Middelburg Ferrochrome

1 Electronic copy to MDARDLEA

1 Electronic copy to the Central Data folder for 4115442

Table of Contents

TABLES

FIGURES

APPENDICES

APPENDIX E
Impact Assessment and Mitigation Table

ABBREVIATIONS AND ACRONYMS

Abbreviation/ Acronym	Explanation
BA	Basic Assessment
BAR	Basic Assessment Report
BID	Background Information Letter
CRR	Comments and Responses Report
DEFF	Department of Environment, Forestry and Fisheries
DEA	Department of Environmental Affairs
dBAR	draft Basic Assessment Report
dEMPr	Draft Environmental Management Programme
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
fBAR	Final Basic Assessment Report
fEMPr	Final Environmental Management Programme
GDP	Gross Domestic Product
GN	Government Notice
I&APs	Interested and affected parties
IWWMP	Integrated Water and Waste Management Plan
MAR	Mean Annual Runoff
NAAQS	National Ambient Air Quality Standards
NEMA	National Environmental Management Act 1998 (Act No. 107 of 1998), as amended
NWA	National Water Act 1998 (Act No. 36 of 1998), as amended
SAHRA	South African Heritage Resources Agency

Abbreviation/ Acronym	Explanation
SAWQ	South African Water Quality
WML	Waste Management Licence
WUL	Water Use Licence

UNIT MEASUREMENT

Unit	Explanation
ºC	Degrees Celsius
cm	Centimetre
ha	Hectares
km	Kilometres
m	Metre
m/s	Metres per second
m3/d	Metres cubed per day
mamsl	Metres above mean sea level
mbgl	Meters below ground level
Mtpa	Million tons per annum
ML	Million litres
Mm	Million metres
mm	Millimetre
t/year	Tons per year

PART A
SCOPE OF ASSESSMENT AND BASIC ASSESSMENT REPORT

1.0 INTRODUCTION AND BACKGROUND

Samancor Chrome produces charge chrome at its Middelburg Ferrochrome (MFC) site in two complete Submerged-Arc furnaces (SAFs) and two complete Direct-Current furnaces (DCFs) with associated atmospheric emissions abatement and other related equipment. The products are produced from the smelting of a combination of chrome ore, reductants and fluxes.

The production facilities at the MFC site also comprises a pelletising and sintering plant (PSP), in which chrome ore fines and furnace dust are agglomerated and sintered to produce pellets which join lumpy chrome ore as feed to the SAFs.

Slag tapped from the furnaces contains entrained ferrochrome. It is allowed to cool, then crushed and fed to a metal recovery plant. The barren slag is disposed on a licenced site located on the southern side of the MFC site.

MFC is proposing to upgrade the existing M3 and M4 furnaces, and PSP to increase the current production rate. In addition, pre-heaters will be installed for the M3 and M4 furnaces and the gas abatement equipment for the M3 furnace and PSP will be upgraded.

WSP Group Africa (Pty) Ltd (WSP), an independent environmental assessment practitioner (EAP), is appointed by MFC to conduct the required environmental authorisations for the proposed project.

1.1 Contents of this report

The main purpose of this Basic Assessment (BA) and Environmental Management Programme (EMPr) report is to provide a description of the current baseline environmental conditions within the proposed project area, and to describe the identified environmental impacts and mitigation measures for the proposed activities.

This document has been structured as follows to meet the requirements of Appendix 1 of the Environmental Impact Assessment Regulations, 2014, as amended:

a) **Introduction and overview** – Introduce the project and the project proponent, provides an overview of the project, provides the details of the environmental assessment practitioner, and explains the BA process.

b) **Project Motivation** – Motivates the need for and desirability of the project.

c) **Basic Assessment Process** – Summarises the process being undertaken with respect to the BA for the project.

d) **Description of the Proposed Project** - Provides a summary of the key project components, the project location, scale, nature, main inputs and outputs, schedule and activities during the different phases of the project, inclusive of a description of the project location and the properties on which the project will take place.

e) **Project Alternatives** – Summarises alternatives considered by the project proponent.

f) **Policy, Legal and Administrative Framework** – Discusses the environmental policy, legal, and administrative framework applicable to the proposed project. This framework includes a summary of relevant South African regulations, the applicable administrative framework, and the environmental permitting process.

g) **Description of the Environment that may be affected** – Describes the current biophysical, socio-economic, and cultural status of the area, key characteristics (sensitive or vulnerable areas), important heritage resources, current land use and livelihoods.

h) **Environmental Issues and Potential Impacts of the Project -** Describes the identified impacts and recommended mitigation measures.

i) **Public Consultation** – This section provides a summary of the public consultation activities undertaken as part of the BA/EMPr process.

j) **Next Steps in the Process** – Indicates what the next steps in the process are.

k) **References** – References to literature consulted.

l) **Appendices** – Technical material supporting the BA report, including the Curricula Vitae (CV) of the EAP, stakeholder comments and supporting information, specialist impact assessment reports, and document limitations.

2.0 PROPONENT AND PRACTIONER DETAILS

2.1 Details of the Proponent

For the purposes of the draft Basic Assessment Report (dBAR), the following person may be contacted at Samancor Middelburg Ferrochrome:

Table 1: Applicants details

Applicant:	Samancor Chrome - Middelburg Ferrochrome
Contact person:	Willie Botha
Physical address:	Hendrina Road, Middelburg, 1050
Postal address:	Private Bag X251846, Middelburg, 1050
Telephone:	013 249 4401
Cell:	071 684 6975
E-mail:	Willie.Botha@samancorcr.com

2.2 Environmental Assessment Practitioner (EAP)

Samancor has appointed WSP as the independent EAP to undertake the BA process that is required to support the application for environmental authorisation (EA) and amendment of the site's Atmospheric Emission Licence (AEL) for the proposed furnace and abatement upgrade project.

WSP has no vested interest in the proposed project and hereby declares its independence as required by the EIA Regulations, 2014 (as amended).

For purposes of this Basic Assessment Process, the following persons may be contacted at WSP:

Table 2: Details of the Environmental Assessment Practitioner

Name:	**WSP Group Africa (Pty) Ltd**
Address:	Building 1, Magwa Crescent West, Maxwell Office Park, Waterfall City, Midrand P.O. Box 6001, Halfway House, 1685, South Africa Telephone: (011) 254 4800 Fax: (086)582 1561
Environmental Assessment Practitioner (EAP):	**Marié Schlechter** (Senior Environmental Specialist) Ms Schlechter has worked in the mining industry and environmental consultancy for over twenty (20) years, gaining experience in the environmental management discipline. Marié has experience in conducting and managing environmental impact assessment projects, implementation, maintenance and internal auditing of environmental management systems as well as compliance audits. Marié is a Registered Environmental Assessment Practitioner (EAP No: 2020/1430). Email: marie.schlechter@wsp.com *Full CV is provided APPENDIX A.*
Public Participation Specialist:	**Brian Magongoa** (Public Participation Specialist) Email: brian.magongoa@wsp.com

3.0 PROJECT INFORMATION AND DESCRIPTION

3.1 Location of the Activity

Samancor's Middelburg Ferrochrome plant is located along Hendrina Road, approximately 4.5 km south-east of the town of Middelburg, within the Mpumalanga Province, South Africa (Figure 1).

Covering approximately 365 ha, the plant is located within the Loskop Dam catchment. The Vaalbankspruit, a tributary of the Klein Olifants River, is flowing through the western portion site.

The nearest residential area is Nazareth, located towards the eastern side of the site and within 1 km of MFC. MFC's plant falls under the jurisdiction of the Steve Tshwete Local Municipality. Columbus Stainless Steel Plant lies immediately adjacent to site. Several smaller contracting operations are located adjacent to the site. The Industria and Vaalrand industrial areas lie further to the north of the site (Figure 2).

3.1.1 Magisterial District and relevant Local Authority

MFC is located in the jurisdiction of the Steve Tshwete Local Municipality, which falls within the boundaries of the Nkangala District Municipality, in the Mpumalanga Province.

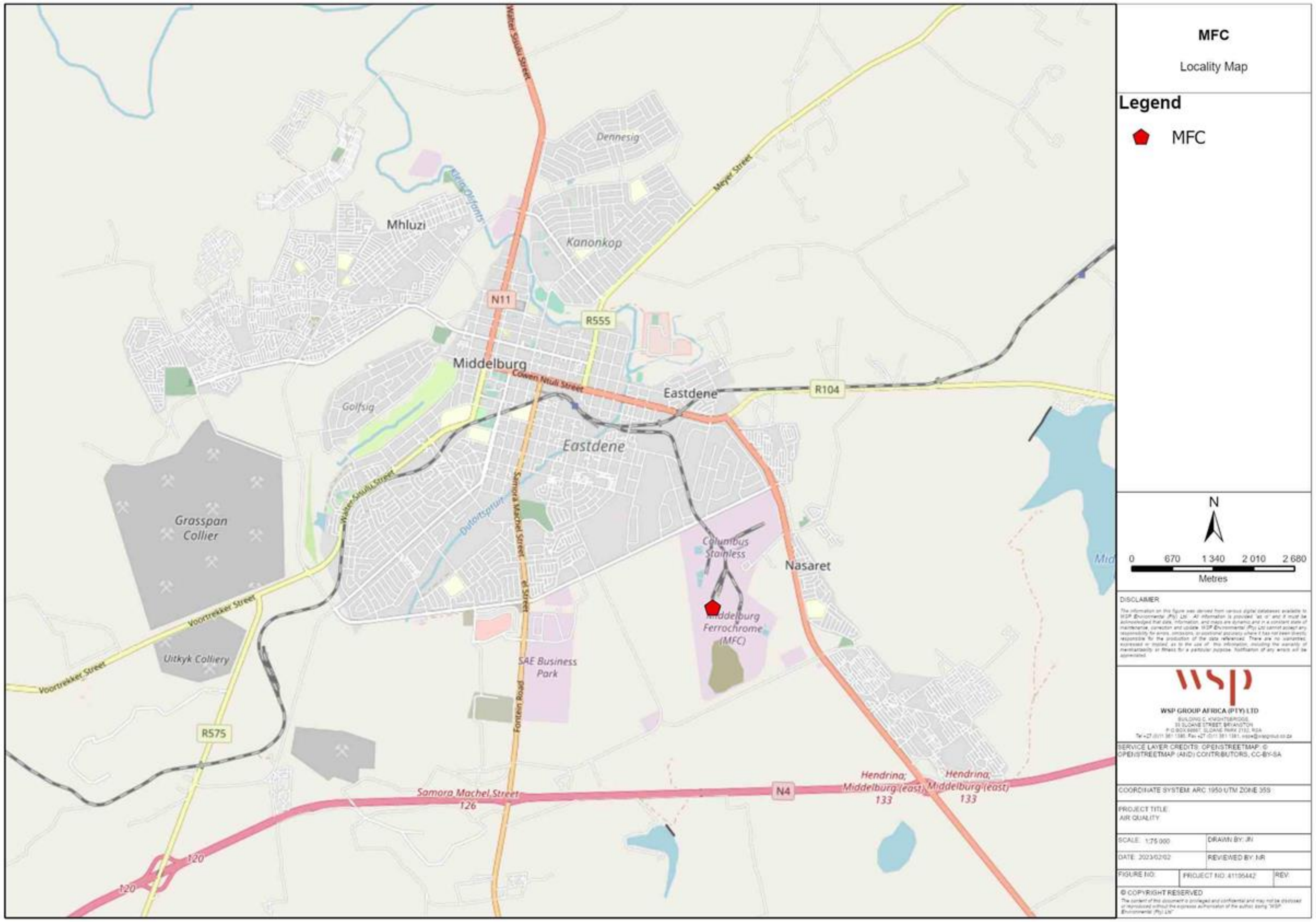


Figure 1: Regional locality of the MFC site

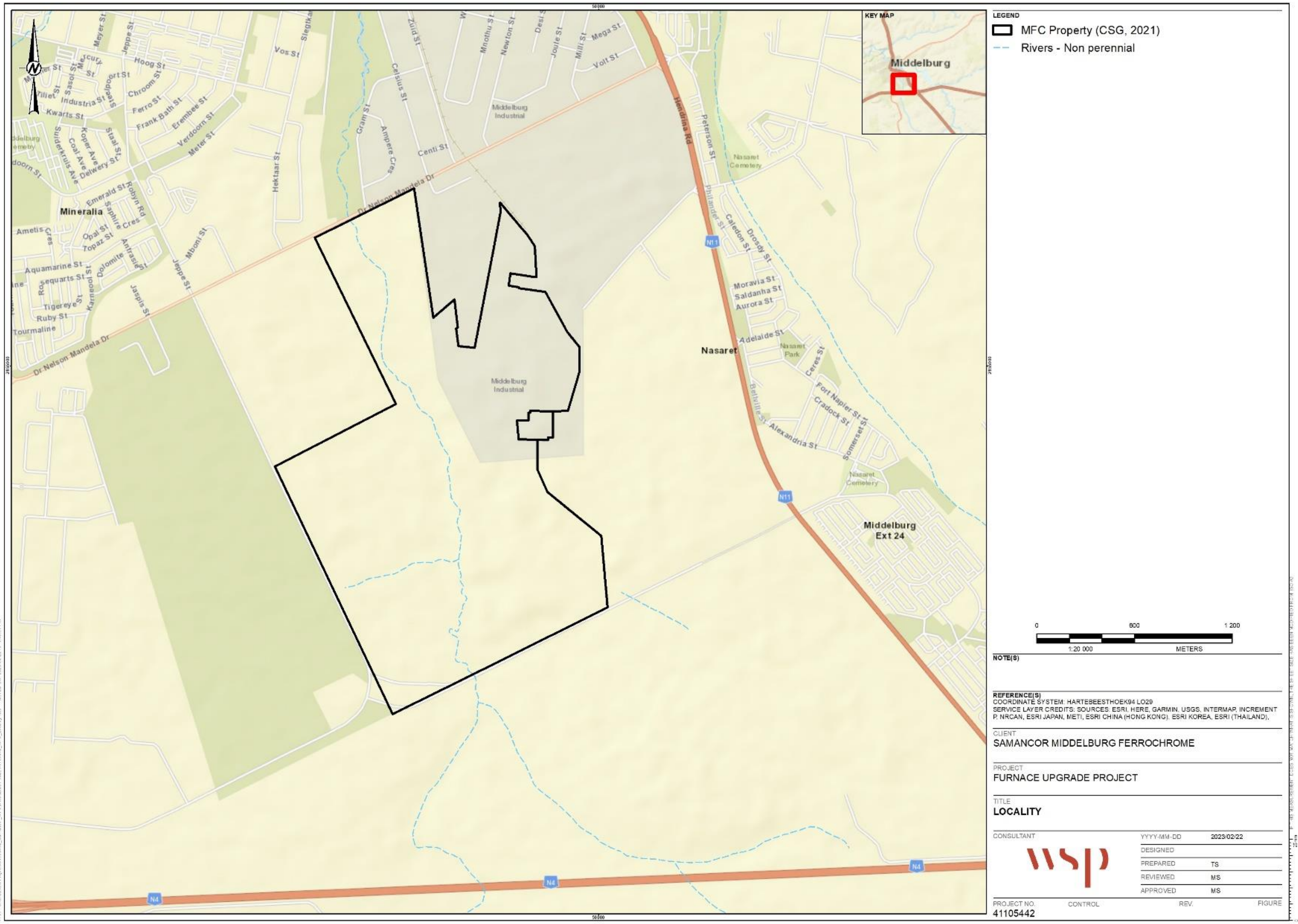


Figure 2: Locality of the Middelburg Ferrochrome site

3.1.2 Description of the property

Table 3: Details of area applicable to the application for environmental authorisation

Farm names:	Farm Middelburg Town and Townlands 287 JS portions 380 and 377
Application area (Ha):	3.1 Ha
Magisterial District:	Nkangala District Municipality
Distance and direction to nearest town	The site is located 5.1 km south-east of the Middelburg CBD
SG Codes	T0JS00000000028700380 T0JS00000000028700377

3.1.3 Surface Rights Owners and use of immediate adjacent land

MFC is located on portions 380 and 377 of the farm Middelburg Town and Townlands 287 JS, currently owned by Samancor Middelburg Ferrochrome.

Table 4: Landowner's details

Farm Middelburg Town and Townlands 287 JS Portion 380 and 377	
Landowner:	Samancor Middelburg Ferrochrome
Contact person:	Willie Botha
Postal address:	Private Bag x251846, Middelburg, 1050
Telephone:	+27 13 249 4401
E-mail:	Willie.botha@samancorcr.com

The MFC site is bordered to the immediate east and north-west by properties owned by Columbus Stainless (Pty) Ltd. The property to the immediate south and south-east are privately owned.

The surface rights owners of the various farm portions in the vicinity of the project area are listed in Table 5 and illustrated in Figure 3.

Table 5: Surface Rights Owners

Farm Name and Portion	Surface Right Owner
Middelburg Town and Townlands 287 JS Portion 380 and 377	Samancor Chrome Limited
Middelburg Town and Townlands 287 JS Portion 340	Samancor Chrome Limited
Middelburg Town and Townlands 287 JS Portion 381	Columbus Stainless (Pty) Ltd
Vaalbank 289 JS Portion 12	Daniel and Johannah Mokwena Mampuru
Vaalbank 289 JS Portion 2	J V Ranch cc

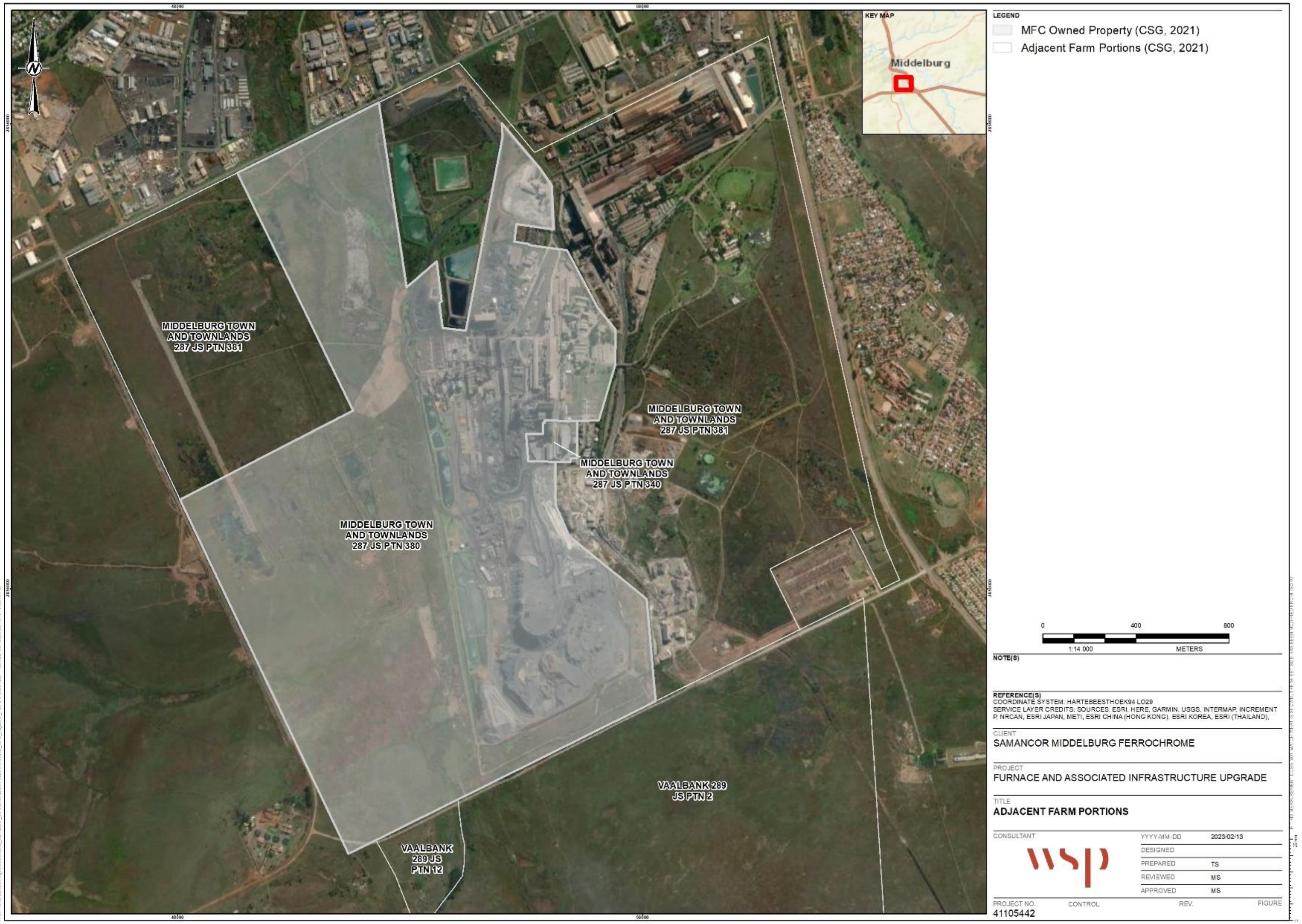


Figure 3: Neighbouring Farm Portions

3.2 Middelburg Ferrochrome Process Description

Samancor Chrome produces charge chrome at its MFC site in two complete submerged arc furnaces (SAFs) and two complete direct current furnaces (DCFs) with associated atmospheric emissions abatement and other related equipment. The products are produced from the smelting of a combination of chrome ore, reductants and fluxes.

The production facilities at the MFC site also comprises a Pelletising and Sintering Plant (PSP), in which chrome ore fines and furnace dust are agglomerated and sintered to produce pellets which join lumpy chrome ore as feed to the SAFs.

Slag tapped from the furnaces contains entrained ferrochrome. It is allowed to cool, then crushed and fed to a metal recovery plant. The barren slag is disposed on a site located on the southern side of the MFC site. Figure 4 and Figure 5 provides a simplified illustration of the production process.

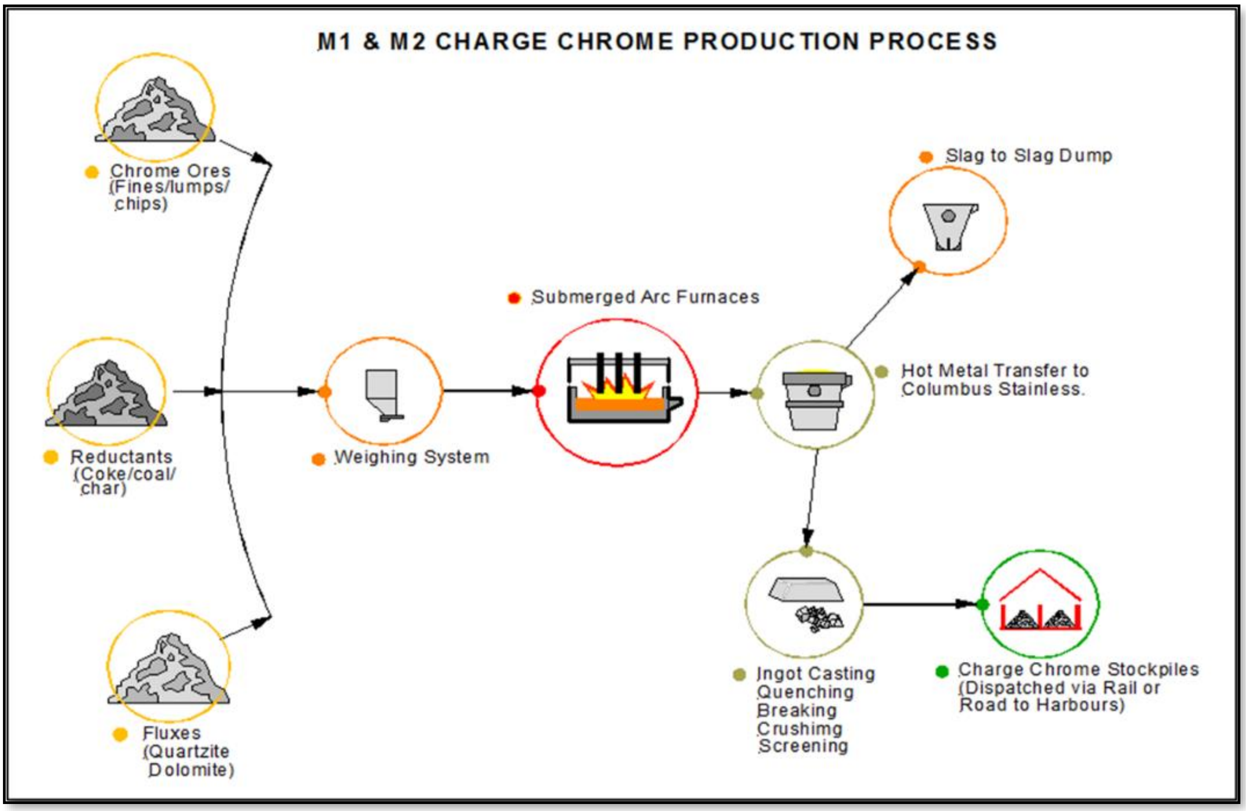


Figure 4 : Process flow diagram of the submerged arc furnaces.

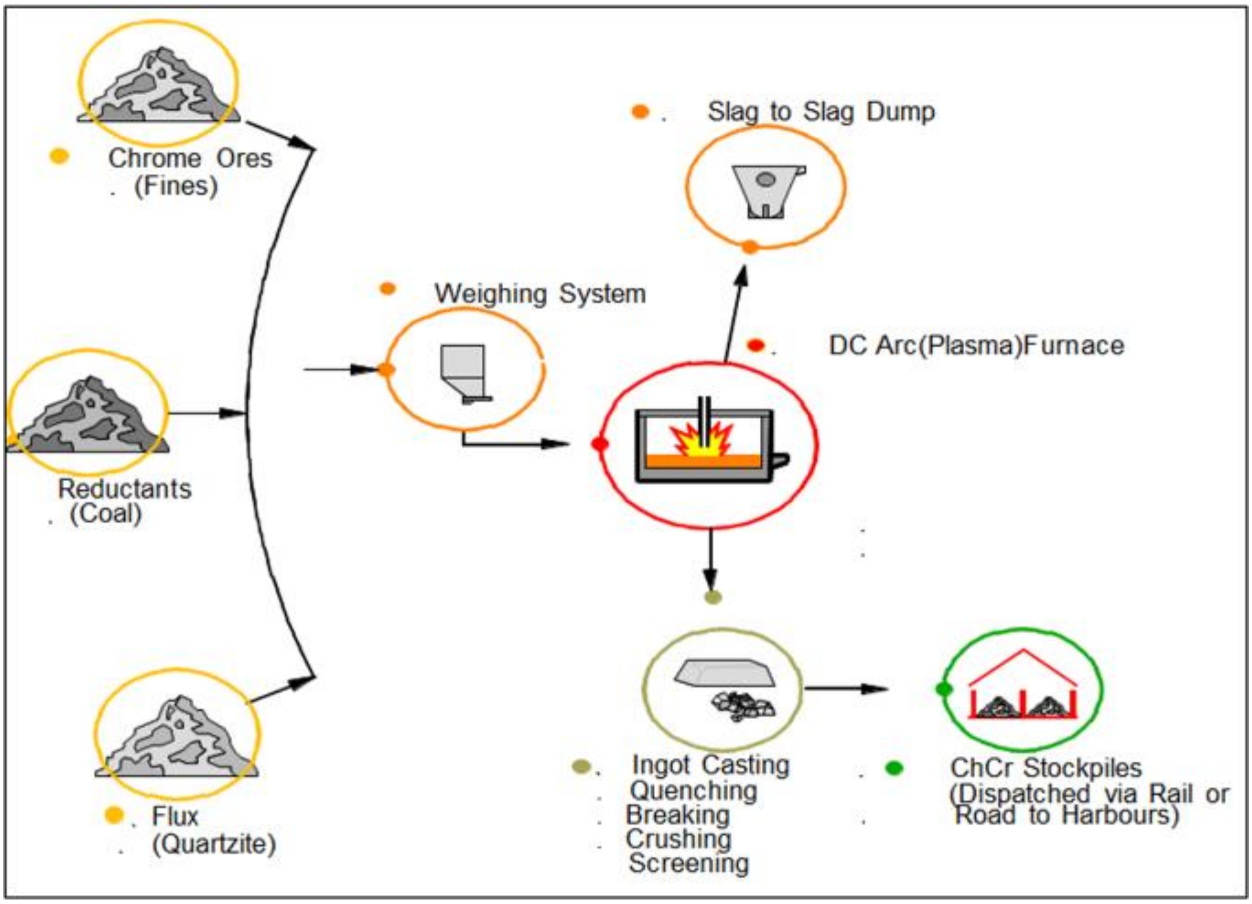


Figure 5 : Process flow diagram of the direct current furnaces.

MFC produces two grades of ferrochrome namely charge chrome and intermediate carbon ferrochrome. Ferrochrome is a carbo-thermic reduction operation, taking place at high temperatures. The ore (an oxide of chromium and iron) is reduced by reductants to form an iron-chromium alloy called ferrochrome.

The chrome production process flow and existing infrastructure is illustrated in Figure 6 and described in the sections below:

3.2.1.1 Pelletising and Sintering Plant (PSP)

The PSP produces pellets through sintering of chromite ore fines. The chromite ore and reductants are agglomerated to produce pellets. The pellets are passed through the sintering plants to ensure they remain intact during handling. The PSP produces filter cake from the main stack scrubber system.

3.2.1.2 M1 and M2 Furnaces

Chromite ore, reductants and fluxes are stored in raw material stockpile bunkers. Chromite ore from the raw material stockpiles and the reductants and fluxes are pre-mixed into a recipe, which is then fed into the open furnaces (M1, M2 furnaces).

The key furnace inputs are pellets, chromite ore, reductants and fluxes.

The furnaces then produce alloy-slag, which is taken to the licenced slag disposal site, dust from the filter bag plant (baghouse), which is disposed at a licenced hazardous landfill site. Final product is then produced and transported to various customers.

3.2.1.3 M3 and M4 Furnaces

The M3 and M4 furnaces input dried raw materials from the chromite ore dryers as well as the reductant dryer. The chromite ore dryers are fed raw materials from the raw material stockpiles and output "dried" chromite ore material. The heat for the reaction at M3 and M4 comes from the electric arc formed between the tip of the electrode in the bottom of the furnace and the furnace hearth (**Figure 7**).

Tapping takes place intermittently at all the furnaces. When enough smelted ferrochrome has accumulated in the furnace, the tap hole is drilled and lanced open and a stream of molten metal and/or slag flows down a trough into a casting bay or ladle.

The ferrochrome solidifies in large casting bays, while the slag is separated and stockpiled for further processing.

The bulk of the slag is transported by slag carriers and hot tipped at the hot tip on the slag disposal site. When cooled the alloy-slag is temporarily stockpiled before it is directed to the metal separation plant (MSP) to separate slag from alloy.

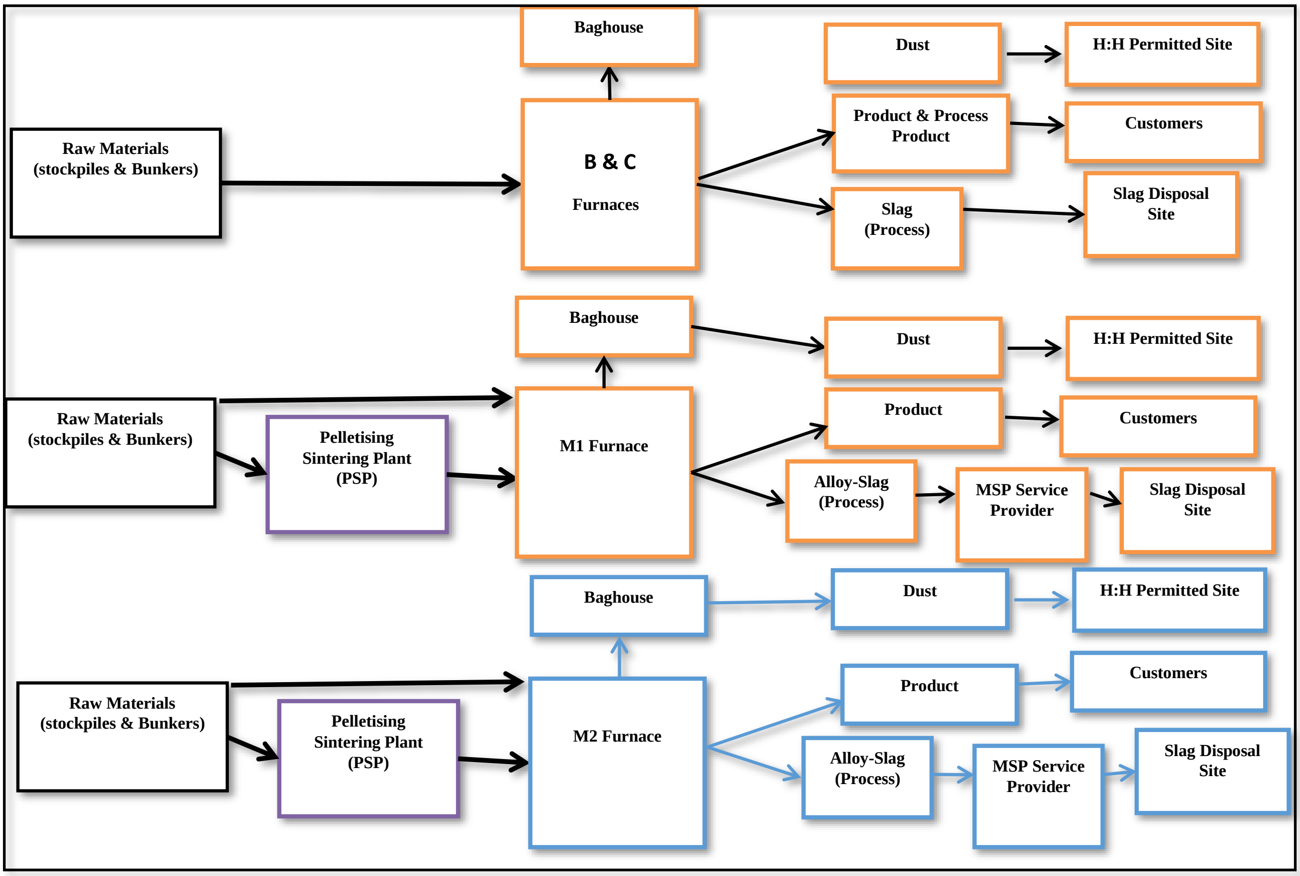


Figure 6 : Flow diagram of the PSP, B&C, M1 and M2 Furnaces

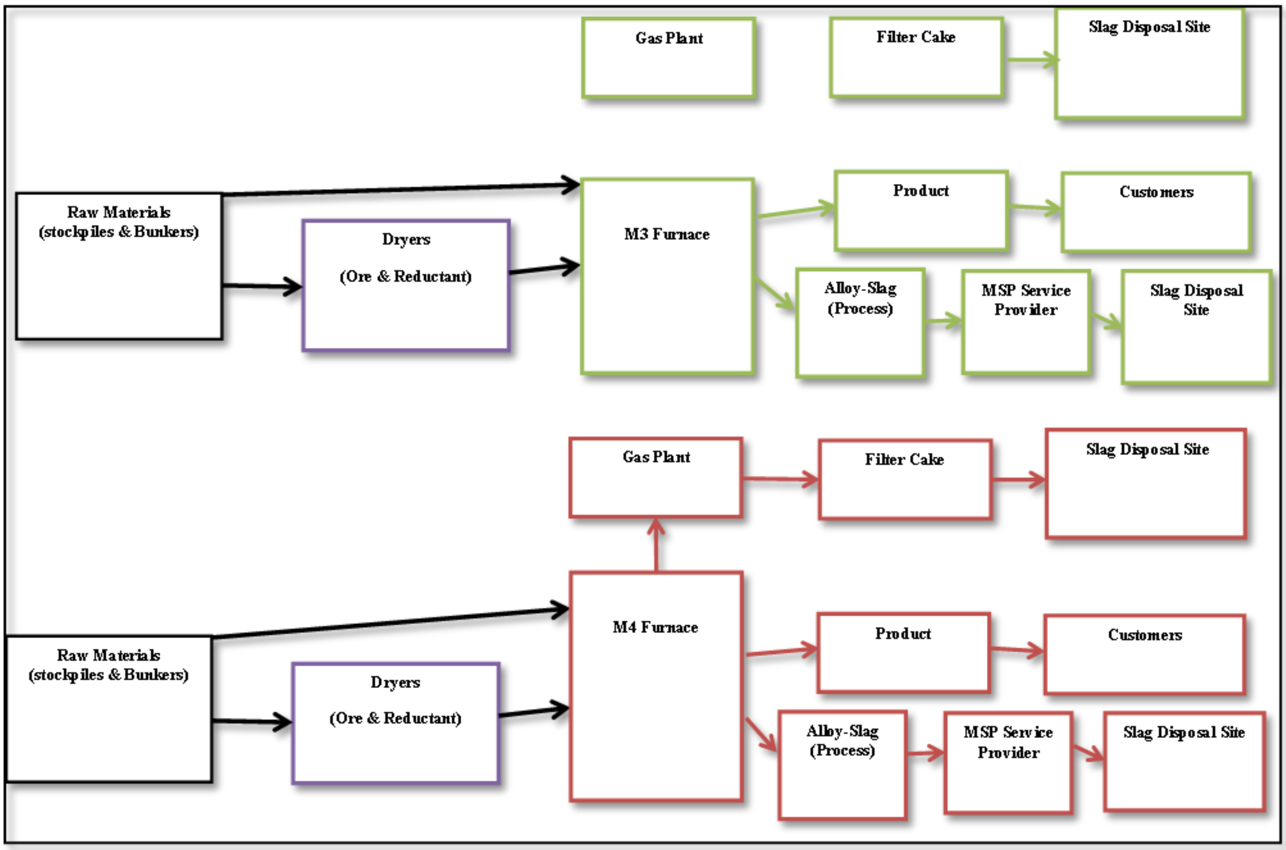


Figure 7 : Flow diagram of the ore dryers, M3 and M4 furnaces

3.3 Description and scope of proposed overall activity

3.3.1 Description of activities to be undertaken

MFC is proposing to increase the capacity of the existing M3 and M4 furnaces, and PSP in order to increase the production rate. In addition, pre-heaters will be installed for the M3 and M4 furnaces and the gas abatement equipment for M3 furnace will be upgraded.

In order to achieve the increase production rate and to upgrade the abatement equipment, MFC is proposing to install and upgrade to the following infrastructure within the existing footprint of the plant area (Figure 8):

3.3.1.1 Increased in throughput of the M3 and M4 Furnaces

The proposed preheating of raw materials (refer to section 3.3.1.2) is expected to increase the throughput of the M3 and M4 furnaces. This will result in in more raw materials being required proportional to the improvement in efficiency. Consequently, more alloy product would be produced in the process. The anticipated increase in production will require an increase in the licensed consumption, production and off-gas volumes.

Figure 8: Locality of the project components within the MFC site.

Additional infrastructure will be incorporated in the process feed stream of the furnace. This will improve the furnace electrical efficiency and will result in the furnace producing more HCFeCr, consuming more raw materials and other utilities. It will increase the gas stack volumetric flow.

3.3.1.1 Pelletising and Sintering Plant

The Pelletising and Sintering Plant (PSP) makes use of a steel belted sintering furnace. Historically the steel belt was replaced on a six-to-nine-month cycle. An improved technology steel belt has been installed, and this increases the availability of the PSP. An opportunity presents itself to increase the annual throughput of the PSP. This will require an increase in the licensed annual consumption and production volumes of the unit.

The proposed change to PSP involves an improved operating philosophy resulting in an increased production throughput. This will result in a higher consumption of raw materials and other plant utilities and an increase in the gas stack volumetric flow.

3.3.1.2 Preheaters

Carbon Monoxide gas (CO-gas) is produced by the carbonaceous reduction of chromite ore into ferrochrome in the M3 and M4 furnaces. Historically, this flammable CO-gas was flared into the atmosphere after being cleaned in a gas scrubbing plant, converting it to carbon dioxide gas and heat before being release to atmosphere.

Currently, the sole source of energy supplied to the M3 and M4 furnaces is electrical energy supplied by a DC arc inside the furnace reaction zone. An opportunity was identified to utilise the CO-gas produced by the furnace as an energy source to preheat the raw material feed to the furnace. This will reduce the energy requirement per unit of ferrochrome produced. The electrical energy input to the furnace will remain unchanged thus increasing the throughput of the furnaces.

Each of the preheaters will receive combustion gas from the CO-gas reticulation system and burn this gas to generate thermal energy, which will in turn be used to heat up the raw material feed to the furnace. Sasol gas, from an existing source at the MFC site, will be used as a backup energy source if CO-gas is not available from the DC furnaces.

The selected preheating technology will have indirect heat transfer from the combustion products to the raw material. Therefore, the off gas from the preheater will have similar particulate matter content than that of the off gas. Since the gas is already fully combusted in a highly oxidizing atmosphere, it is not expected that this gas will contain any CO.

The preheaters will be installed at both the M3 and M4 furnaces.

3.3.1.3 M3 and PSP Abatement Equipment

In a continuous drive for improvement and to ensure future legal compliance, the current gas scrubbing plants on the M3 furnace and PSP will be upgraded which is expected to improve the particulate matter remissions.

The proposed changes to the M3 furnace and PSP will include the upgrade of the current furnace off gas abatement equipment to ensure future environmental compliance to the latest air emissions requirements[1].

All the proposed upgrades and equipment will be installed at the existing M3 and M4 furnaces, and PSP sections, within the existing footprint of the MFC site (Figure 8).

[1] Section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEM:AQA) (Government Notice 893 in Government Gazette 37054 of 2013)

3.3.2 Listed and specific activities

The proposed activities that will require authorisation in terms of Regulations GN R.327, under the National Environmental Management Act (NEMA) are listed in Table 6.

Table 6: Listed and specified activities

Notice Number	Listed Activity	Relevance to Project
GN R. 327, *Listed Activity 34*	*The expansion of existing facilities or infrastructure for any process or activity where such expansion will result in the need for a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the release of emissions, effluent or pollution, excluding:* *(i) where the facility, infrastructure, process or activity is included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the National Environmental Management: Waste Act, 2008 applies;* *(ii) the expansion of existing facilities or infrastructure for the treatment of effluent, wastewater, polluted water or sewage where the capacity will be increased by less than 15 000 cubic metres per day; or* *the expansion is directly related to aquaculture facilities or infrastructure where the wastewater discharge capacity will be increased by 50 cubic meters or less per day.*	The proposed upgrade of the furnaces and the upgrade and addition of the associated infrastructure will require the amendment of the MFC Atmospheric Emission License (AEL).

A Basic Assessment Process is therefore followed for this application.

3.3.3 Description of Activities to be Undertaken

The following activities will be undertaken a part of the proposed project:

- Installation of pre-heaters and operation hereof by using CO-gas from the furnaces as an energy source to heat up the raw materials feed to the furnace.
- Operating the M3 and M4 furnaces at an increased throughput as a result of the additional infrastructure that will be incorporated in the process feed stream of the furnaces.
- Operating the PSP at an increased production throughput resulting in a higher consumption of raw materials and other plant utilities and an increase in the gas stack volumetric flow.

- Installation and operation of upgraded M3 furnace and PSP off gas abatement equipment.

All activities will take place within the existing footprint of the MFC site (Figure 8).

3.4 Policy and Legislative Context

MFC operates under legislative requirements of, *inter alia*, the NEMA, National Environmental Management: Waste Act (Act 59 of 1998), National Environmental Management: Air Quality Act (Act 39 of 2004) (NEM:WA) and the National Water Act (Act 36 of 1998) (NWA). The legislation and all policies relevant to the proposed additional infrastructure, infrastructure upgrades and activities are discussed in Table 7 below.

Table 7: Applicable and other legislation

Applicable Legislation and Guidelines used to compile the Report	Reference where applied	How does this development comply with and respond to the legislation and policy context
National Environmental Management Act, 1998 (Act 107 of 1998)	Entire document	The BAR and EMPr is compiled in accordance with the NEMA as well as the Regulations thereunder.
Government Notice Regulation (GNR) 324 to 327, dated 7 April 2017: Environmental Impact Assessment Regulations 2014, as amended.	Section 3.3.2	The listed and triggered activities that are included in the application are listed in Table 6.
GN 891 dated 2014: Guideline on Need and Desirability in terms of the Environmental Impact Assessment (EIA) Regulations, 2010.	Section 4.0	The need and desirability of the project is described in Section 4.0
National Environmental Management: Air Quality Act (Act 39 of 2004) and amendments	Section 8.8.1	An air quality impact assessment was conducted and is attached in APPENDIX B. An application for an amendment of the site's AEL is currently underway to include the project changes.
GNR 827 dated 1 November 2013: National Dust Control Regulations		
GN 1210 dated 24 December 2009: National Ambient Air Quality Standards		
GN 486 dated 29 June 2012: National Ambient Air Quality Standard for Particulate Matter with Aerodynamic Diameter less than 2.5 Micron Metres (PM2.5)		
GNR 533 dated 11 July 2014: Regulations Regarding Air Dispersion Modelling		
GNR 283 dated 2 April 2015: National Atmospheric Emission Reporting Regulations		
GN 275 dated 3 April 2017: National Greenhouse Gas Emission Reporting Regulations		

3.4.1 National Environmental Management Act (Act No. 107 of 1998)

The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) is South Africa's framework environmental legislation. It encompasses a set of principles that govern environmental management and against which all EMPrs and actions are measured. These principles include and relate to sustainable development, protection of the natural environment, waste minimisation, public consultation, the right to an environment that is not harmful to one's health or wellbeing, and a general duty of care. The latest amendment to the NEMA, the National Environmental Management Amendment Act 2014 (Act No. 25 of 2014) was gazetted on 2 June 2014 and commenced on 2 September 2014.

3.4.1.1 EIA Regulations

The current EIA Regulations, 2014 (as amended), are detailed in GN R.324, GN R.325, GN R.326 and GN R.327, promulgated in terms of Sections 24(5), 24M and 44 of the NEMA and subsequent amendments. GN R.327 lists those activities for which a Basic Assessment is required, GN R.325 lists the activities requiring a full EIA (Scoping and Impact Assessment phases) and GN R.324 lists certain activities and competent authorities in specific identified geographical areas. GN R.326 defines the EIA processes that must be undertaken to apply for Environmental Authorisation.

The activities requiring environmental authorisation in terms of the NEMA are included in Table 6.

The proposed project requires authorisation by means of a Basic Assessment process in addition to the application for an amendment of the site's Atmospheric Emission License (AEL).

3.4.2 National Environmental Management: Air Quality Act (Act No. 39 of 2004)

The NEM: AQA approach to air quality management is based on the control of the receiving environment. The main objectives of the act are to protect the environment by providing reasonable legislative and other measures that (i) prevent air pollution and ecological degradation, (ii) promote conservation and (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development alignment with Sections 24a and 24b of the Constitution of the Republic of South Africa.

3.4.2.1 South African ambient air quality legislation

The South African ambient air quality standards for common pollutants prescribe the allowable ambient concentrations of pollutants which are not to be exceeded during a specified time period in a defined area (Table 8).

Table 8: South African Ambient Air Quality Standards for criteria pollutants

Pollutant	Averaging Period	Limit Value (µg/m3)	Frequency of Exceedance	Compliance Date
NO2	1 hour	200	88	Immediate
	1 year	40	0	Immediate
PM10	24 hours	75	4	Immediate
	1 year	40	0	Immediate
PM2.5	24 hours	40	4	1 January 2016 – 31 December 2029
	24 hours	25	4	1 January 2030
	1 year	20	0	1 January 2016 – 31 December 2029
	1 year	15	0	1 January 2030
O3	8 hours	120	11	Immediate
Pb	1 year	0.5	0	Immediate
CO	1 hour	30000	88	Immediate
	8 hours	10000	11	Immediate
C6H6	1 year	5	0	Immediate
SO2	10 minutes	500	526	Immediate
	1 hour	350	88	Immediate

Pollutant	Averaging Period	Limit Value (µg/m3)	Frequency of Exceedance	Compliance Date
	24 hours	125	4	Immediate
	1 year	50	0	Immediate

The National Dust Control Regulations were published on 25th May 2018, Government Gazette no. 41650. The dust fall standard, applicable to this study, defines acceptable dust fallout rates in terms of the presence of residential and non-residential areas (

Table **9**).

Table 9: Acceptable dust fallout rates

Restriction Areas	Dust Fall Rate (mg/m2/day over a 30-day average)	Permitted Frequency of Exceedance
Residential areas	Dust fall <600	Two per annum (not in sequential months)
Non-residential areas	600 < Dust fall <1 200	Two per annum (not in sequential months)

Note: The method to be used for measuring dust fall rate and the standard for locating sampling points shall be ASTM D1739

3.4.2.2 International ambient air quality legislation

In the absence of local standards for Cr, international guidance has been sourced, from the 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 (TCEQ, 2006).

The short-term ESL for Cr (VI) is 0.39 µg/m^3, whilst the long-term ESL is 0.0043 µg/m^3.

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

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

3.4.3 Highveld Priority Area Air Quality Management Plan

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

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

3.4.4 Nkangala District Municipality: Air Quality Management By-Law

MFC is located within the Nkangala District Municipality which has a by-law pertaining to air quality management. The air quality management by-law for the Nkangala District Municipality was issued in June 2016 (Provincial Gazette No. 2701 of June 2016). The purpose and objective of the by-law is to enable the council and its local municipalities to protect, intervene, regulate and control activities which emit emissions and promote the long-term health, well-being and safety of people and environment within its jurisdiction area. The by-law states that any person who is responsible for causing air pollution or creating a risk of air pollution within the municipality must take reasonable measures to:

a) Prevent any potential air pollution from occurring; or

b) Where the causing of any air pollution is permitted, not prohibited, or cannot be reasonably avoided or stopped, to minimise that pollution.

Reasonable measures, as provided by the by-law, include the following:

a) Investigate, assess and evaluate the impact of air pollution on the environment.

b) Inform and educate employees about the environmental risks of their work and how they can perform their work in order to avoid air pollution.

c) Cease, modify or control any act, activity or process causing the air pollution.

d) Contain or prevent the movement of pollutants or remedy the effects of the air pollution.

The municipality may direct any person causing significant air pollution either to cease the activity; investigate, evaluate and assess the impact of such; implement specific measures before a given date and continue with those measures in place. The municipality also has the authority to issue a directive. Should the person fail to comply with the directive, the municipality may take reasonable steps to remedy the situation or apply to court for appropriate relief.

The by-law has identified 26 substances (air pollutants) which may present a threat on the health and well-being of people in the municipal area. The municipality may add more substances to the list in the future. The by-law makes provision for the Nkangala District Municipality to develop and adopt local emissions standards for any of the identified substances. A person emitting any of the identified substances must comply with the relevant emission standards.

Under the air quality management by-law for the Nkangala District Municipality there are specific provisions pertaining to the several activities or emissions sources that need to be complied with. In most instances, authorisation from the Municipality is required before the emitting activities can take place and in other instances the activity is prohibited. The relevant activities or emissions sources are summarised below:

a) Emissions from compressed ignition powered vehicles.

b) Operation of small boilers including the installation, alteration, extension and/or replacement of the boiler.

c) Any activity resulting in dust emissions.

d) Sand blasting emissions.

e) Open burning emissions.

f) Emissions caused by burning of industrial waste, domestic waste and garden waste.

g) Emissions caused by pesticide spraying.

h) Spray painting emissions.

i) Emissions that cause a nuisance.

3.4.4.1 Atmospheric Emission Licence

MFC was issued with an Atmospheric Emission Licence (AEL) by Nkangala District Municipality on 31 May 2019. The AEL was issued to authorise a number of listed activities which may result in atmospheric emissions, as per Government Notice 893 of 22 November 2013. Activities at the existing MFC operations are classified, as a listed activity in terms of *Category 4: Metallurgical Industry, Subcategory 4.1 Drying and Calcining, Subcategory 4.5 Sinter Plant and Subcategory 4.9 Ferro-alloy Production*.

The proposed upgrade to increase the production rate will hence require an amendment of their existing AEL. Additionally, the facility has a storage and handling location designed to hold more than 100,000 tonnes, and as such *subcategory 5.1 Storage and Handling of Ore and Coal* will need to be included. Given the above, an Air Quality Impact Assessment (AQIA), in the prescribed Atmospheric Impact Report (AIR) format, for the proposed production increase and upgrades, is required in support of the AEL amendment.

3.4.4.1.1 Listed activities and minimum emissions standards

The NEM:AQA makes provision for the setting and formulation of national ambient air quality and emission standards. On a provincial and local level, these standards can be set more stringently if the need arises. The control and management of emissions in NEM:AQA relates to the listing of activities that are sources of emission and the issuing of AELs. In terms of Section 21 of the NEM:AQA, a listed activity is an activity which 'results in atmospheric emissions that are regarded to have a significant detrimental effect on the environment, including human health'. Listed activities for the MFC operations are provided in Table 10 to Table 13.

Table 10: Minimum emission standards for Subcategory 4.1: Drying and Calcining

Description:	**Drying and calcining of mineral solids including ore**		
Applications:	**Facilities with capacity of more than 100 tonnes/month product**		
Substance or Mixture of Substances		**Plant Status**	**mg/Nm^3 under normal conditions of 10% O_2, 273 Kelvin and 101.3 kPa.**
Common Name	**Chemical Symbol**		
Particulate matter	N/A	New	50
		Existing	100
	SO_2	New	1000

Description:	Drying and calcining of mineral solids including ore		
Applications:	Facilities with capacity of more than 100 tonnes/month product		
Substance or Mixture of Substances		Plant Status	mg/Nm^3 under normal conditions of 10% O_2, 273 Kelvin and 101.3 kPa.
Common Name	Chemical Symbol		
Sulphur dioxide		Existing	1000
Oxides of nitrogen	NO_x expressed as NO_2	New	500
		Existing	1200

Table 11: Minimum emission standards for Subcategory 4.5: Sinter Plants

Description:	Sinter plants for agglomeration of fine ores using a heating process, including sinter cooling where applicable		
Applications:	All installations		
Substance or Mixture of Substances		Plant Status	mg/Nm^3 under normal conditions of 10% O_2, 273 Kelvin and 101.3 kPa.
Common Name	Chemical Symbol		
Particulate matter	N/A	New	50
		Existing	100
Sulphur dioxide	SO_2	New	500
		Existing	1000
Oxides of nitrogen	NO_x expressed as NO_2	New	700
		Existing	1200

Table 12: Minimum emission standards for Subcategory 4.9: Ferro-alloy Production

Description:	Production of alloys of iron with chromium, manganese, silicon or vanadium, the separation of titanium slag from iron-containing minerals using heat		
Applications:	All installations		
Substance or Mixture of Substances		Plant Status	mg/Nm^3 under normal conditions of 10% O_2, 273 Kelvin and 101.3 kPa.
Common Name	Chemical Symbol		
Sulphur dioxide	N/A	New	500
		Existing	500
Oxides of nitrogen	NO_x expressed as NO_2	New	400
		Existing	750
Particulate matter from primary fume capture system, open and semi-closed furnaces			

Description:	**Production of alloys of iron with chromium, manganese, silicon or vanadium, the separation of titanium slag from iron-containing minerals using heat**		
Applications:	**All installations**		
Substance or Mixture of Substances		**Plant Status**	**mg/Nm^3 under normal conditions of 10% O_2, 273 Kelvin and 101.3 kPa.**
Common Name	**Chemical Symbol**		
Particulate matter	N/A	New	30
		Existing	100
Particulate matter from primary fume capture system, closed furnaces			
Particulate matter	N/A	New	50
		Existing	100
Particulate matter from secondary fume capture system, all furnaces			
Particulate matter	N/A	New	50
		Existing	100

a) The following special arrangements shall apply –

i) Secondary fume capture installations shall be fitted to all new furnace installations; and

ii) Emission of Cr(VI), Mn and V from primary fume capture systems of ferrochrome, ferromanganese and ferrovanadium furnaces respectively to be measured and reported to licensing authority annually

Table 13: Minimum emission standards for Subcategory 5.1: Storage and Handling of Ore and Coal

Description:	**Storage and handling of ore and coal not situated on the premises of a mine or works as defined in the Mines Health and Safety Act 29/1996**		
Applications:	**Locations designed to hold more than 100 000 tonnes**		
Substance or Mixture of Substances		**Plant Status**	**mg/Nm^3 under normal conditions of 10% O_2, 273 Kelvin and 101.3 kPa.**
Common Name	**Chemical Symbol**		
Dustfall	N/A	New	a
		Existing	a

[a] three months running average not to exceed limit value for adjacent land use according to dust control regulations promulgated in terms of section 32 of NEM:AQA, 2004 (Act No. 39 of 2004), in eight principal wind directions

3.4.5 National Environmental Management: Waste Act

The National Environmental Management: Waste Act, 2008 (Act 59 of 2008) (NEMWA) commenced on 1 July 2009. In terms of this Act, all listed waste management activities must be licensed and in terms of Section 44 of the Act, the licensing procedure must be integrated with the environmental impact assessment process.

Government Notice 921 (as amended), which commenced on 29 November 2013, lists the waste management activities that require licensing in terms of the NEMWA. Licence applications for activities involving hazardous waste must be submitted to the national authority, the Department of Forestry, Fisheries and the Environment (DFFE) and those for general waste to the provincial authority, in this case the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (MDARDLEA).

The proposed project will not require the application for or the amendment of a Waste Management licence (WML).

3.4.6 National Water Act

The National Water Act, 1998 (Act No. 36 of 1998) (NWA) is the primary legislation regulating both the use of water and the pollution of water resources. It is applied and enforced by the Department of Water and Sanitation (DWS).

Section 19 of the National Water Act regulates pollution, which is defined as *“the direct or indirect alteration of the physical, chemical or biological properties of a water resource so as to make it:*

Less fit for any beneficial purpose for which it may reasonably be expected to be used; or

Harmful or potentially harmful to -

- *The welfare, health or safety of human beings;*
- *Any aquatic or non-aquatic organisms;*
- *The resource quality; or*
- *Property.”*

The persons held responsible for taking measures to prevent pollution from occurring, recurring or continuing include persons who own, control, occupy or use the land. This obligation or duty of care is initiated where there is any activity or process performed on the land (either presently or in the past) or any other situation which could lead or has led to the pollution of water.

The following measures are prescribed in the Section 19(2) of the NWA to prevent pollution:

- Cease, modify or control any act or process causing the pollution;
- Comply with any prescribed standard or management practice;
- Contain or prevent the movement of pollutants;
- Eliminate any source of the pollution;
- Remedy the effects of pollution; and
- Remedy the effects of any disturbance to the bed or banks of a watercourse.

The NWA states in Section 22 (1) that a person may only use water:

- Without a licence –
  - if that water use is permissible under Schedule 1;
  - if that water use is permissible as a continuation of an existing lawful use; or
  - if that water use is permissible in terms of a general authorisation issued under Section 39;
- If the water use is authorised by a licence under this Act; or
- If the responsible authority has dispensed with a licence requirement under subsection (3).

Regulation 704 of 4 June 1999 defines the manner in which rainwater falling or flowing onto a mining area or an industrial site must be managed and requires inter alia the following:

a) Separation of clean (unpolluted) water from dirty water;

b) Collection and confinement of the water arising within any dirty area into a dirty water system;

c) Design, construction, maintenance and operation of the clean water and dirty water management systems so that it is not likely for either system to spill into the other more than once in 50 years;

d) Design, construction, maintenance and operation of any dam that forms part of a dirty water system to have a minimum freeboard of 0.8 metres above full supply level, unless otherwise specified in terms of Chapter 12 of the Act; and

e) Design, construction, and maintenance of all water systems in such a manner as to guarantee the serviceability of such conveyances for flows up to and including those arising as a result of the maximum flood with an average period of recurrence of once in 50 years.

The proposed project does not require the application for or the amend of an existing Water Use Licence (WUL). MFC must ensure that the management of clean and dirty water around the project site areas conforms to the requirements of GN R 704.

4.0 NEED AND DESIRABILITY OF THE PROPOSED PROJECT

The Needs and Desirability Guidelines, in terms of the Environmental Impact Assessment Regulations, Government Notice 792 of 2012[2], as amended[3], highlights the need to consider how the proposed project may impact ecosystems and biological diversity; pollution; and renewable and non-renewable resources. It should also consider how the development may affect or promote justifiable economic and social development.

The furnace and associated infrastructure upgrades are required to ensure the continued sustainable production of ferrochrome at the MFC operations and the continued provision of employment within the district. MFC had previously considered the construction of the M5 and M6 furnaces and an environmental authorisation was obtained for the proposed project (17/2/1/25 MP-19), however the project was never implemented.

In addition, the upgrades are required to ensure the continual efficient operation of the furnaces, resulting in an increased production of ferrochrome. This negates the need for MFC to construct the additional proposed furnaces and facilities (proposed M5 and M5 furnaces).

The proposed increase in production at the M3 and M4 furnaces and the PSP provides the opportunity for the upgrading of the existing abatement equipment to more efficient abatement equipment, thus enabling environmentally sustainable ferrochrome production operations at the MFC site.

Part 1 - Need	
Is the land use associated with the activity being applied for considered within the timeframe intended by the existing approved SDF agreed to be the relevant environmental authority?	The MFC site is located in an area that is zoned as Industrial – Commercial. The proposed project areas are within the existing MFC site.
Should the development, or if applicable, expansion of the town/area concerned in terms of this land use occurs here at this point in time?	The MFC site is located in an area that is zoned as Industrial – Commercial. The proposed project areas are within the existing MFC site.

[2] DEA (2010), Companion to the EIA Regulations 2010, Integrated Environmental Management Guideline Series 9, Department of Environmental Affairs (DEA), Pretoria, South Africa.

[3] DEA (2017), Guideline on Need and Desirability, Department of Environmental Affairs (DEA), Pretoria, South Africa.

Does the community/area need the activity and the associated land use concerned? This refers to the strategic as well as local level.	The MFC site is located in an area that is zoned as Industrial – Commercial. The proposed project areas are within the existing MFC site.
Are the necessary services with adequate capacity currently available (at the time of application) or must additional capacity be created to cater for the development?	Yes. The necessary services are available at the existing MFC site.
Is this development provided for in the infrastructure planning of the municipality, and if not what will the implication be on the infrastructure planning of the municipality (priority and placement of the services and opportunity cost)?	The current project entails upgrading of existing infrastructure at the MFC site. The MFC site is located in an area that is zoned as Industrial – Commercial. The proposed project areas are within the existing MFC site.
Is the project part of a national programme to address an issue of national concern or importance?	The current project entails upgrading of existing infrastructure at the MFC site. The MFC site is located in an area that is zoned as Industrial – Commercial. The proposed project areas are within the existing MFC site.
Part 2 - Desirability	
Is the development the best practicable environmental option for this land/site?	The current project entails upgrading of existing infrastructure at the MFC site to ensure continued sustainable production of ferrochrome at the MFC operations and the continued provision of employment within the district. The proposed increase in production at the M3 and M4 furnaces provides the opportunity for the upgrading of the existing furnace abatement equipment to more efficient abatement equipment, thus enabling environmentally sustainable ferrochrome production operations at the MFC site.
Would the approval of this application compromise the integrity of the existing approved and credible IDP and SDF as agreed to by the relevant authorities?	No, the project is aligned with the SDF and IDP of the Steve Tshwete Local Municipality (Steve Tshwete Local Municipality, 2022/2023 Integrated Development Plan (IDP) , 2022), (Steve Tshwete Local Municipality, 2021).
Would the approval of this application compromise the integrity of the existing environmental management priorities for the area (e.g. as defined in EMFs), and if so, can it be justified in terms of sustainability considerations?	The MFC site is located in an area that is zoned as Industrial – Commercial. The proposed project areas are within the existing MFC site. The proposed upgrading of existing infrastructure will therefore not compromise the integrity of the existing environmental management priorities for the area.

Do location factors favour this land use at this place? (this relates to the contextualization of the proposed land use on this site within its broader context).	The MFC site is located in an area that is zoned as Industrial – Commercial. The proposed project areas are within the existing MFC site. The current project entails upgrading of existing infrastructure at the MFC site.
How will the activity of the land use associated with the activity being applied for, impact on sensitive natural and cultural areas (built and rural/natural environment)?	The MFC site is located in an area that is zoned as Industrial – Commercial. The proposed project areas are within the existing MFC site. The site is an existing industrial site that has been operational since 1964 and is located in an industrial zoned area, with surrounding industries. The project components will be upgraded within the existing operational areas and on hardstanding and will not result in the removal of any vegetation or impact on ant cultural areas.
How will the development impact on people's health and well-being? (E.g. In terms of noise, odours, visual character and sense of place, etc.)?	It is anticipated that medium-term low impacts, as a result of dust and noise, could occur during the project.
Will the proposed activity or the land use associated with the activity being applied for, result in unacceptable opportunity costs?	No. MFC will incur the cost for the upgrading project.
Will the proposed land use result in unacceptable cumulative impacts?	No. Cumulative impacts associated with air quality could occur, however the impacts are expected to be low.

5.0 PROCESS FOLLOWED TO REACH THE PROPOSED PREFERRED ALTERNATIVES WITHIN THE SITE

5.1 Project Alternatives

The proposed project is limited in opportunities for site selection, activity and technology alternatives. The project will entail the upgrading of the existing M3 and M4 furnaces, PSP and associated infrastructure. For this reason, the chosen site, activity and technology is limited to the location, activity and technology of the existing infrastructure.

5.1.1 Option of not implementing the activity

Not implementing the proposed furnace and associated infrastructure upgrades will result in a future increased cost of production per ton of ferrochrome. This will hinder MFC's ability to remain competitive in the ferrochrome market. Continued production of ferrochrome at higher costs in future operations will result in job losses and environmentally unsustainable production of ferrochrome.

6.0 PUBLIC PARTICIPATION PROCESS UNDERTAKEN

This section provides an overview of the public participation process undertaken to date in this BA application process.

6.1 Objectives of Public Participation

The principles that determine communication with society at large are included in the principles of the National Environmental Management Act (NEMA) (Act 107of 1998, as amended) and are elaborated upon in General Notice 657, titled *"Guideline 4: Public Participation"* (Department of Environmental Affairs and Tourism, 19 May, 2006), which states that: *"Public participation process means a process in which potential interested and affected parties (I&APs) are given an opportunity to comment on, or raise issues relevant to, specific matters."*

Opportunities for Comment

Documents will be available during the BA process to provide stakeholders with information, further opportunities to identify issues of concern and suggestions for enhanced benefits and to verify that the issues raised have been considered.

Public participation is an essential and regulatory requirement for an environmental authorisation process and must be undertaken in terms of Regulations 39 to 44 of the Environmental Impact Assessment (EIA) Regulations GN R.326 (April 2017). Public participation is a process that is intended to lead to a joint effort by stakeholders, technical specialists, the authorities and the proponent/developer who work together to produce better decisions than if they had acted independently.

The public participation process is designed to provide sufficient and accessible information to Interested and Affected Parties (I&APs) in an objective manner and enable them to:

- Raise issues of concern and make suggestions for enhanced benefits.
- Verify that their issues have been recorded.
- Assist in identifying reasonable alternatives.
- Contribute relevant local information and traditional knowledge to the environmental assessment.
- Comment on the findings of the environmental impact assessment and the mitigation measures proposed.
- Once the DEDT has announced its decision, I&APs will be notified of the outcome and the appeal procedure.

6.2 Identification of I&APs

I&APs were initially identified through a process of networking and referral, obtaining information from WSP's existing stakeholder database, liaison with potentially affected parties in the study area, a newspaper advertisement and a registration process involving completion of a registration and comment sheet. The registration sheet encourages I&APs to indicate the names of their colleagues and friends who may also be interested in participating in the public participation process.

6.3 Register of I&APs

The NEMA Regulations (GN R.326) distinguish between I&APs and registered I&APs. I&APs, as contemplated in Section 24(4)(d) of the NEMA include: "*(a) any person, group of persons or organisation interested in or affected by an activity; and (b) any organ of state that may have jurisdiction over any aspect of the activity".*

In terms of the Regulations:

"An EAP managing an application must open and maintain a register which contains the names, contact details and addresses of:

j) All persons who; have submitted written comments or attended meetings with the applicant or EAP;

k) All persons who; have requested the applicant or EAP managing the application, in writing, for their names to be placed on the register; and

l) *All org*ans of state which have jurisdiction in respect of the activity to which the application relates.

A Register for I&APs has been opened and will be updated throughout the Basic Assessment process (APPENDIX C).

As per the EIA Regulations, future consultation during the Basic Assessment application process will take place with **registered I&APs**. The I&AP register will be updated throughout the process.

6.4 Public Participation process to be followed

This section provides a summary of the public participation process followed to date.

6.4.1 Announcement of the proposed project

The proposed project was announced on 22 March 2023 and stakeholders were invited to participate in the Basic Assessment and public participation process and to pass on the information to friends, colleagues, and neighbours who may be interested and to register as interested and affected parties (I&APs).

The proposed project was announced as follows:

- Distribution of a background information letter (BIL), locality map and registration and comment sheet to all identified I&APs with email addresses. A bulk SMS was sent to identified I&APs with mobile phone numbers. The announcement documents provide information on the proposed project, how I&APs can register and how to access the dBAR, should they want to comment. Copies of the announcement documents are attached as **APPENDIX C**.
- An advertisement, providing information on the project and the availability of the dBAR for review, was published in English in two newspapers, the Witbank News on Thursday, 16 March 2023 and the Middelburg Observer on Friday, 17 March 2023 (**APPENDIX C**).
- Site notices have been placed at the entrance to the MFC site and at visible places at the boundaries of the site (**APPENDIX C**), as well as at the public places listed below.
- The draft Basic Assessment report and BIL are available at the public places listed in Table 14 below and posted to the WSP website - *https://www.wsp.com/en-za/services/public-documents* and data free website - *https://wsp-engage.com/*

Table 14: Public places used during the consultation period

Public place	Town
Gerard Sekoto Library, Cnr Sisulu and Wanderers Street, Middelburg	Middelburg
Nazareth Library, 16 Fort Napier Street, Nazareth	Middelburg
Samancor Middelburg Ferrochrome Security Entrance, Hendrina Road, Middelburg	Middelburg

6.4.2 Draft Basic Assessment and EMPr Report

The dBAR is available for public review from 22 March 2023 to 24 April 2023.

Copies of this dBAR have been sent to the following commenting authorities:

- Nkangala District Municipality
- Steve Tshwete Local Municipality
- Department of Water and Sanitation (DWS)
- Mpumalanga Tourism and Parks Agency
- South African Heritage Resources Agency (SAHRA)

6.4.3 Final Basic Assessment and EMPr Report

The dBAR will be updated after the expiry of the public review period and submitted to the MDARDLEA for decision-making.

6.4.4 Summary of Issues Raised by I&APs

All issues raised by I&APs, together with responses provided by the proponent and the environmental assessment practitioner, will be recorded in the Comments and Responses Report (CRR), which will be included in the final BA Report.

7.0 BASELINE ENVIRONMENTAL ATTRIBUTES

7.1 Topography

The Mpumalanga Highveld Region, within which the plant is located, has an average elevation of approximately 1,550 m above mean sea level.

The wider landscape in the area is made up of scattered trees and grasslands and gently rolling hills and the surrounding area is defined by moderately undulating plains, being relatively flat with minor hills and undulations. (Figure 9).

The highest point on the MFC property is in the eastern corner at an elevation of 1,520 m above MSL and slopes down to 1,460 m MSL towards the Vaalbankspruit

7.2 Geology

The MFC site is considered to be geologically complex with very little rock outcropping on site. Geologically the site is described as consisting of three sections, namely a southern section, a central section and a northern section.

The northern section of the site consists primarily of shale, siltstone and sandstone of the Loskop Formation (Post Rooiberg Group), dipping at 10 to 15 degrees in an N-NW direction. A contact with an intrusive diabase rock is described as occurring in the northern part of the southern section.

The central section is considered to consist of diabase, and the northern section is considered to consist of shale and some mudstone, also belonging to the Loskop Formation (Post-Rooiberg Group). A diabase–shale contact zone similar to the one described in the southern section of the zone is noted.

Rhyolite is also described as occurring in the south-eastern portion of the site. Younger non-conformable Dwyka Tillite occurs in small patches across the MFC site (Figure 10).

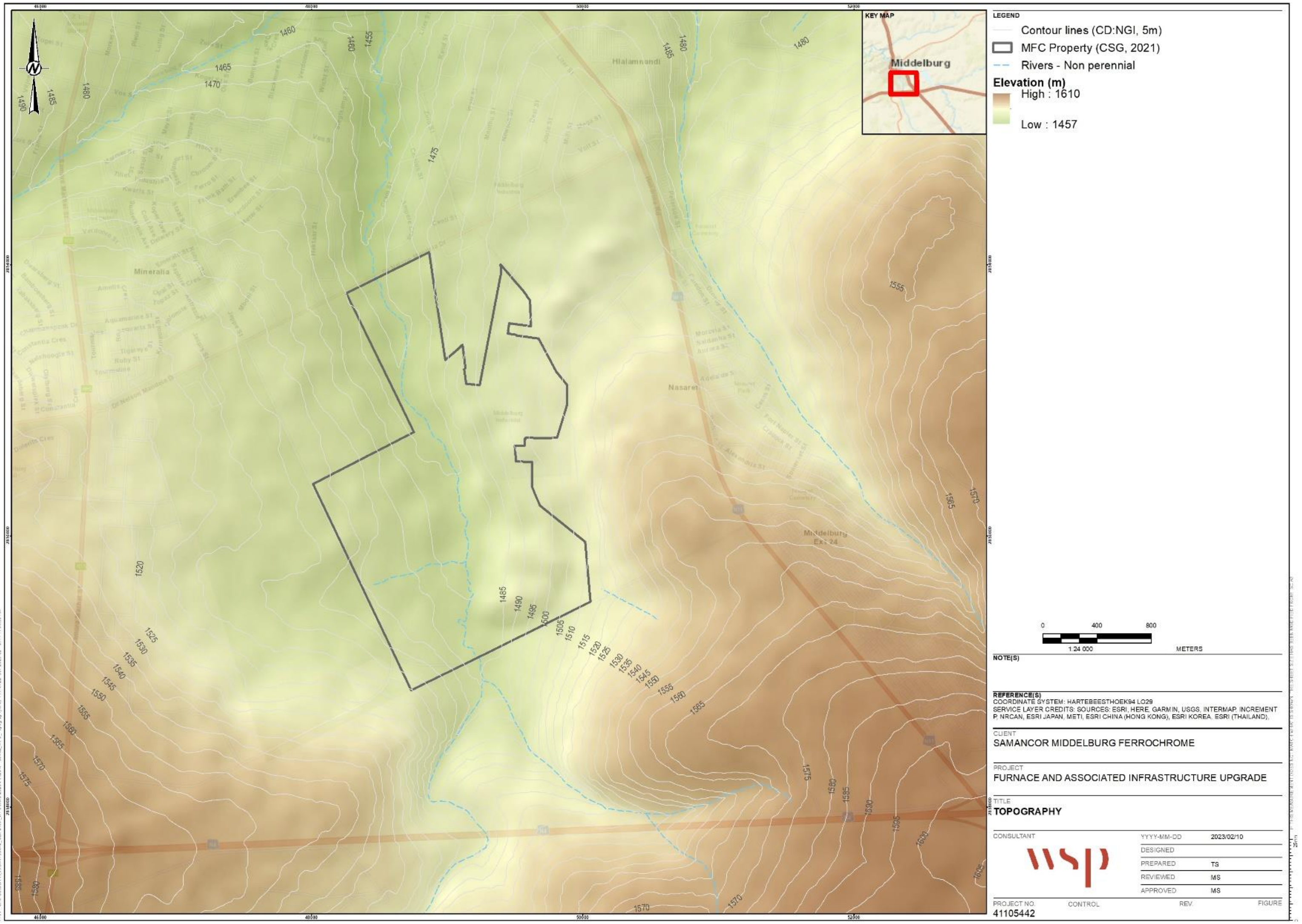


Figure 9: Topography of the project site and wider area

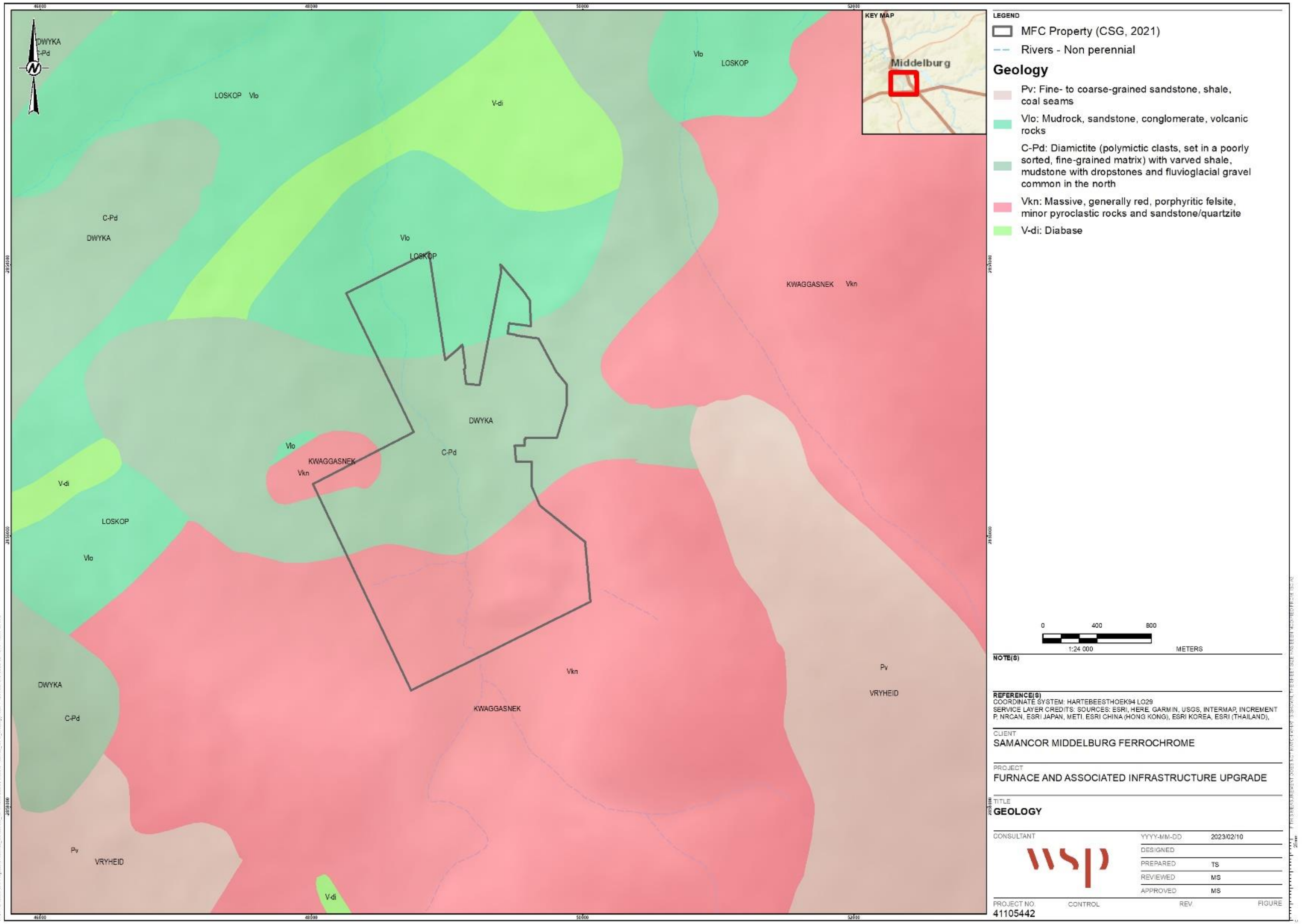


Figure 10: Geology of the area.

7.3 Climate

7.3.1 Climatic overview

The climate experienced along the south-western coastline and adjacent interior of South Africa is controlled predominantly by subtropical high pressure, with temporary disruptions by low pressure cells or fronts. This high-pressure zone is located along 33°S latitude and is associated with strong divergence at the surface and convergence in the upper atmosphere (Tyson and Preston-Whyte, 2000, as cited by (Reddy & Collet, 2023)). Figure 11 shows the predominant macroscale atmospheric circulations over the subcontinent. Easterly waves and lows tend to be summer phenomena, while the westerly wave and lows tend to be autumn to spring phenomena.

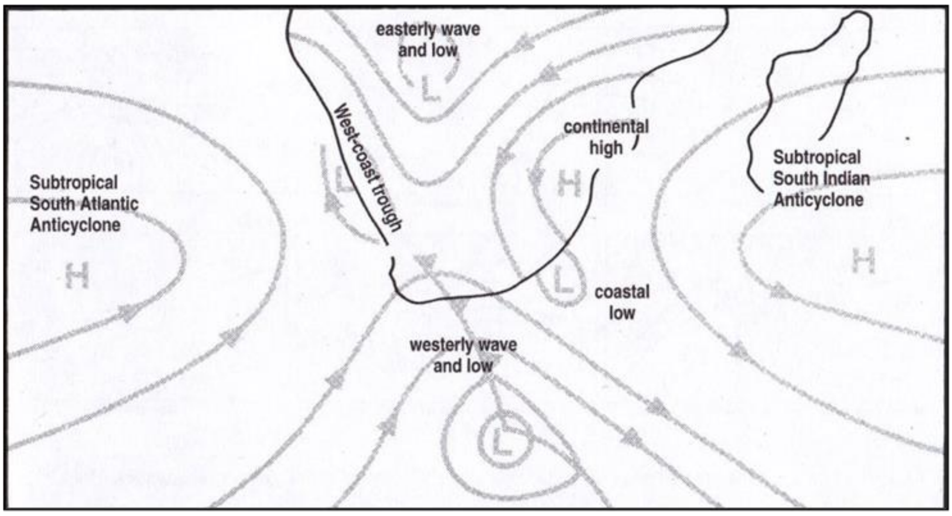


Figure 11: South African meteorological phenomena (Tyson and Preston-Whyte, 2000).

Rainfall occurs predominantly in winter and spring over the south-western sector of the country due to the influence of westerly waves. Upper-level divergence and surface-level convergence occurs to the rear of a trough, which causes uplift and cloud formation resulting in precipitation. A surface trough over the west coast and an upper-tropospheric westerly atmospheric wave to the west of the continent can results in widespread rainfall over the western region. During summer, cold fronts associated with these westerly waves migrate further south and thus away from the coast of South Africa, limiting frontal rainfall in the region. While a warm ocean current and onshore winds promote summer rainfall along the east coast of South Africa, the cold Benguela Ocean Current along the west coast of South Africa limits evaporation off the ocean surface (Tyson and Preston-Whyte, 2000, as cited by (Reddy & Collet, 2023)). Saldanha consequently has a semi-arid Mediterranean climate of warm, dry summers and cool, wet winters.

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

7.3.2 Meteorological overview

To assess ambient meteorological conditions, site-specific modelled Weather Research and Forecasting (WRF) meteorological data was purchased from Lakes Environmental Software for the period January 2018 to December 2020 to provide an understanding of surface and upper air dispersion characteristics. The data coverage is centred over the MFC facility (Latitude: 25.80621°S – Longitude: 29.49335°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 meteorological conditions experienced onsite and is further recommended in terms of the South African Regulations Regarding Air Dispersion Modelling (2014). The South African National Accreditation System (SANAS, 2012) TR 07-03 standards stipulate a minimum data recovery of 90% for the dataset to be deemed representative of conditions during a specific reporting period. The percentage recovery for parameters recorded is 100 % and is thus considered reliable for use in this assessment. Further, site-specific meteorological data from the MFC station was also obtained for comparisons of the wind conditions. Importantly, temperature and rainfall data from the station was not useful and was not used for this assessment. The station data recovery for wind conditions was 98% and was thus also reliable for this assessment. The meteorological conditions for the site using the modelled WRF and station data (where applicable) is discussed in the following sections.

7.3.2.1 Temperature, rainfall and humidity

Temperature, rainfall and humidity are key influencing factors in ambient air quality:

- Ambient air temperature affects both plume buoyancy and the development of mixing and inversion layers. Furthermore, the greater the difference in temperature between the plume and the ambient air, the higher the plume is able to rise.
- Over the period January 2018 to December 2020, average summer and winter temperatures recorded were approximately 21 and 11 °C, respectively (Figure 12) using modelled WRF data. Minimum monthly average temperatures ranged from -4 to 2°C in winter, with maximum monthly average temperatures ranging from 30 to 35 °C in summer.
- Rainfall is an effective removal mechanism of atmospheric pollutants as when it falls, it brings pollutants down with it. Rainfall further reduces the erosion potential by increasing the moisture content of erodible materials.
- MFC receives most of its rainfall during summer as indicated by the modelled WRF data. The lowest rainfall levels are experienced during the winter months (June - August) (Figure 13). Total rainfall received for 2018, 2019 and 2020 was 585 mm, 374 mm and 586 mm, respectively. Relative humidity is generally moderate, with values ranging from 54 to 66% during summer and 35 to 52% during winter.
- MFC falls within the HPA and experiences distinct weather patterns in summer and winter that affect the dispersal of pollutants in the atmosphere. In summer, unstable atmospheric conditions result in mixing of the atmosphere and rapid dispersion of pollutants. Summer rainfall also aids in removing pollutants through wet deposition. In contrast, winter is characterised by atmospheric stability caused by a persistent high-pressure system over South Africa. This dominant high-pressure system results in subsidence, causing clear skies and a pronounced temperature inversion over the Highveld. This inversion layer traps the pollutants in the lower atmosphere, which results in reduced dispersion and a poorer ambient air quality.

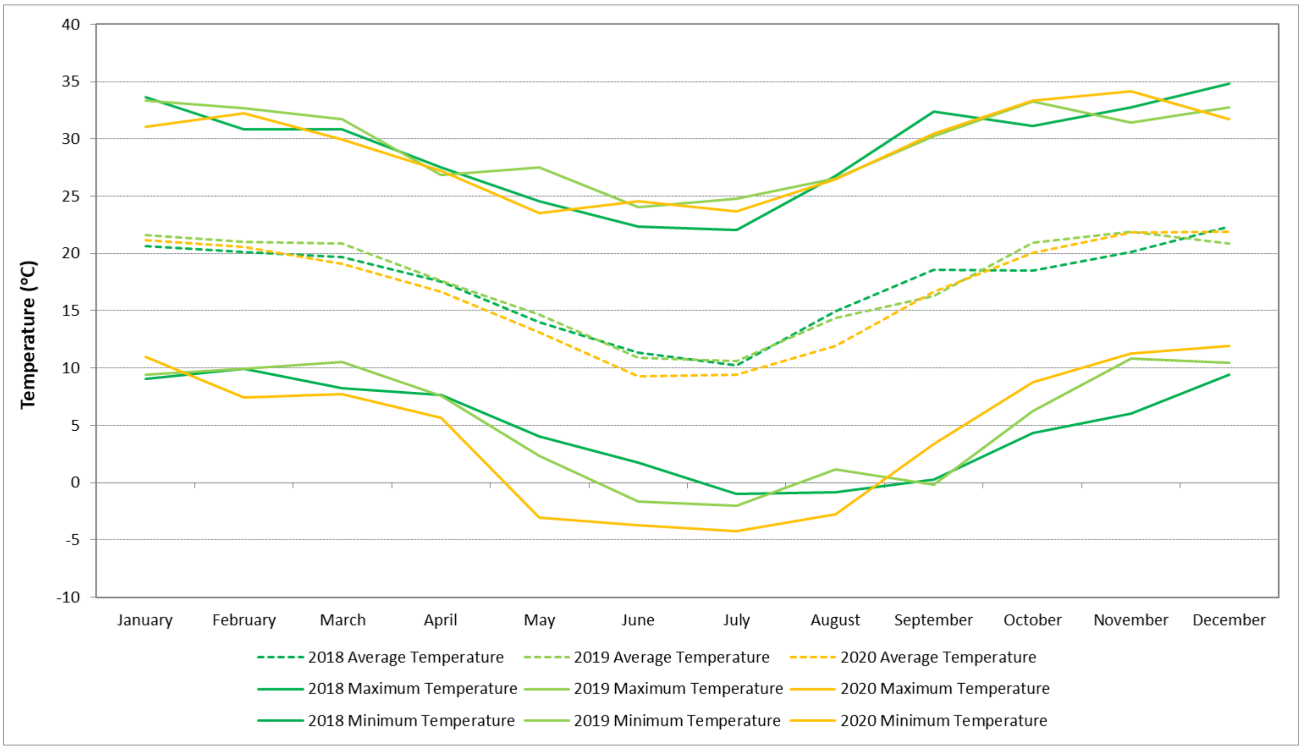


Figure 12: Average, maximum and minimum temperatures for 2018 to 2020 (WRF data)

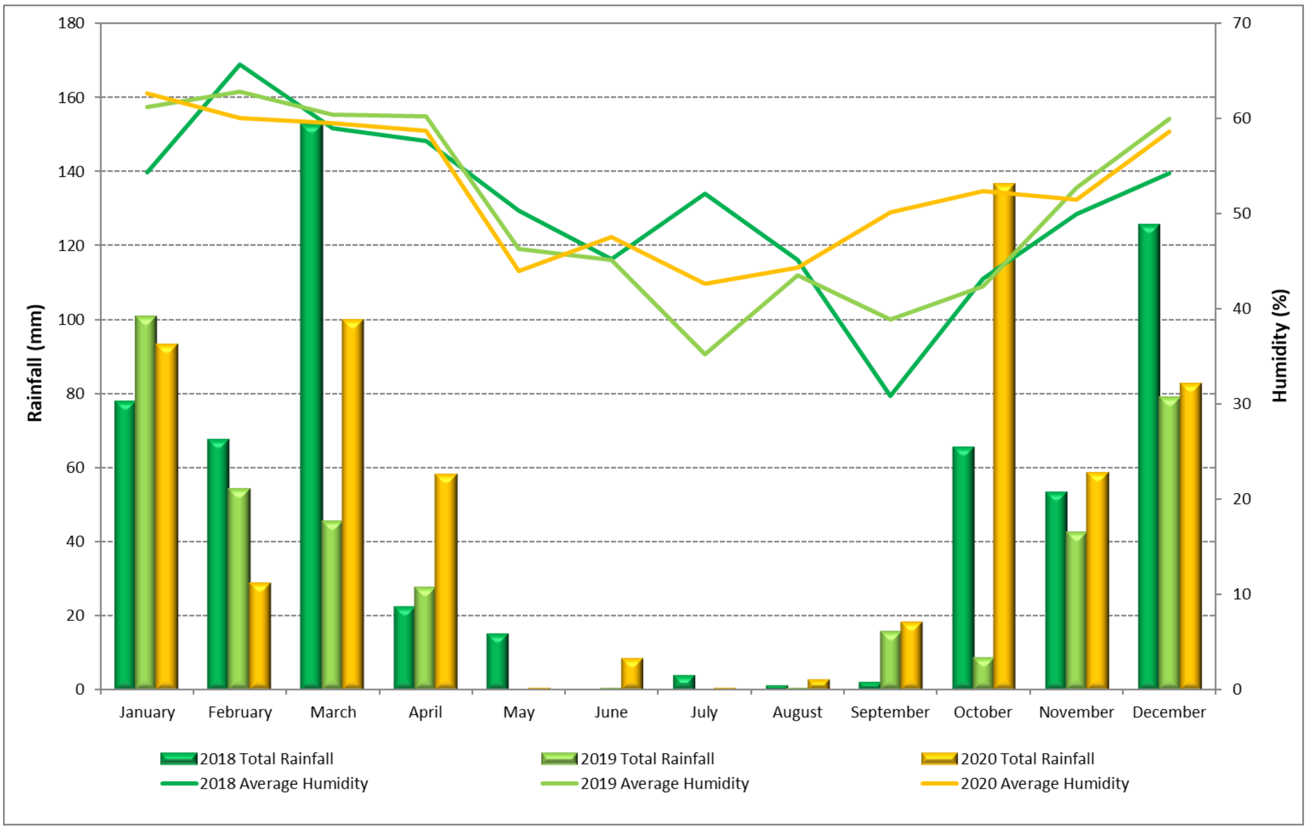


Figure 13: Monthly rainfall and average humidity for 2018 to 2020 (WRF data)

7.3.2.2 Wind field

Wind roses summarise the occurrence of winds at a specified location by representing their strength, direction and frequency. Calm conditions are defined as wind speeds of less than 1 m/s which are represented as a percentage of the total winds in the centre circle. Each directional branch on a wind rose represents wind originating from that specific cardinal direction (16 cardinal directions). Each cardinal branch is divided into segments of different colours which represent different wind speed classes. Period, seasonal and diurnal wind roses using modelled WRF and station data are presented below. The following can be observed from the wind roses:

- Light to strong winds from the east southeast prevailed in the region as indicated in the modelled WRF and station data, with calm conditions occurring frequently (5.3% and 7.3% of the time, from the WRF and station data, respectively) during the full periods for each dataset.
- During the day, winds are predominantly from the northwest while at night, winds shift completely and are predominantly from the east-southeast as observed from the modelled WRF and MFC station datasets. Winds speeds are generally moderate to strong with higher wind speeds noted during the day.
- During the summer to winter months, winds are dominant from the east-southeast from both the WRF and MFC datasets. In spring, a shift in winds is observed in the modelled WRF data, with winds originating predominantly from the north-northwest, whilst the dominant wind direction remains in the east-southeast and northwest direction in the MFC station data. Wind speeds are moderate to strong during all months in the modelled WRF data but show light to moderate winds in the MFC data. Higher wind speeds are noted during the months of spring and summer using both sets of data.
- It is noted that the datasets are similar and hence gives confidence that the WRF data is an accurate representation for the dispersion model.

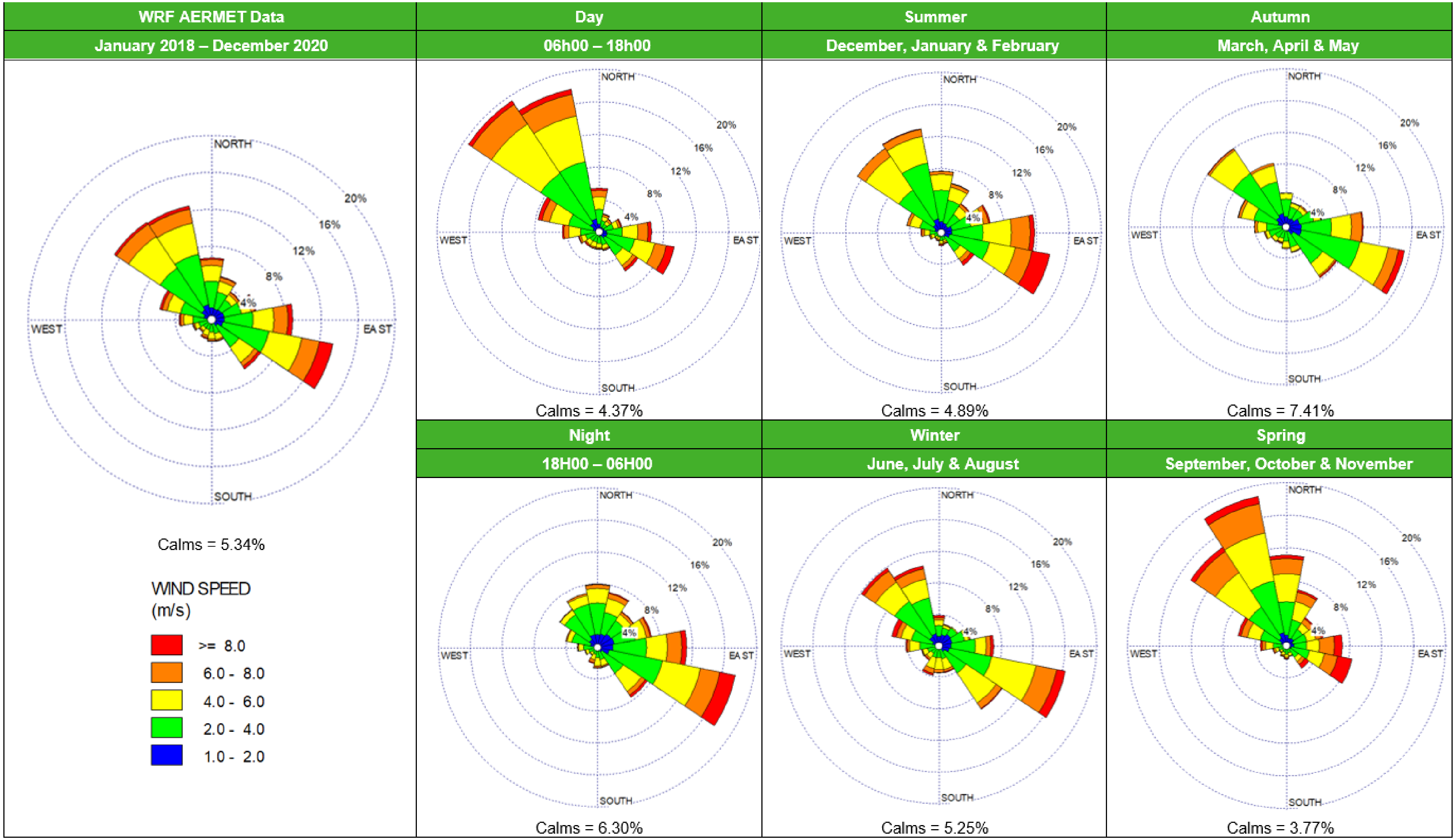


Figure 14: Wind conditions using WRF data for the period January 2018 to December 2020

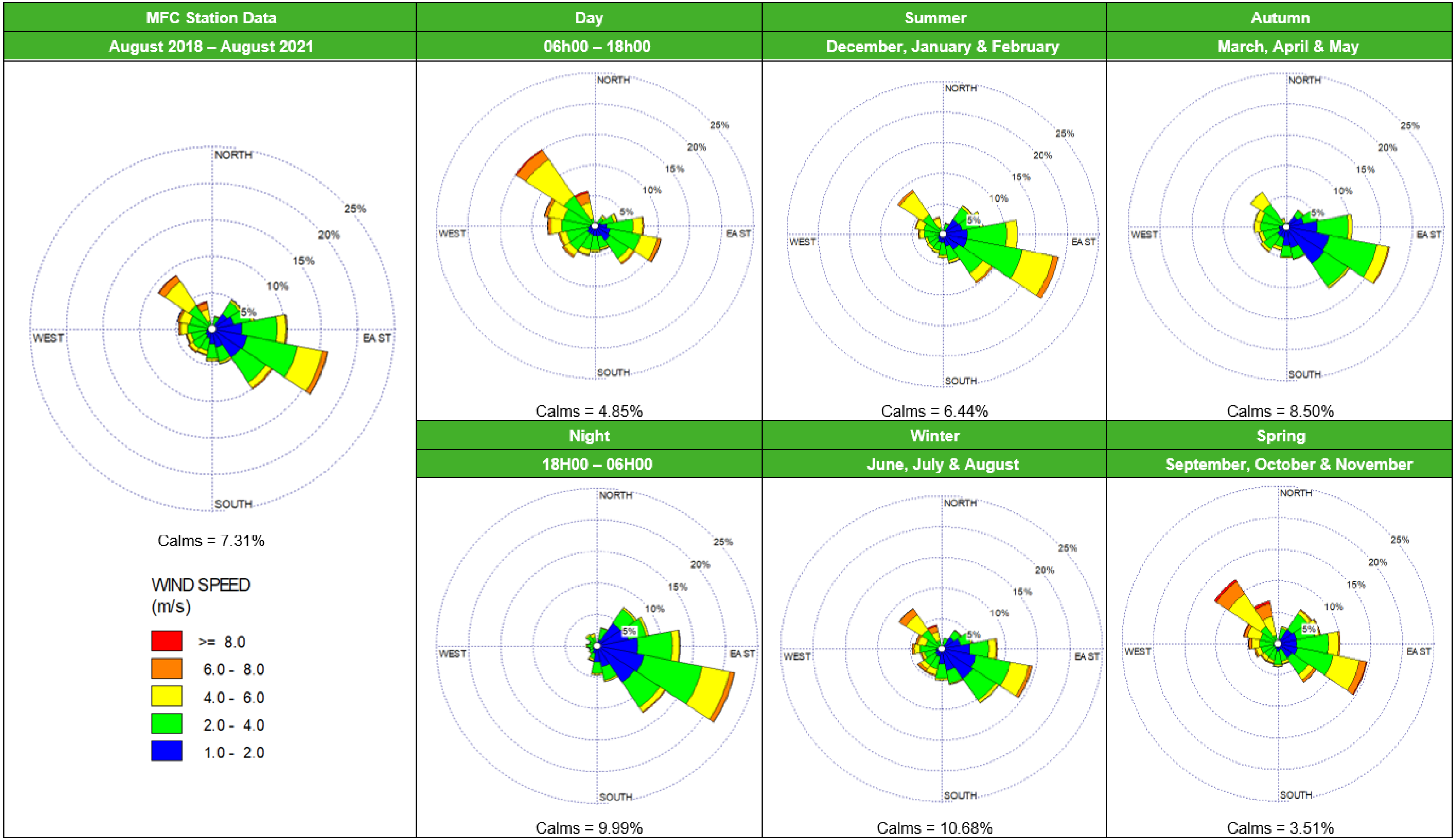


Figure 15: **Wind conditions using MFC station data for the period August 2018 to August 2021**

7.4 Air Quality

This section includes extracts from the Air Quality Impact Assessment (AQIA) report (Reddy & Collet, 2023), which is appended in APPENDIX B.

7.4.1 Regional ambient air quality overview

MFC is located in the Steve Tshwete Local Municipality within the Nkangala District Municipality and as such, falls within the HPA. This infers that the authorities may impose measures on MFC and other industries in the area in order to improve the air quality in the region.

Driving forces of poor air quality include both anthropogenic and natural processes. Anthropogenic driving forces for example include economic activity, urbanisation, industrial development, population growth, and the current political climate. Natural process driving forces for example include climate change, natural disasters and many others. These driving forces lead to pressures on the natural environment such as increased demand for resources, habitat change and increased development (Mpumalanga State of Environment report, 2003), which can lead to impacts being exerted on the natural, social, political and economic environments.

The Highveld experiences a wide range of both natural and anthropogenic sources of air pollution ranging from veld fires to industrial processes, agriculture, mining activities, power generation, paper and pulp processing, vehicle use and domestic use of fossil fuels. Different pollutants are associated with each of the above activities, ranging from volatile organic compounds and heavy metals to dusts and odours.

While certain areas of the HPA experience relatively good air quality, ambient air quality is largely of poor quality. Exceedances of fine particulate matter with an aerodynamic diameter ten microns (PM_{10}), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and ozone (O_3) have often been recorded in the pollution hotspots of the eMalahleni, Kriel, Steve Tshwete, Ermelo, Secunda, Ekurhuleni, Lekwa, Balfour and Delmas areas (DEA, 2015, as cited by (Reddy & Collet, 2023)). Despite the implementation of the HPA AQMP there continue to be exceedances in:

- PM_{10} and $PM_{2.5}$ in particular, areas proximate to significant industrial operations as well as residential areas where domestic coal burning is occurring.
- SO_2 in eMalahleni, Middelburg, Secunda, Ermelo, Standertonne, Balfour, and Komati due to a combination of emissions from the different industrial sectors, residential fuel burning, motor vehicle emissions, mining and cross-boundary transport of pollutants into the HPA adding to the base loading.
- NO_2 in the eMalahleni, Steve Tshwete and Ekurhuleni areas where anthropogenically induced and naturally occurring biomass fires occur throughout the HPA at all times of the year and contribute NO_2.
- O_3 in Kendal, Witbank, Hendrina, Middelburg, Elandsfontein, Camden, Ermelo, Verkykkop and Balfour thought to be due to biomass burning.

Based on the available information and the data analysed, it is clear that the regional air quality in the project area is relatively poor.

7.4.2 Local ambient air quality overview

Existing sources of air pollution within the area have been identified to include:

- Agricultural activities
- Biomass burning
- Domestic fuel burning
- Mining activities
- Vehicle emissions

- Power generation

Agricultural activities

Emissions from agricultural activities are difficult to control due to the seasonality of emissions and the large surface area producing emissions (USEPA, 1995, as cited by (Reddy & Collet, 2023)). Most of the agricultural activities in the region appear to be the commercial farming dedicated to crops and to a smaller extent grazing, which is common in the region.

Despite the large-scale presence of agricultural activities within the area, agricultural emissions are not expected to significantly influence the air quality in the area. As per the HPA AQMP, industrial sources are by far the largest contributor of emissions, accounting for 89% of PM_{10}, 90% of NO_x and 99% of SO_2. Particulate emissions may increase during the frequent periods where the Highveld grasslands are subjected to wildfires.

Biomass burning

Biomass burning may be described as the incomplete combustion process of natural plant matter with CO, Methane (CH_4), NO_2 and PM_{10} being emitted during the process. During the combustion process, approximately 40% of the nitrogen in biomass is emitted as nitrogen, 10% remains in the ashes and it is assumed that 20% of the nitrogen is emitted as higher molecular weight nitrogen compounds. In comparison to the nitrogen emissions, only small amounts of SO_2 and sulphate aerosols are emitted. With all biomass burning, visible smoke plumes are typically generated. These plumes are created by the aerosol content of the emissions and are often visible for many kilometres from the actual source of origin.

The extent of emissions liberated from biomass burning is controlled by several factors, including:

- The type of biomass material.
- The quantity of material available for combustion.
- The quality of the material available for combustion.
- The fire temperature.
- Rate of fire progression through the biomass body.

Crop-residue burning and general wildfires represent significant sources of combustion-related emissions associated with agricultural areas. Given that the region has significant agricultural activities rather, controlled burning related to the agricultural activities contribute to air quality.

Domestic fuel burning

Domestic fuel burning of coal emits a large amount of gaseous and particulate pollutants including sulphur dioxide, heavy metals, total and respirable particulates, inorganic ash, CO, polycyclic aromatic hydrocarbons (PAH), and benzo(a) pyrene. Pollutants arising due to the combustion of wood include respirable particulates, NO_2, CO, PAH, particulate benzo(a) pyrene and formaldehyde. The main pollutants emitted from the combustion of paraffin are NO_2, particulates, CO and PAH. The density of housing in the region is relatively low with most residential areas being confined to small local towns such as Phola, Wilge and Ogies. In addition to these small residential areas, individual farms/homesteads are scattered throughout the region and comprise of formal and informal residential structures. It is thus highly likely that certain households within the communities are likely to use coal, wood and paraffin for space heating and/or cooking purposes.

Emissions from these communities and/or the individual residences/homesteads are not anticipated to have a significant impact on the regional air quality due to their low density and dispersed nature.

Mining activities

Numerous significant mining operations are present in the region. Mining, along with contributions from power stations, are likely to be the largest sources of particulates (PM_{10}, $PM_{2.5}$, TSP) within the region, with smaller contributions from industry and biomass burning.

Dust and fine particulate emissions associated with mining operations include wind erosion from stockpiles, open mining pits, blasting, drilling, crushing and screening, material handling, ore processing and refining, sintering operations, unpaved mine access roads and other exposed areas. Factors which influence the rate of wind erosion include surface compaction, moisture content, vegetation, shape of storage pile, particle size distribution, wind speed and rain.

Emissions from the mining activities are anticipated to be one of the dominant emissions influencing and impacting on the regional air quality.

Vehicle emissions

Air pollution generated from vehicle emissions may be grouped into primary and secondary pollutants. Primary pollutants are those emitted directly to the atmosphere as tail-pile emissions, whereas secondary pollutants are formed in the atmosphere as a result of atmospheric chemical reactions, such as hydrolysis, oxidation, or photochemical reactions. The primary pollutants emitted typically include carbon dioxide (CO_2), CO, hydrocarbons (including benzene, 1.2-butadiene, aldehydes and PAH), SO_2, oxides of nitrogen (NO_x) and particulates. Secondary pollutants formed in the atmosphere typically include nitrogen dioxide (NO_2), photochemical oxidants such as ozone, hydrocarbons, sulphur acid, sulphates, nitric acid, sulphates, nitric acid and nitrate aerosols.

The quantity of pollutants emitted by a vehicle depends on specific vehicle related factors such as vehicle weight, speed and age; fuel-related factors such as fuel type (petroleum or diesel), fuel formulation (oxygen, sulphur, benzene and lead replacement agents); and environmental factors such as altitude, humidity and temperature (Samaras and Sorensen, 1999, as cited by (Reddy & Collet, 2023)).

Given the population density in the region, and the distribution of the mining activities, it is anticipated that vehicle exhaust emissions and their contribution to ambient air pollutant will be relatively insignificant.

Power generation

South Africa mainly relies on its extensive coal reserves as its primary source of energy. Several coal-fired power stations are in close proximity to the proposed Project. A large amount of CO_2, CO, SO_2, sulphur trioxide (SO_3), NO_2 and nitric oxide (NO), some traces of heavy metals and particulates such as PM_{10} are released whenever coal is burned at these stations (Munawer, 2017, as cited by (Reddy & Collet, 2023)).

These power stations are one of the key emission sources and contribute significantly to the level of air pollution within the region.

7.4.3 Local ambient air quality monitoring

7.4.3.1 Dust fallout monitoring

Dust fallout monitoring at MFC is currently conducted at four on-site monitoring locations, all equipped with single dust fallout units and in line with the National Dust Control Regulations and the ASTM D1739-70 methodology (Figure 16). Importantly, the eastern boundary is monitored by adjacent industries situated between MFC and residential areas to the east of the property and no concerns have been noted. The dust fallout monitoring results for the twelve-month period June 2020 to May 2021 are presented in Table 15.

Results indicate that all dust fallout monitoring locations are compliant with the National Dust Control Regulations. To date a non-residential network average of 447 mg/m^2/day was recorded, below the non-residential dust fallout guideline of 1,200 mg/m^2/day.

Figure 16: Location of dust fallout monitoring points

Table 15: Dust fallout results for a rolling twelve-month period

Sample Location	Guidelines	Dust Fallout (mg/m²/day)												Compliant
		Jun-20	Jul-20	Aug-20	Sept-20	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	
MFC-3	1200	262	266	402	295	449	221	222	432	186	171	313	155	Yes
MFC-4	1200	343	679	585	440	526	326	417	150	364	523	708	180	Yes
MFC-5	1200	487	564	631	640	293	464	562	590	375	640	529	351	Yes
MFC-7	1200	432	455	842	488	606	344	403	463	694	509	834	642	Yes

7.4.3.2 MFC station monitoring

MFC continuously monitors background concentrations of PM_{10}, SO_2 and NO_2 via their onsite station. As such, background concentrations of these pollutants have been assessed below for the period August 2018 to August 2021. The SANAS (SANAS, 2012) TR 07-03 standards stipulate a minimum data recovery of 90% for the dataset to be deemed representative of conditions during a particular reporting period. Data recovery at MFC's continuous monitoring station for each pollutant is given in Table 16. Given the extremely low data recovery of PM_{10} concentrations in 2018 and 2019, this data should be viewed with caution.

Table 16: Data recovery for each pollutant measured at MFC for the period August 2018 to August 2021

Pollutant	2018	2019	2020	2021
PM_{10}	No data	26%	82%	97%
SO_2	60%	80%	96%	97%
NO_2	82%	98%	77%	95%

7.4.3.2.1 Particulate concentrations

Table 17 presents the PM_{10} concentrations recorded at MFC for the period August 2018 to August 2021. Measured PM_{10} concentrations were compliant with the annual average NAAQS for PM_{10} (40 µg/m^3) for the entire monitoring period. Ambient PM_{10} concentrations exceeded the 24-hour NAAQS (75 µg/m^3) twenty times and five times during 2019 and 2020 respectively. Since only four exceedances of the 24-hour NAAQS are permitted per annum, PM_{10} concentrations at MFC were non-compliant for 2019 and 2020. PM_{10} concentrations were above the 24-hour NAAQS in 2021 but remained compliant, with less than four exceedances of the 24-hour NAAQS recorded per annum (Figure 17). It is noted that such exceedances are likely to be influenced by road works to the east of the property as well as adjacent industries and as such, is likely not fully attributable to MFC. Given the low data recovery of PM_{10} in 2018 and 2019, these datasets were excluded to obtain an average across all years from the station.

Table 17: Particulate matter concentrations and exceedances recorded at MFC for the period August 2018 to August 2021

Pollutant	Ambient Particulate Concentrations					
	Averaging Period	2018	2019	2020	2021	Average
PM_{10}	Annual average (µg/m^3)	No data	18	18	19	19
	24-hour exceedances	No data	20	5	3	-
	P99 24-hour concentration (µg/m^3)	No data	82	81	81	81

Red values represent exceedances of the relevant standards

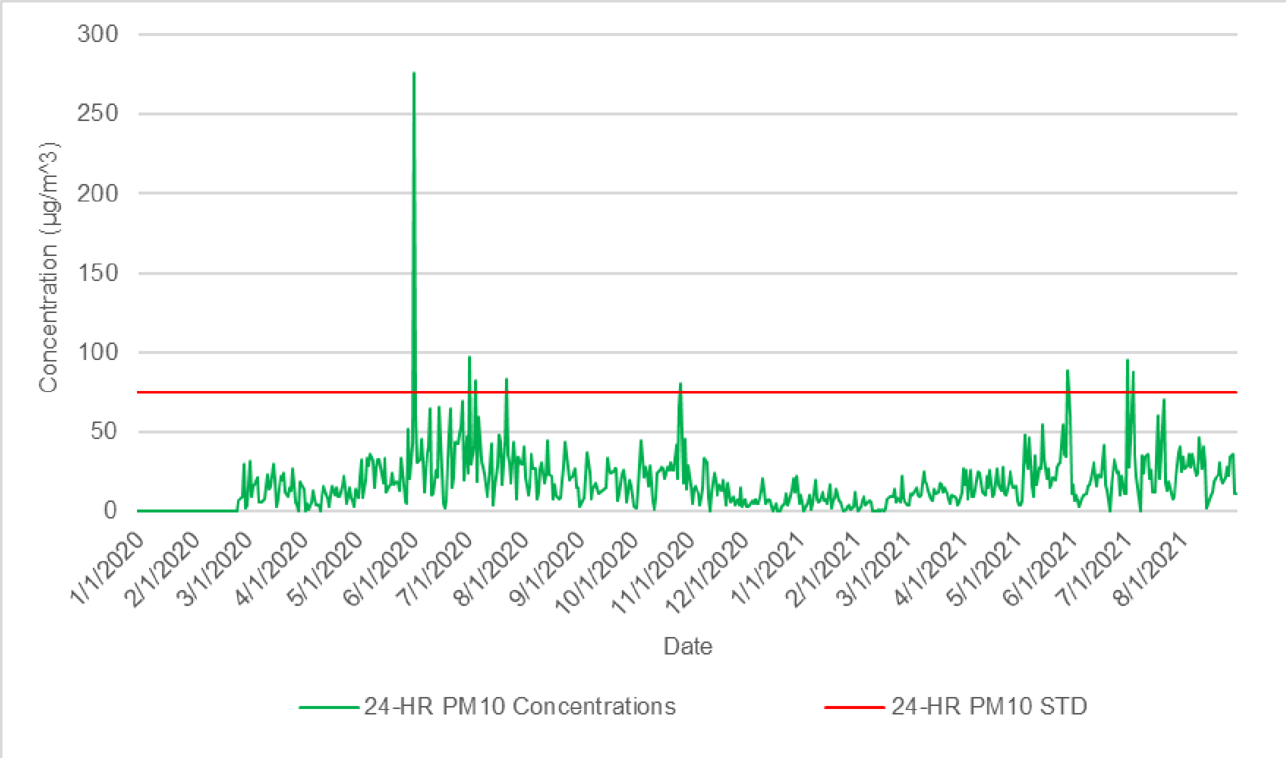


Figure 17: 24-hour PM_{10} concentrations at MFC for the period January 2020 to August 2021

7.4.3.2.2 SO_2 concentrations

Table 18 presents the SO_2 concentrations recorded at MFC for the period August 2018 to August 2021. Measured SO_2 concentrations were compliant with the annual, 24-hour and 1-hour averaging periods for SO_2 (350 µg/m³, 125 µg/m³ and 50 µg/m³ respectively) for the entire period. (Figure 18 and Figure 19). Importantly, the data recovery in 2018 and 2019 for SO_2 was a little below the recommended data recovery of 90% but has been used in this assessment as it still represents a suitable dataset.

Table 18: Sulphur dioxide concentrations and exceedances recorded at MFC for the period August 2018 to August 2021

Pollutant	Ambient SO_2 Concentrations					
	Averaging Period	2018	2019	2020	2021	Average
SO_2	Annual average (µg/m³)	2	4	6	6	5
	No. of 1-hour exceedances	0	2	2	0	-
	No. of 24-hour exceedances	0	0	0	0	-
	P99 1-hour concentration (µg/m³)	19	34	40	33	32
	P99 24-hour concentration (µg/m³)	6	21	24	16	17

Red values represent exceedances of the relevant standards

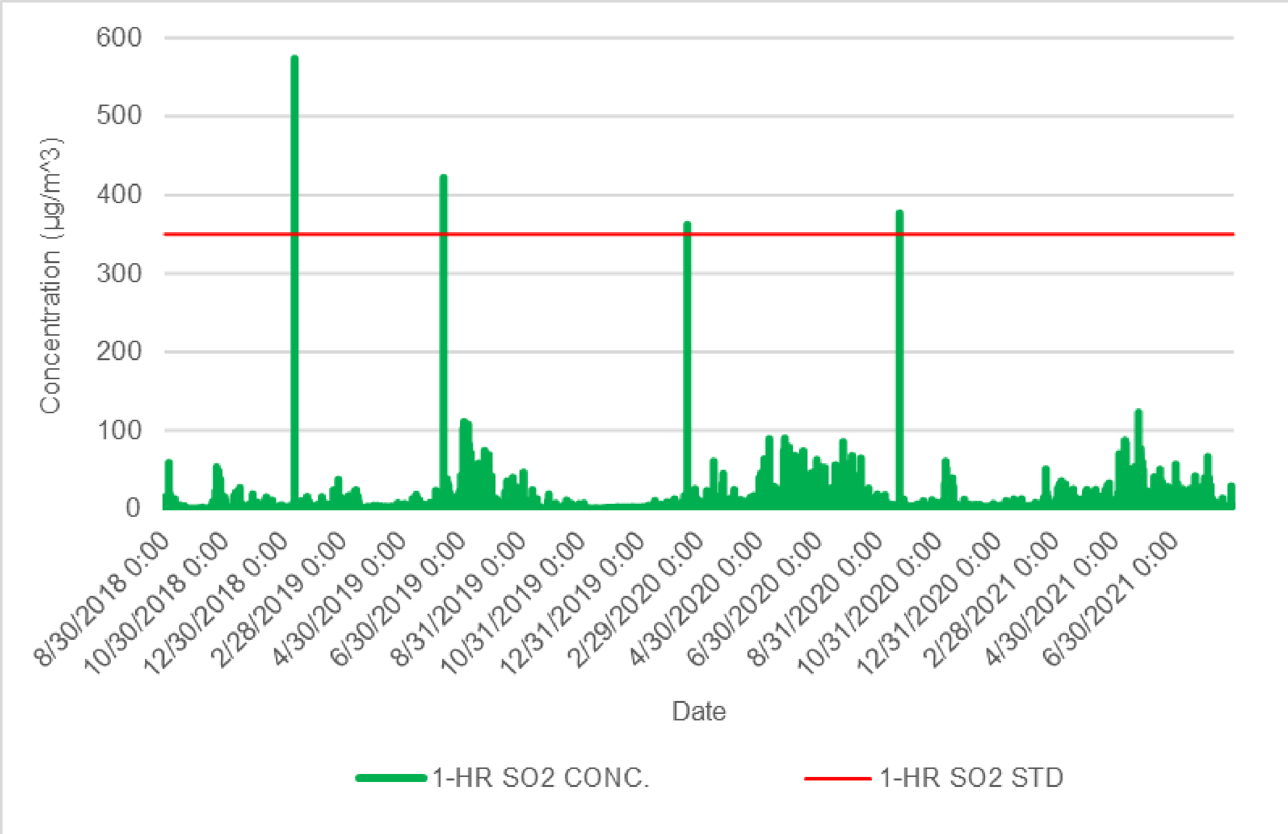


Figure 18: 1-hour SO_2 concentrations at MFC for the period August 2018 to August 2021

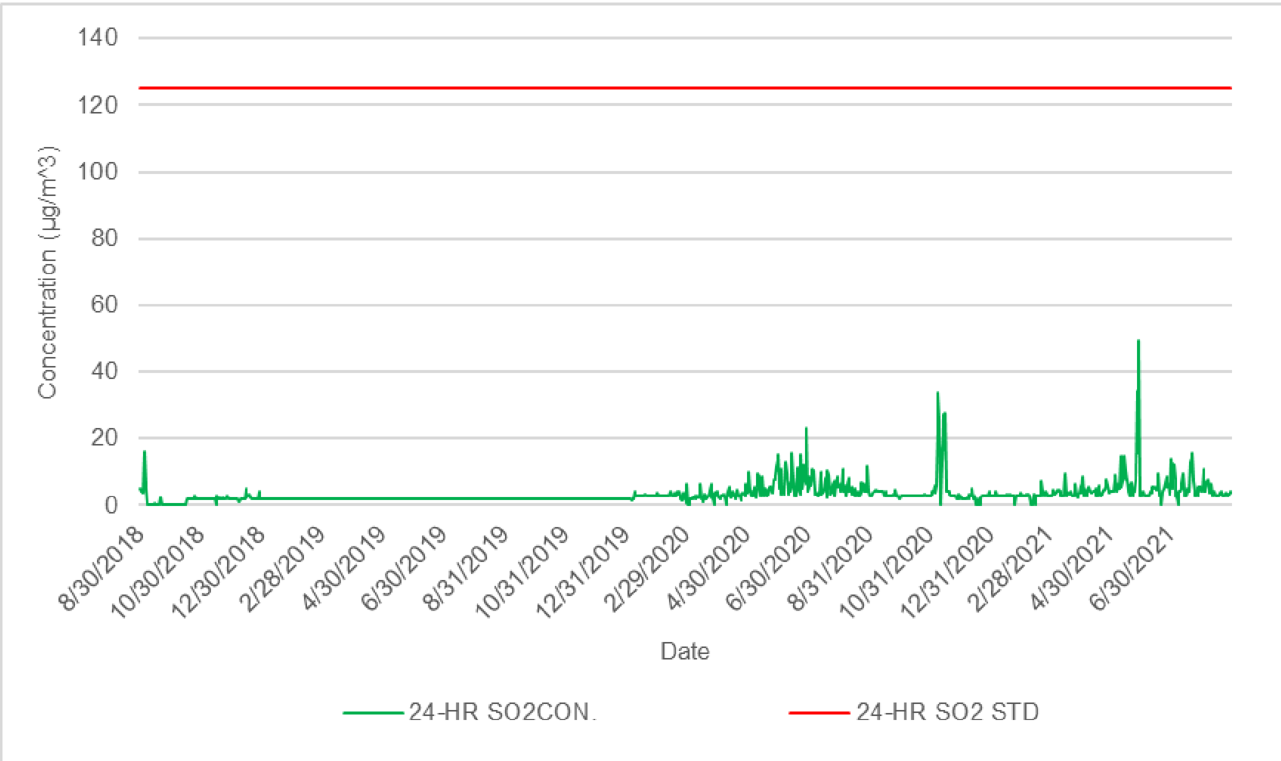


Figure 19: 24-hour SO_2 concentrations at MFC for the period August 2018 to August 2021

7.4.3.2.3 NO_2 concentrations

Table 19 presents the NO_2 concentrations recorded at MFC for the period August 2018 to August 2021. Measured NO_2 concentrations were compliant with the annual averaging period for NO_2 (40 µg/m^3) for 2018, 2020 and 2021, however in 2019 concentrations were above the annual NAAQS (61 µg/m^3). Ambient NO_2 concentrations exceeded the 1-hour NAAQS (200 µg/m^3) 441 times and 106 times during 2019 and 2020 respectively. Since only 88 exceedances of the 1-hour NAAQS are permitted per annum, NO_2 concentrations at MFC were non-compliant for 2019 and 2020 (Figure 20). The P99 1-hour concentration in 2019 was noted to be significantly high and this should be viewed with caution. Such a concentration could likely be a result of inaccurate data recordings from the equipment. Additionally, it is noted that the NO_2 concentrations from MFC stacks are below the National standards, and thus exceedances could likely be from an alternative source in the region. Measurements however have significantly improved in 2021 which suggests better mitigation measures have been put in place. Importantly, the data recovery in 2018 and 2020 for NO_2 was a slightly below the recommended data recovery of 90% but has been used in this assessment as it still represents a valuable dataset.

Table 19: Nitrogen dioxide concentrations and exceedances recorded at MFC for the period August 2018 to August 2021

Pollutant	Ambient NO_2 Concentrations					
	Averaging Period	2018	2019	2020	2021	Average
NO_2	Annual average (µg/m^3)	10	61	14	9	24
	No. of 1-hour exceedances	1	441	106	0	-
	P99 1-hour concentration (µg/m^3)	25	1,000	242	36	101

Red values represent exceedances of the relevant standards

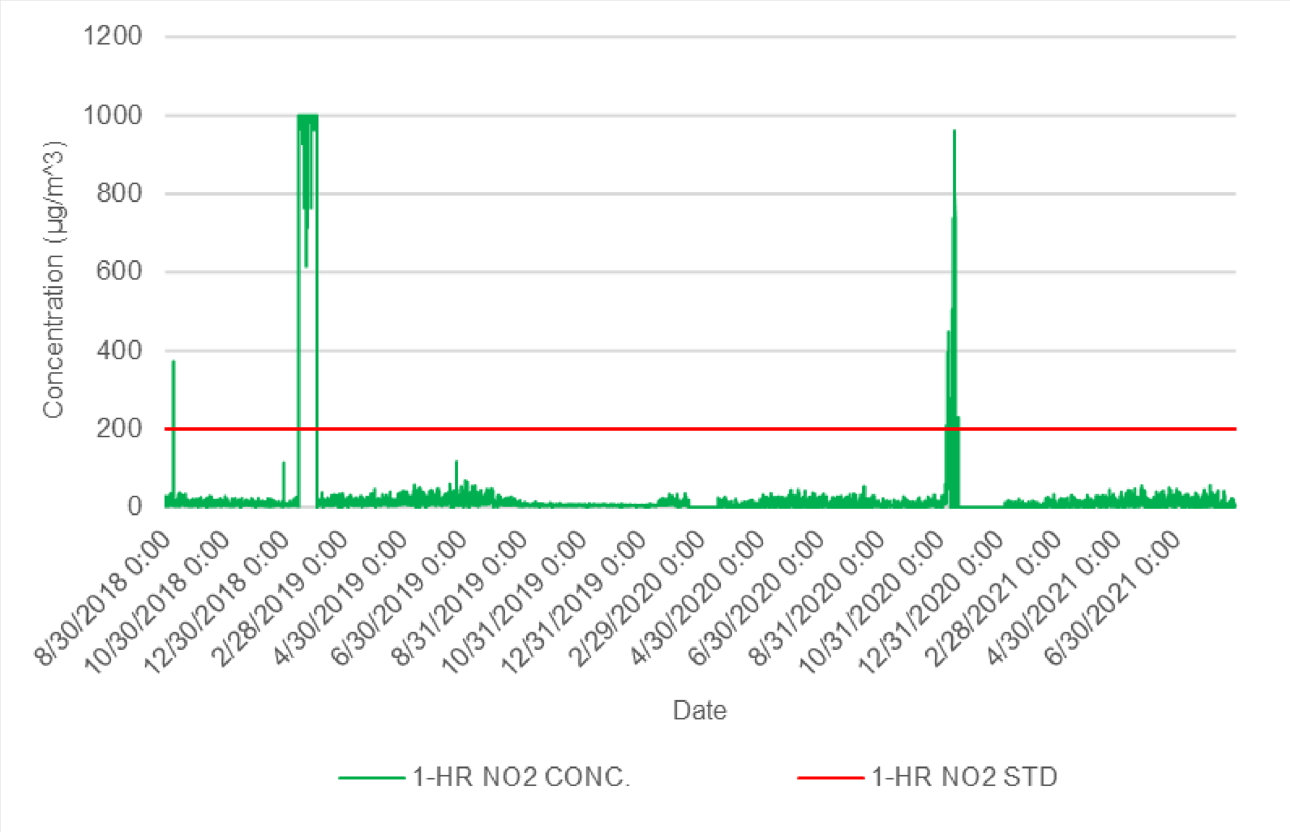


Figure 20: 1-hour NO_2 concentrations at MFC for the period August 2018 to August 2021

7.4.4 Sensitive Receptors

Sensitive receptors are defined by the United Stated Environmental Protection Agency (USEPA) as areas where occupants are more susceptible to the adverse effects of exposure to pollutants. These areas include but are not limited to residential areas, hospitals/clinics, schools and day care facilities and elderly housing.

The following sensitive receptors within a 10 km radius of the MFC operations were identified for this assessment and are presented in Table 20 and Figure 21.

Table 20: Sensitive receptors within a 10 km radius of the MFC operations

No.	Sensitive Receptor Name	Coordinates		Distance from Site Boundary (km)	Direction from Site
		Longitude (°S)	Latitude (°E)		
1	4D Scan Hospital	29.4377	-25.7493	7.52	North-northwest
2	Aerorand	29.4325	-25.8041	5.62	West
3	Dennesig	29.4736	-25.7354	6.94	North
4	Hoerskool Middelburg	29.4564	-25.7698	4.73	North-northwest
5	Industria	29.4905	-25.7853	0.87	North
6	Laerskool Dennesig	29.4784	-25.7332	6.92	North
7	Malope Village	29.4129	-25.7734	8.31	Northwest
8	Mhluzi	29.4266	-25.7573	7.83	Northwest

No.	Sensitive Receptor Name	Coordinates		Distance from Site Boundary (km)	Direction from Site
		Longitude (°S)	Latitude (°E)		
9	Middelburg - MP	29.4684	-25.7725	3.52	North northwest
10	Middelburg Hospital	29.4504	-25.7760	4.63	Northwest
11	Middelburg Town Masjid	29.4585	-25.7662	4.84	North-northwest
12	Middelburg-Midmed PVT Hospital	29.4578	-25.7635	5.13	North-northwest
13	Mineralia	29.4673	-25.7963	2.11	West-northwest
14	Mphanama Secondary School	29.4304	-25.7531	7.95	North-northwest
15	Nazareth	29.5083	-25.7990	0.93	East
16	Rockdale	29.5209	-25.8191	1.86	Southeast
17	Sozama Secondary School	29.4317	-25.7564	7.64	North-northwest

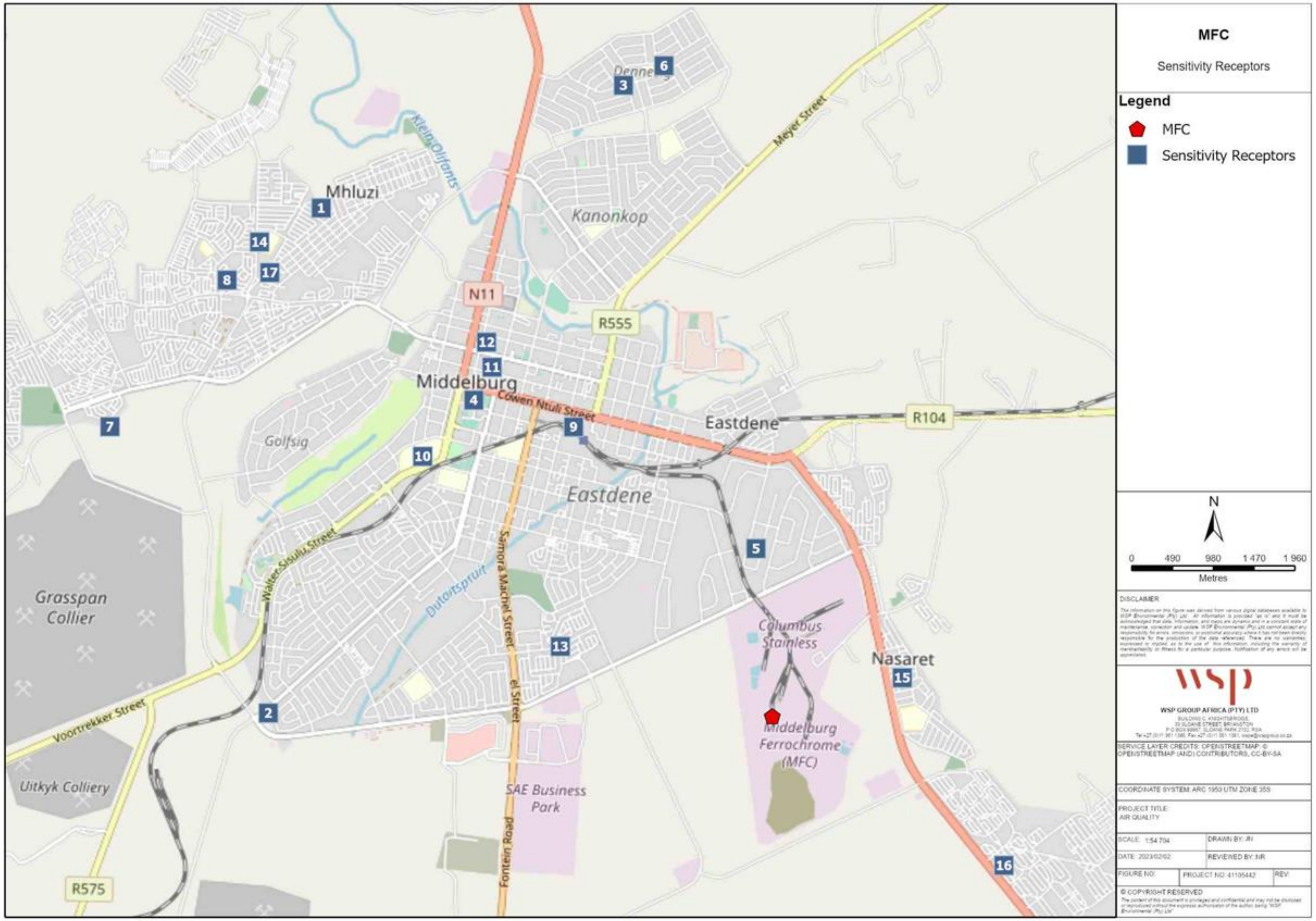


Figure 21: Sensitive receptors within a 10 km radius of the MFC site

7.5 Groundwater

The geology underlying the MFC site is not known to contain economically viable aquifers, but groundwater contributes to stream flow and in some instances relative higher yielding boreholes have been recorded on site. The following aquifers underlie the site:

- **Weathered Aquifer**: A shallow, weathered aquifer in the weathered shale, rhyolite and diabase. All the formations have similar weathering characteristics and although the aquifer parameters may vary dependent on the rock type, the groundwater flow mechanisms are similar. The most consistent water strike is located at the fresh bedrock / weathering interface.
- **Fractured Aquifer**: A deeper, non-weathered aquifer where fracture flow dominates. Groundwater migration within the upper portion of this aquifer appears to be governed by jointing while major faults and intrusions form the significant conduits at depth.

The two aquifers are hydraulically connected. The aquifers are classified as minor.

Aquifer hydraulic parameters are estimated to be between 1.14 x 10^{-2} m/d to 9.9 x 10^{-4} m/d for hydraulic conductivity and between 2 and 3 m^2/day for transmissivity.

The regional groundwater flow direction is from south to north along the drainage, but locally the groundwater flow is east – west, towards the Vaalbankspruit.

Recharge values of approximately 1.2 mm/a or 0.2% of the MAP 660 mm/a were calibrated. A hydrocensus of boreholes and surface water bodies was carried out in May 2015 by Golder. During the hydrocensus 88 boreholes were visited. Water levels were measured at 88 boreholes, 84 of which were reported to be static water levels. The groundwater levels are shallow with an average of 2.3 mbgl. The groundwater levels for the MFC site ranges from artesian to 9.82 mbgl. Four wells were found to be artesian. The boreholes near the study area (SP1-SP4), water levels range from 6.45 – 6.76 mbgl.

7.6 Surface Water

7.6.1 Water Management Area (WMA)

The Vaalbankspruit, which runs through the MFC site, and drains into the Klein Olifants River, a tributary of the Upper Olifants River, and subsequently into the Loskop Dam. The catchment area of the Klein Olifants River is 2 151 km^2, and that of the Vaalbankspruit is 135 km^2.

The division of the Loskop Dam catchments into Management Units was undertaken in the Loskop Dam project, for the Department of Water and Sanitation (formerly Department of Water Affairs and Forestry). The details are contained in the Department of Water Affairs and Forestry report No *PB B100-00-0898* entitled *“Development of an Integrated Water Resources Model of the Upper Olifants River (Loskop Dam) Catchments – Water Quality Situation Assessment of the Loskop Dam Catchments”.*

This part of the Loskop dam catchment was divided into five Management Units, with Middelburg Ferrochrome and the Vaalbankspruit forming part of Management Unit 27.

The location of MFC in relation to the catchment is indicated in Figure 22 below.

7.6.2 Surface water hydrology

The hydrological regimes of the Vaalbankspruit consist mainly of seasonal to permanent wet hydrological zones. Most of the wetland’s functions (flood attenuation and water purification) take place in these hydrological zones. The Vaalbankspruit wetland’s primary hydrological determinants are the lateral seepage off the slopes on both eastern and western sides and the seasonal flooding of the Vaalbankspruit (Figure 23). These appear to play a major part in maintaining the wetland.

The Vaalbankspruit rises in Highveld grassveld in the vicinity of the Hendrina Power station, about 18 km south of the MFC plant and at an altitude of 1 590 m amsl. The stream in the vicinity of MFC is historically perennial, but one stretch has become seasonal because of upstream impoundment. The Pienaars dam, located upstream of MFC, is classified as a Category 2 dam in terms of the Dam Safety Regulations. Downstream of the dam there are permanent pools. Where the channel is clearly defined, it varies from 1 to 2 m in width and is up to 1 m deep or deeper. The Pienaars dam holiday resort discharges treated wastewater into the Vaalbankspruit immediately downstream of the Pienaars dam, and upstream of MFC. This and upstream mining activities influences the upstream water quality.

7.7 Soil, Land Use and Land Capability

7.7.1 Regional Soil

The land type survey was conducted in the early 1970's in order to compile inventories of the natural resources of South Africa in terms of soil, climate and terrain and was conducted as a reconnaissance survey at scale of 1:250 000. The survey reflects the dominant soils in each land type by percentage. The land type information is not a substitute for a detailed soil map, but gives a very good indication of where certain soil patterns are located. The land type memoirs and associated maps of 2528 Pretoria (Land type Survey Staff, 1976-2006) indicate that the site lies within the Bb 14 land type.

In Bb 14 land type unit, a series of soil forms namely Mispah, Glenrosa, Hutton, Clovelly, Avalon, Swartland, Katspruit, Kroonstad, Wasbank, Warwick, Dundee, Rensburg, Longlands and Glencoe all represent 3.5 - 10% of the land type. The majority (60%) of soils of this land type unit is found in footslope terrain position with others (30%) occurring in the valley position. The dominant geology represented by land type Bb14 is predominantly rhyolite of the Selonsrivier and Damwal Formations of the Rooiberg Group and some stone and shale of the Ecca Group, Karoo Sequence.

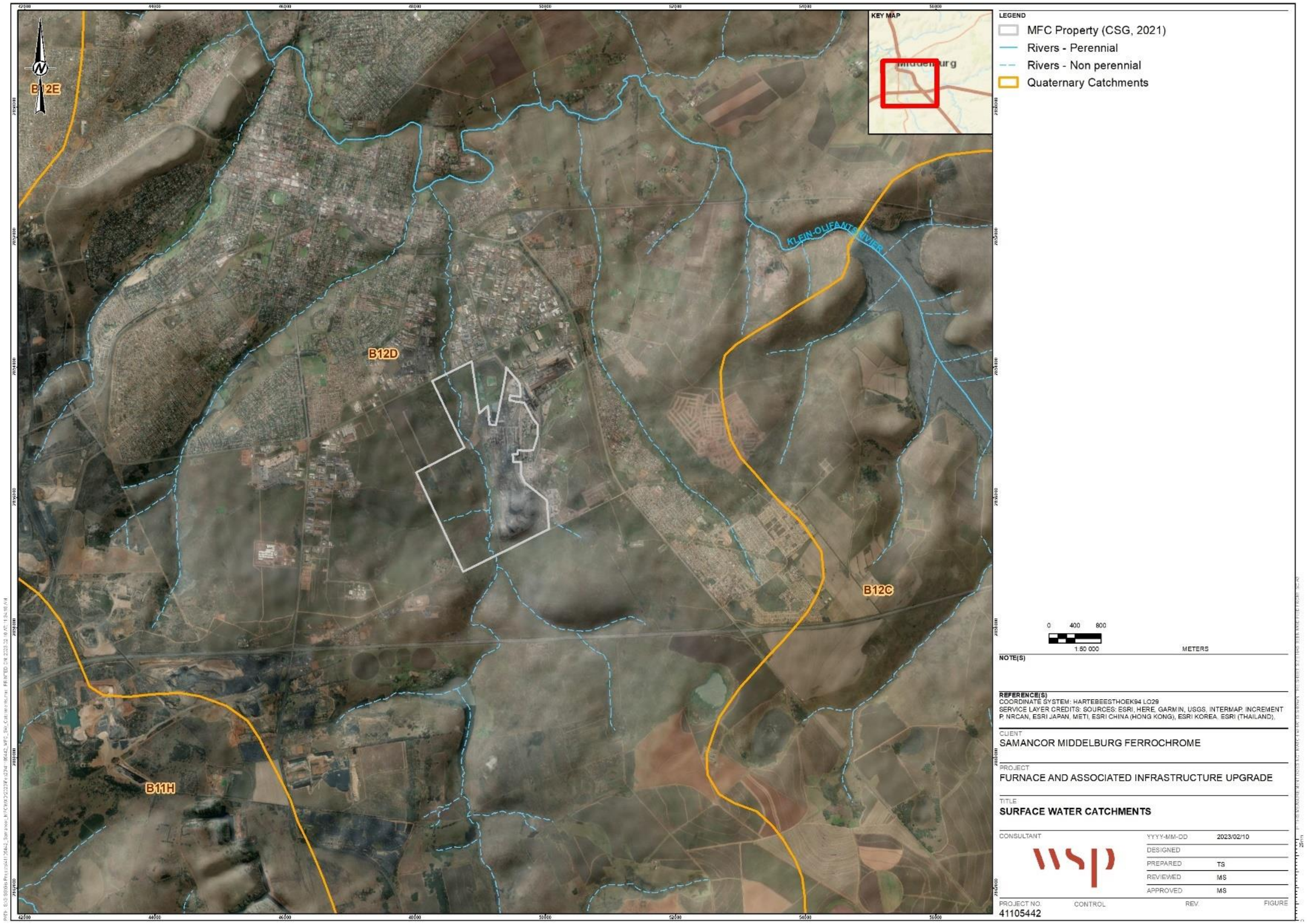


Figure 22: Surface water catchments

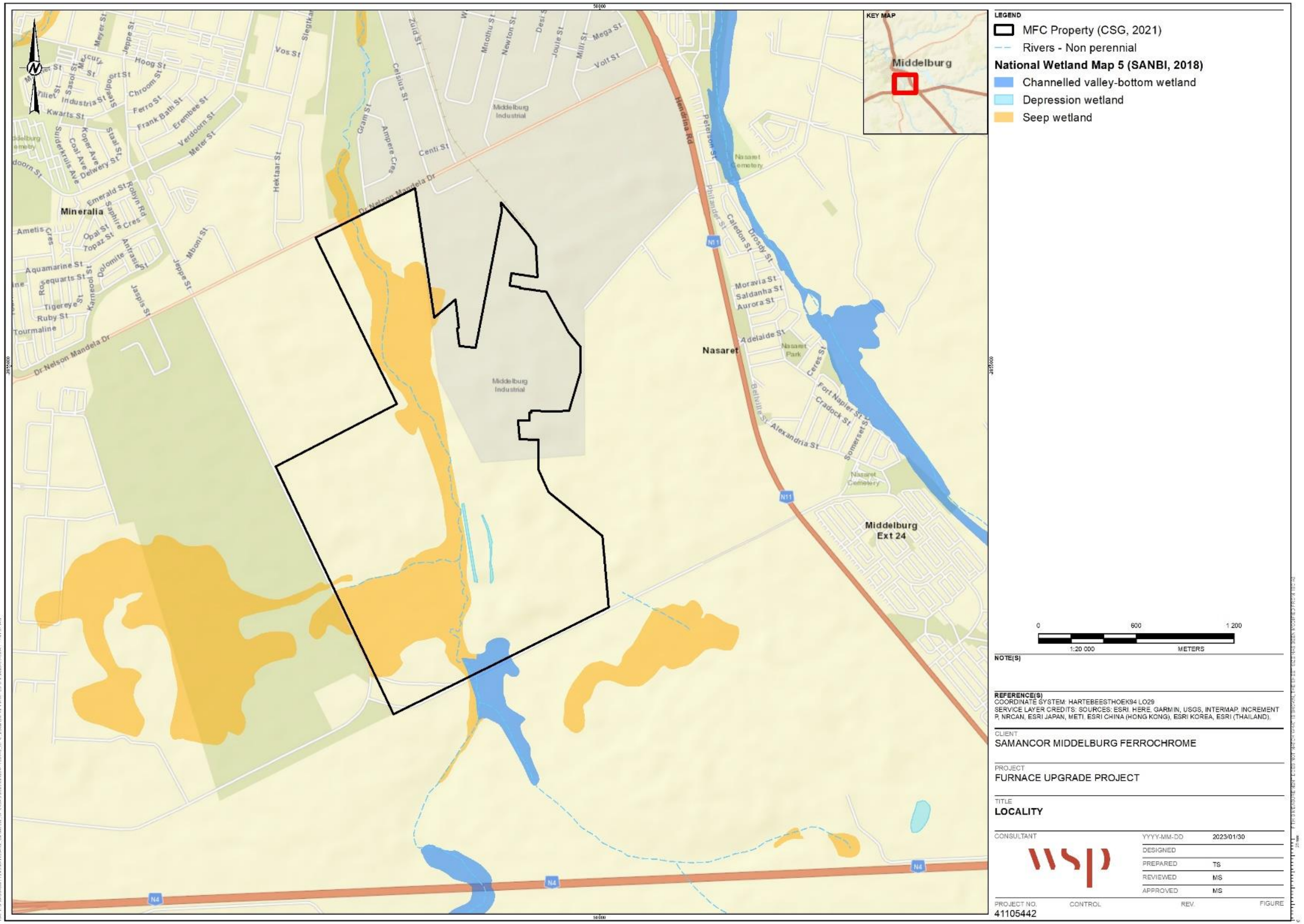


Figure 23: Wetlands

7.7.2 Land Use

The land uses of the areas adjacent or in close proximity to the site include residential, educational, industrial, commercial and a small area of undeveloped property.

7.7.2.1 Residential

The Nazareth residential area and an informal village lie to the east of the site, alongside and east of the N11 national road. Rockdale is situated to the south-east. The Mineralia and the Aerorand residential areas lie to the northwest. Schools are situated within these residential areas.

The suburbs of Middelburg lie approximately 2 km north and north-west of the MFC site. The town of Middelburg is dominated by industry, with rail and road infrastructure servicing industrial developments in the region.

7.7.2.2 Commercial and Industrial

The CBD (central business district) of Middelburg lies 5 km to the northwest of the site.

Calmisil and Harsco operating to the east and southeast of the MFC site with Columbus Stainless operating east and northeast of the site. Infrabuild is also situated between Columbus Stainless and MFC on the northern side of the plant boundary. Several small industries are included in the Industrial Zone to the north of the property. West of the MFC site are several newly established industrial and commercial zones with Steve Tshwete water works located to the southwest of the site.

7.7.2.3 Open areas

The areas to the south and west and immediately adjacent to MFC’s property are undeveloped. The Vaalbankspruit flows through the MFC site, on the western side. The N4 highway runs from east to west, about 1 km south of the site.

The proposed furnace upgrade project will take place within the existing MFC industrial complex. The land use classification for the project area is thus industrial and is assumed to remain industrial land in the long term.

7.8 Biodiversity

The proposed project areas are located inside the existing MFC site, an industrial site that has been operational since 1964. As a result, biodiversity at the site is very limited. The areas where the project infrastructure will be installed are characterised by existing buildings, hard standing and roads (Figure 8).

A small section of an Irreplaceable Critical Biodiversity Area is located in the western side of the MFC site, however this is not in close proximity to the project areas, as illustrated in Figure 24.

7.9 Noise

The MFC site and the neighbouring Columbus Stainless Steel are both operational industrial sites contributing to existing noise sources in the area. Other sources of noise in the area are the national and provincial roads and surrounding light industrial and residential areas.

7.10 Palaeontology and Cultural Heritage

The areas where the project infrastructure will be upgraded have previously been disturbed during the construction of the existing infrastructure. The areas where the project infrastructure will be installed are characterised by existing buildings, hard standing and roads.

7.11 Traffic

7.11.1 Surrounding Roads and Railways

The main roads around the MFC site consists of (Figure 2):

- The N4 National Road, which is approximately 1.5 km south of the plant.
- The N11 National Road which runs to the east of the site. The N14 has an interchange with the N4.
- The R35 which runs to the west of the site. The R35 has an interchange with the N4.
- Dr Mandela Drive (formerly Kilo Street) runs to the north of the site and links the N11 with the R35 / Samora Machel Street intersection.
- An untarred road runs to the south of the site.

The main railway line from central Gauteng to Nelspruit runs through the CBD of Middelburg in an east-west direction. An industrial spur railway line links to the plant.

7.11.1 Road access

The MFC site has good access to both the local and the national road network. The N11 forms the main access to the site and comprises four traffic lanes. At the northern end of the site, there is direct access to Dr Mandela Drive. This access is shared with Columbus Steel. The access is used by heavy vehicles transporting finished product, raw materials and waste.

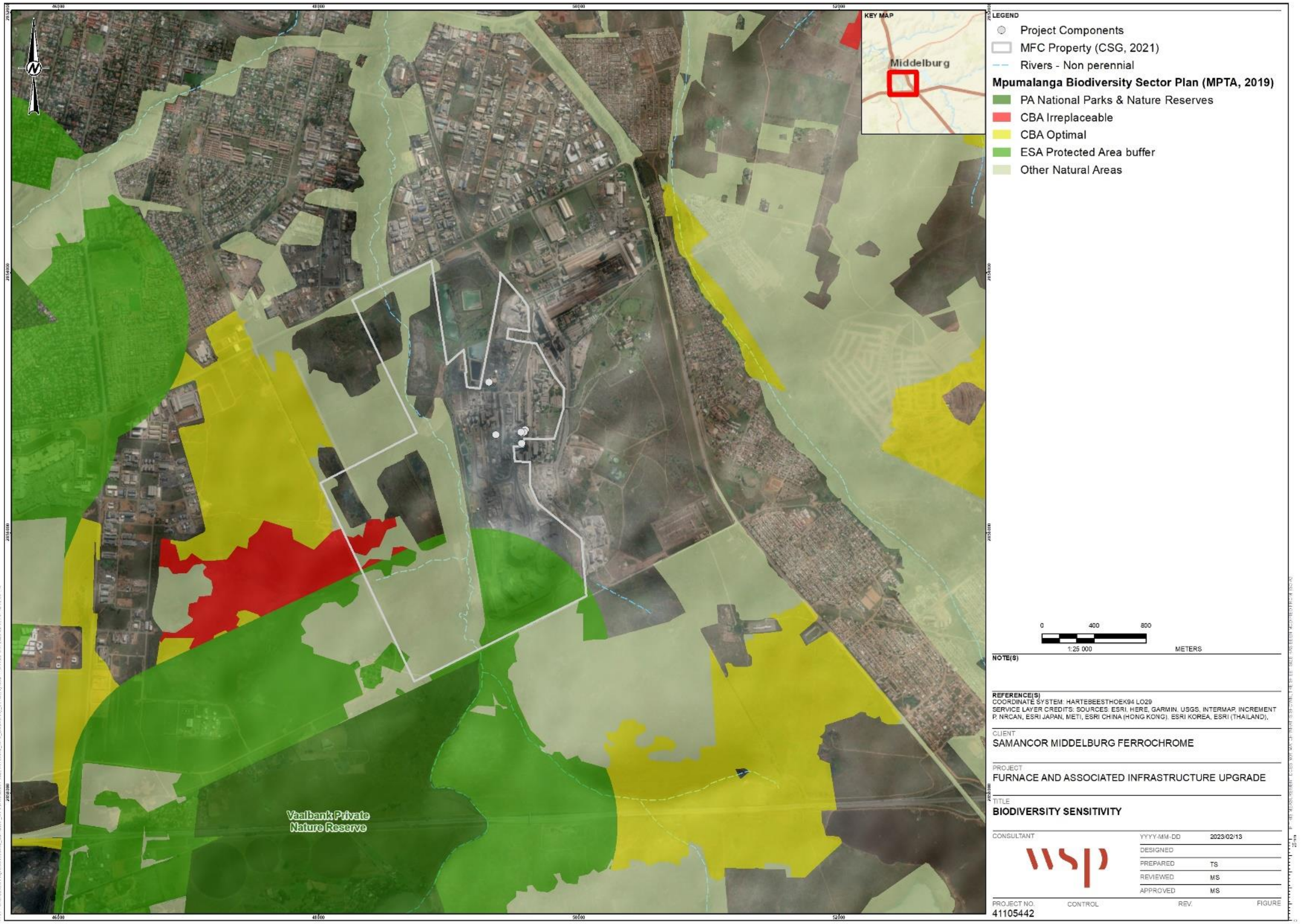


Figure 24: Biodiversity sensitivities

7.12 Socio-economic

Samancor's Middelburg Ferrochrome plant is located along Hendrina Road, approximately 4.5 km south-east of the town of Middelburg. It is situated within Ward 11 of the Steve Tshwete Local Municipality, which is situated at the centre of the Nkangala District Municipality in Mpumalanga.

The Municipality is approximately 3 976 km^2 in extent and represents 23.7% of the District Municipality.

7.12.1 Demographics

(Steve Tshwete Municipality , 2023) states that the Steve Tshwete Local Municipality has a total population of 217 073 people, of whom 73,6% are black African, and 21,8% are white. The other population groups make up the remaining 4,6%.

It is further stated that of those aged 20 years and older, 3,4% have completed primary school, 30,8% have some secondary education, 35% have completed matric, and 14,4% have some form of higher education, while 7,4% of have no form of schooling.

7.12.2 Infrastructure

There are 64 971 households in the municipality, with an average household size of 3,3 persons per household.29,4% of households are headed by females.

62,2% of households have access to piped water inside the dwelling, 23,5% of households have access to piped water in their yard and 1,8% have no access to piped water (Steve Tshwete Municipality , 2023).

7.12.3 Employment

Of the 107 069 economically active people (employed or unemployed but looking for work), 19,7% are unemployed.

Of the 53 630 economically active youth (15 – 34 years) in the area, 27,1% are unemployed.

7.12.4 Economy

The Steve Tshwete Local Municipality contributed approximately 13% to the Mpumalanga economy in 2020, making it the third largest economy in the province. Contribution to the district economy was 34.4%, making it the second largest economy in the district. The average annual economic growth for the Municipality was 2.1% over the period 1996 to 2020 (Steve Tshwete Local Municipality, 2022/2023 Integrated Development Plan (IDP) , 2022).

7.12.5 Key Economic Activities

The main economic sectors in the municipal area are mining, trade, manufacturing and farming.

Middelburg is the primary activity node within the municipal area (Steve Tshwete Local Municipality, 2022/2023 Integrated Development Plan (IDP) , 2022). A number of large industries, such as Columbus Steel and Eskom Power Stations, as well as the Nkangala District Municipality's headquarters and various other government departments are located in the municipality.

8.0 POTENTIAL IMPACTS AND RISKS IDENTIFIED

The detailed description of the impacts and risks identified is provided in Section 8.8

8.1 National Environmental Screening Tool

The Department of Forestry, Fisheries and the Environment (DFFE) has developed the National Web-based Environmental Screening Tool in order to flag areas of potential environmental sensitivity related to a site as well as a development footprint and produces the screening report required in terms of regulation 16 (1)(v) of the EIA Regulations (2014, as amended). The *Notice of the requirement to submit a report generated by the national web-based environmental screening tool in terms of section 24(5)(h) of the NEMA, 1998 (Act No 107 of 1998) and regulation 16(1)(b)(v) of the EIA regulations, 2014, as amended* (GN 960 of July 2019) states that the submission of a report generated from the national web-based environmental screening tool, as contemplated in Regulation 16(1)(b)(v) of the EIA Regulations, 2014, published under Government Notice No. R982 in Government Gazette No. 38282 of 4 December 2014, as amended, is compulsory when submitting an application for environmental authorisation in terms of regulation 19 and regulation 21 of the EIA Regulations, 2014 as of 04 October 2019. The web based environmental screening tool can be accessed at https://screening.environment.gov.za/screeningtool to generate a report that shows environmental features and sensitivities near the proposed project and identifies recommended specialist studies.

The Environmental Screening Report generated for this application process are attached as APPENDIX D.

8.1.1 Site Sensitivity Verification

The Screening Report for the project identified various sensitivities for the site. The report also generated a list of specialist assessments that should form part of the legalisation process based on the development type and the environmental sensitivity of the site. Assessment Protocols in the report provide minimum information to be included in a specialist report to facilitate decision-making.

The Screening Report recognises that *"it is the responsibility of the EAP to confirm this list and to motivate in the assessment report, the reason for not including any of the identified specialist study including the provision of photographic evidence of the footprint situation.*" This section therefore addresses the findings of the Screening Report and provides a motivation for the proposed specialist studies identified to be conducted.

It also discusses whether the specialist studies forming part of this project are required to comply with the *Procedures for the Assessment and Minimum Criteria for Reporting on identified Environmental Themes in terms of Section 24(5) (a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation* ("the Protocols") (Government Notice No. 320 as published in Government Gazette No. 43110 on 20 March 2020 (GNR 320)).

8.1.1.1 Project and Site Overview

The proposed project areas are located inside the existing MFC site, an industrial site that has been operational since 1964. The MFC site, which measures 3 651 338 m^2 in extent, comprises established industrial buildings, equipment, reagent storage areas and waste management facilities associated with the existing ferrochrome operations (Figure 8).

8.1.1.2 Environmental Sensitivity

As per the Screening Tool Report (APPENDIX D), the proposed site is indicated to be located within areas ranging from low to very high sensitivity. These are identified in Table

The environmental sensitivities identified in the screening report and their associated sensitivity ratings are listed in Table 21, together with comments on their applicability.

Table 21: Themes identified by Screening Tool Report and verification thereof

Theme	Environmental Sensitivity	Relevant (YES/No)	Comments
Agriculture	High	No	Land capability at the project areas is indicated to be Low-Moderate and for the rest of the site Moderate-High sensitivity. The site is an existing industrial site that has been operational since 1964. High sensitivity is therefore refuted. It is the EAP's view that the site has no agricultural potential based on its size and the highly developed nature of its surroundings and the high sensitivity for agriculture is **refuted**.
Animal Species	High	No	Animal Species is indicated at the project areas to have a Low-Moderate sensitivity and for the rest of the site Moderate-High sensitivity. The site is an existing industrial site that has been operational since 1964 and is located in an industrial zoned area, with surrounding industries. The project components will be upgraded within the existing operational areas and on hardstanding and will not result in the removal of any vegetation. Furthermore, there is no terrestrial animal habitat located at the project areas. The high sensitivity identified for the site is as such, **refuted**.
Aquatic Biodiversity	Very High	No	A seep wetland system is present on the western side of the MFC site and a channelled valley-bottom wetland towards the south (Figure 23). However, the project components will be upgraded within the existing operational areas and on hardstanding, areas indicated as low in the Screening Report, and will not have any impact on aquatic biodiversity. Ver high sensitivity is therefore **refuted** within the project and site-specific context.
Archaeological and Cultural Heritage	Low	No	The site is an existing industrial site that has been operational since 1964. The project components will be upgraded within the existing operational areas and on hardstanding. The proposed project activities will not have any effect on any heritage features. The low sensitivity in the site-specific context is therefore **refuted and no further assessment is required**.
Civil Aviation	High	No	The proposed project would not have elements that would affect civil aviation. The site is an existing industrial site that has been operational since 1964. The project components will be upgraded within the existing operational areas.

Theme	Environmental Sensitivity	Relevant (YES/No)	Comments
			High sensitivity in the site-specific context is therefore **refuted**.
Defence	Low	No	The proposed project would not have elements that would affect military or defence sites. The site is an existing industrial site that has been operational since 1964. The project components will be upgraded within the existing operational areas. The low sensitivity in the site-specific context is therefore **refuted and no further assessment is required**.
Palaeontology	Medium	No	The site is an existing industrial site that has been operational since 1964. The project components will be upgraded within the existing operational areas. The proposed project activities will not have any effect on palaeontological resources. Medium sensitivity is therefore **refuted** within the project and site-specific context.
Plant Species	High	No	The site is an existing industrial site that has been operational since 1964. The project components will be upgraded within the existing operational areas, area indicated as low sensitivity in the Screening Report. No impacts to plant species are therefore expected at the project areas. High sensitivity is therefore **refuted** within the project and site-specific context.
Terrestrial Biodiversity	Very High	No	The site is an existing industrial site that has been operational since 1964. The project components will be upgraded within the existing operational areas and therefore would not have affected on natural ecosystem areas. Very High sensitivity is therefore **refuted** within the project and site-specific context.

Based on the identified sensitivities, the Screening Tool Report recommended 15 specialist assessments to be undertaken as part of the assessment process.

Table 22 identifies the specialist studies as indicated in the Screening Tool Report and whether they are proposed to be undertaken as part of the BA process or not. A motivation by the EAP is also provided.

Table 22: Identification of specialist studies as per the Screening Tool Report to be undertaken as part of the Basic Assessment Process and motivation for including or excluding the study

Specialist Assessment	To be undertaken (yes/No)	Motivation
Ambient Air Quality Impact Assessment	Yes	Included in this report under Section 8.8.1.
Air Quality Impact Assessment	Yes	
Agricultural Impact Assessment	No	Not assessed as the proposed project areas are within the existing MFC industrial site and therefore not deemed applicable within the project and site-specific context.
Landscape / Visual Impact Assessment	No	Not assessed as the proposed project areas are within the existing MFC industrial site and therefore not deemed applicable within the project and site-specific context.
Archaeological and Cultural Heritage Impact Assessment	No	Not assessed as the proposed project areas are within the existing MFC industrial site and therefore not deemed applicable within the project and site-specific context. The areas where the project infrastructure will be constructed have previously been disturbed during the construction of the existing infrastructure. The areas where the project infrastructure will be installed are characterised by existing buildings, hard standing and roads.
Palaeontology Impact Assessment	No	
Terrestrial Biodiversity Impact Assessment	No	Not assessed as the proposed project areas are within the existing MFC industrial site and therefore not deemed applicable within the project and site-specific context.
Aquatic Biodiversity Impact Assessment	No	Not assessed as the proposed project areas are within the existing MFC industrial site and therefore not deemed applicable within the project and site-specific context.
Hydrology Assessment	No	Not assessed as the proposed project areas are within the existing MFC industrial site and therefore not deemed applicable within the project and site-specific context.
Noise Impact Assessment	No	Not assessed as the proposed project areas are within the existing MFC industrial site and therefore not deemed applicable within the project and site-specific context.
Traffic Impact Assessment	No	Not assessed as the proposed project areas are within the existing MFC industrial site and therefore not deemed applicable within the project and site-specific context.
Health Impact Assessment	No	Not assessed as the proposed project areas are within the existing MFC industrial site and therefore not deemed applicable within the project and site-specific context.

Specialist Assessment	To be undertaken (yes/No)	Motivation
Socio-Economic Assessment	No	The positive and negative socio-economic impacts of the proposed project is addressed in Section 8.8.8 of this report. It is not deemed necessary that a separate Socio-Economic Assessment be undertaken for the project.
Plant Species Assessment	No	Not assessed as the proposed project areas are within the existing MFC industrial site and therefore not deemed applicable within the project and site-specific context.
Animal Species Assessment	No	Not assessed as the proposed project areas are within the existing MFC industrial site and therefore not deemed applicable within the project and site-specific context.

Table 23: Site Photos

Project Area	Photo
Pelletising and Sintering Plant	
M3 Closed Furnace Building	

Project Area	Photo
M4 Closed Furnace Building	
M3 Gas Plant	

8.2 Impact Assessment Methodology

The specialist study that was undertaken for the proposed project is attached in the appendices to this report. The significance of each identified impact was determined using the approach outlined below (terminology from the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998). This approach incorporates two aspects for assessing the potential significance of impacts, namely occurrence and severity, which are further sub-divided as follows:

Occurrence		Severity	
Probability of occurrence	Duration of occurrence	Scale/extent of impact	Magnitude (severity) of impact

To assess each of these factors for each impact, the following four ranking scales are used:

Magnitude	Duration
10 - Very high / Unknown	5 – Permanent (post closure)
8 – High	4 - Long-term (impact ceases after site closure has been obtained)
6 – Moderate	3 - Medium-term (impact ceases after operational life of the activity)
4 – Low	2 - Short-term (impact ceases after the construction phase)
2 – Minor	1 – Immediate
Scale	**Probability**
5 – International	5 – Definite / Unknown
4 – National	4 - Highly Probable
3 – Regional	3 - Medium Probability
2 – Local	2 - Low Probability
1 - Site only	1 - Improbable
0 – None	0 – None

Once these factors are ranked for each impact, the significance of the aspects, occurrence and severity, is assessed using the following formula:

SP (significance points) = (Magnitude + Duration + Scale) x Probability

The maximum value is 100 significance points (SP). The impact significance will then be rated as follows:

SP >60	Indicates high environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 – 60	Indicates moderate environmental significance	An impact or benefit which is sufficiently important to require management, and which could have an influence on the decision unless it is mitigated.

SP <30	Indicates low environmental significance	Impacts with little real effect and which should not have an influence on or require modification of the project design.
+	Positive impact	An impact that is likely to result in positive consequences / effects.

For the methodology outlined above, the following definitions were used:

- ***Magnitude*** is a measure of the degree of change in a measurement or analysis (e.g., the severity of an impact on human health, well-being, and the environment), and is classified as none/negligible, low, moderate, high, or very high/unknown.
- ***Scale/Geographic*** extent refers to the area that could be affected by the impact and is classified as site, local, regional, national, or international.
- ***Duration*** refers to the length of time over which an environmental impact may occur i.e. immediate/transient, short-term, medium term, long-term, or permanent.
- ***Probability*** of occurrence is a description of the probability of the impact occurring as improbable (less than 5% chance), low probability (5% to 40% chance), medium probability (40% to 60% chance), highly probable (most likely, 60% to 90% chance) or definite (impact will definite occur).

8.3 The possible mitigation measures that could be applied and the level of risk

The possible mitigation measures for the anticipated impacts are summarised in Section 8.8 and detailed in Section 14.4.

8.4 The positive and negative impacts that the proposed activity (in terms of the initial site layout) and alternatives will have on the environment and the community that may be affected

As described in Section 5.0, the proposed project components will be within the existing MFC site in close proximity to the relevant infrastructure pertaining the proposed upgrades (Figure 8).

8.5 Motivation where no alternative sites were considered

See Section 5.0 of this report for a discussion on the alternatives considered.

8.6 Statement motivating the alternative development location within the overall site

The placement of the proposed upgrade infrastructure is limited to in terms of its location as it must firstly be located within the existing MFC site and secondly in close proximately to associated infrastructure. The preferred locations were determined to limit potential impacts on the receiving environment, operational and financial implications, as described in Section 5.0.

The final layout plan is provided in section 14.3.

8.7 Full description of the process undertaken to identify, assess and rank the impacts and risks the activity will impose on the preferred site

A list of potential impacts associated with the proposed upgrade project were identified during the Basic Assessment process and are summarised in Section 8.8. A detailed description of the impact assessment and rating methodology is provided in Section 0. The following information sources were used in the assessment process:

- Observations made on site.
- Outcomes of the air quality specialist study.
- Review of existing approved EMPs, and environmental authorisations.
- Liaison with the MFC environmental and project teams.
- Discussions with specialists, where required, regarding assessment and ranking of impacts.

8.8 Assessment of each identified potentially significant impact and risk

8.8.1 Air Quality

As a result of the MFC operations, stationary emissions are likely to arise from the PSP, preheaters, and furnaces and dryers whilst fugitive emissions are likely to arise from material handling, wind erosion, crushing and paved and unpaved roads.

8.8.1.1 Overview of key pollutants and associated health effects

A description of the key pollutants of concern identified in this assessment, as well as the associated health effects are provided in Table 24.

Table 24: Key pollutants and associated health effects

Pollutant	Description	Health effects
Dust, PM_{10} and $PM_{2.5}$	Particulate matter comprises solid or liquid particles suspended in the air. These vary in size from particles that are only visible under an electron microscope to soot or smoke particles that are visible to the human eye. Ambient particulates contribute to deteriorations in visibility, as well as posing health risks since small particles (PM10) can penetrate deep into lungs, while even smaller particle sizes (PM2.5) 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, and in more extreme exposure cases, cancer and premature death (WHO, 2000; US EPA, 2011, as cited by (Reddy & Collet, 2023)).	Dust fallout is a nuisance and is unlikely to result in health effects. PM10 and PM2.5 area associated with: ■ Airway allergic inflammatory reactions & a wide range of respiratory problems. ■ Increase in medication usage related to asthma, nasal congestion and sinuses problems. ■ Adverse effects on the cardiovascular system.

Pollutant	Description	Health effects
NO_2	Formed though the oxidation of nitric oxide in the atmosphere, it is a primary pollutant emitted from the combustion of stationary point sources and from motor vehicles. It is toxic by inhalation. However, as the compound is acrid and easily detectable by smell at low concentrations, inhalation exposure can generally be avoided.	Effects on pulmonary function, especially in asthmatics Increase in airway allergic inflammatory reactions
SO_2	One of a group of highly reactive gasses known as “oxides of sulphur.” Anthropogenic sources include; fossil fuel combustion (particularly coal burning power plants) industrial processes such as wood pulping, paper manufacture, petroleum and metal refining, metal smelting (particularly from sulphide containing ores, e.g. lead, silver and zinc ores) and vehicle tailpipe emissions.	Reduction in lung function Respiratory symptoms (wheeze and cough)
Cr	Chromium (Cr) is a trace element critical to human health and well-being. In the last few decades, its contamination, especially hexavalent chromium [Cr(VI)] form in both terrestrial and aquatic ecosystems, has amplified as a result of various anthropogenic activities. Cr pollution is a significant environmental threat, severely impacting our environment and natural resources.	When inhaled, chromium compounds are respiratory tract irritants and can cause pulmonary sensitization. Chronic inhalation of Cr(VI) compounds increases the risk of lung, nasal, and sinus cancer. Severe dermatitis and usually painless skin ulcers can result from contact with Cr(VI) compounds (Agency for Toxic Substances and Disease Registry, 2013, as cited by (Reddy & Collet, 2023))

8.8.1.2 Atmospheric Dispersion modelling

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

As per the Regulations Regarding Air Dispersion Modelling (2014), the level of assessment is dependent on technical factors such as geophysical and meteorological context and the complexity of the emissions inventory. The temporal and spatial resolution and accuracy required from a model must also be taken into account. As such, this assessment is considered to be a Level 2 assessment (Reddy & Collet, 2023).

Level 2 assessments should be used for air quality impact assessment in standard/generic licence or amendment processes where:

- The distribution of pollutant concentrations and depositions are required in time and space;
- Pollutant dispersion can be reasonable treated by a straight-line, steady-state, Gaussian plume model with first order chemical transformation. Although more complicated processes may be occurring, a more complicated model that explicitly treats these processes may not be necessary depending on the purposes of the modelling and the zone of interest; and
- Emissions are from sources where the greatest impacts are in the order of a few kilometres (less than 50 km), downwind.

For this air quality assessment, the AERMOD dispersion modelling software was utilised. 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 latest National and International ambient air quality standards for compliance testing. AERMOD is the recommended level 2 model prescribed in the Regulations Regarding Air Dispersion Modelling (2014) (Reddy & Collet, 2023).

8.8.1.3 Modelling scenarios

Three modelling scenarios have been considered for this assessment:

1) Scenario 1: (Existing operations): All operations at MFC under the current existing conditions.
2) Scenario 2: (Cumulative operations - existing operations including the proposed production increase and new installations/PSP abatement): All operations at MFC for the existing operations and proposed changes in production of the M3 and M4 furnaces and PSP. Additionally, the new installations of the PSP abatement and M3 and M4 preheaters have been included.
3) Scenario 3: (Cumulative operations - Scenario 2 plus the M3 abatement upgrade change).

Various statistical outputs that have been generated, are described below:

- Short-term averages: Refers to the predicted 99th percentile (P99) 1-hour and 24-hour average outputs. The P99 is required as per the ambient air quality guidelines and makes allowance for exceedances, eliminating outliers.
- Annual average (long-term) outputs, which is calculated by averaging all hourly concentrations. The calculation is conducted for each grid point within the modelling domain.

It must be noted that, as defined in the Regulations Regarding Air Dispersion Modelling, 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 (Reddy & Collet, 2023).

8.8.1.4 Air Quality Modelling results

This section presents the results of the atmospheric dispersion modelling conducted for the proposed operations as a result of the upgraded furnace and associated infrastructure upgrades (Refer to APPENDIX E). Concentration results at specified sensitive receptors are presented in tabular format, while concentration isopleths are presented graphically to indicate the dispersion of pollutants.

Furthermore, 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 taking into account all local and regional contributions to background concentrations. For the different facility locations and averaging times, the comparisons with NAAQS must be based on recommendations in Table 25.

Table 25: Summary of recommended procedures for assessing compliance with NAAQS

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

*For an isolated facility influenced by regional background pollution C_B (background concentration) must be considered

** C_P is the predicted concentration

In order to assess the cumulative impacts, the existing and proposed operations were modelled together and are presented as Scenario 2 and Scenario 3. As such, the background concentrations were not added to the proposed operations, which is an alternative method to obtain the cumulative impacts. If this were to be added to Scenario 2 and Scenario 3, this would result in double accounting/over estimation of the emissions for Scenario 2 and Scenario 3.

8.8.1.4.1 Dust fallout

Predicted dust fallout rates associated with the existing and cumulative (existing and proposed) operating scenarios for the highest rate and at each discrete receptor are presented in Table 27. Figure 26 shows the plume isopleths for the predicted dust fallout rates for all scenarios at the operations.

- Offsite Concentrations:
  - The highest predicted offsite rates for all scenarios are below the residential and non-residential Dust Control Regulations standards.
- Receptor Concentrations:

Predicted dust fallout rates for all scenarios are below the residential and non-residential dust control regulation standards at all surrounding sensitive receptors.

Table 26: Dust fallout at specified sensitive receptors

No.	Sensitive Receptor	Residential Dust Fallout Standard (mg/m²/day)	Non-residential Dust Fallout Standard (mg/m²/day)	Scenario 1	Scenario 2	Scenario 3
				Existing Dust Fallout Rate (mg/m²/day)	Cumulative Dust Fallout Rate (mg/m²/day)	Cumulative Dust Fallout Rate (mg/m²/day)
1	4D Scan Hospital	600	1,200	5.70	6.02	6.02
2	Aerorand			6.83	7.79	7.79
3	Dennesig			5.23	5.37	5.37
4	Hoerskool Middelburg			10.66	11.29	11.29
5	Industria			34.19	39.68	39.68
6	Laerskool Dennesig			5.99	6.19	6.19
7	Malope Village			6.12	6.92	6.92
8	Mhluzi			6.53	6.75	6.75
9	Middelburg - MP			10.29	11.48	11.48
10	Middelburg Hospital			18.42	18.83	18.83
11	Middelburg Town Masjid			10.24	10.77	10.77
12	Middelburg-Midmed PVT Hospital			7.06	7.45	7.45
13	Mineralia			26.10	27.73	27.73
14	Mphanama Secondary School			8.37	8.71	8.71
15	Nazareth			26.78	30.31	30.31
16	Rockdale			12.61	14.16	14.16
17	Sozama Secondary School			6.86	7.21	7.21
Highest Offsite Rate				71.03	72.90	72.90

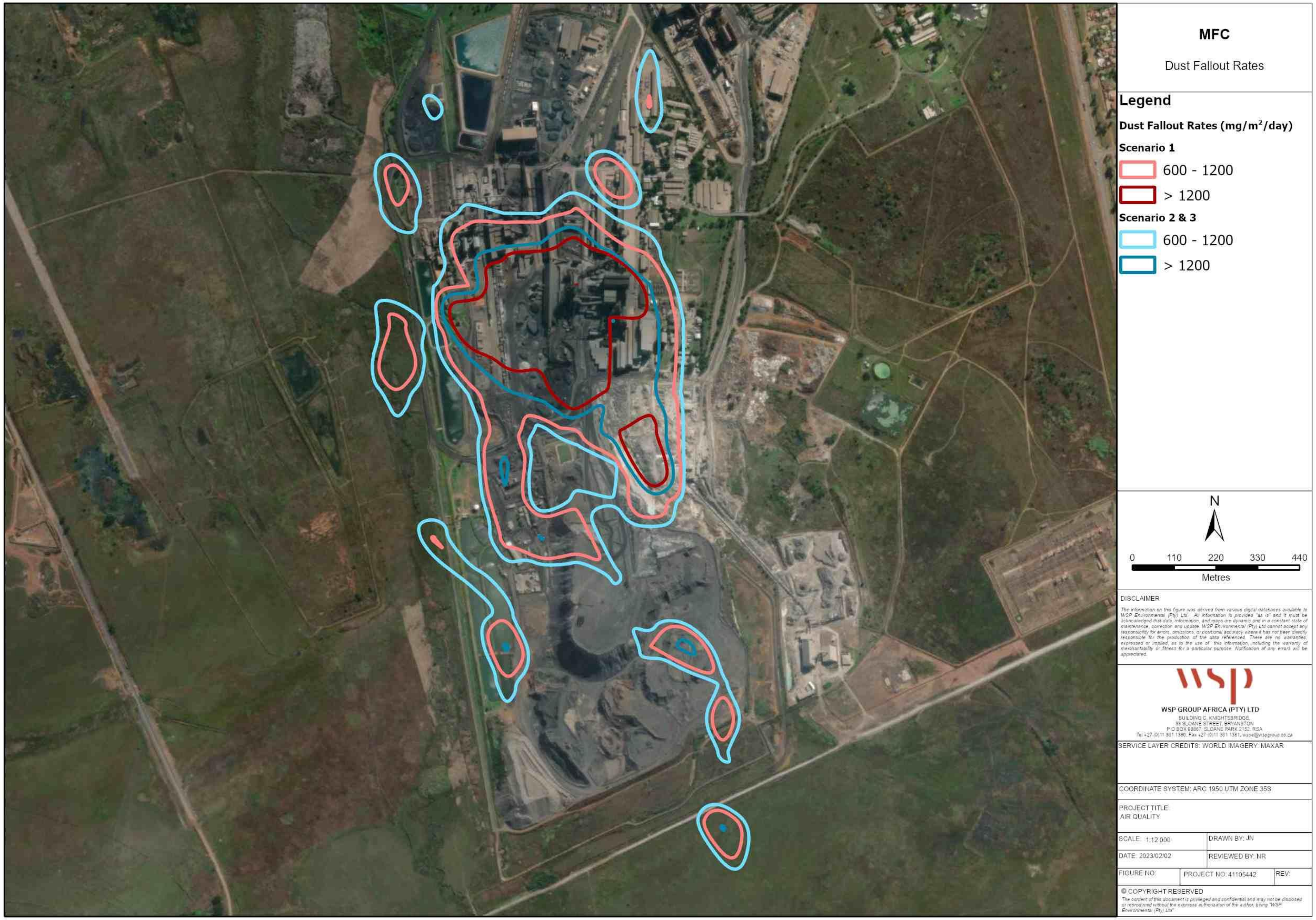


Figure 25: Predicted dust fallout rates at MFC (mg/m²/day)

8.8.1.4.2 PM_{10} concentrations

Predicted PM_{10} concentrations associated with the existing and cumulative (existing and proposed) operating scenarios for the highest offsite concentration and at each discrete receptor are presented in Table 27. Figure 26 and Figure 27 show the plume isopleths for the predicted P99 24-hour and annual average PM_{10} concentrations for all three scenarios at the operations.

- Offsite Concentrations:
  - The highest predicted offsite P99 24-hour average PM_{10} concentration from Scenario 1 is below the 24-hour average PM_{10} NAAQS of 75 µg/m^3.
  - The highest predicted offsite P99 24-hour average PM_{10} concentration from Scenario 2 and Scenario 3 are above the 24-hour average PM_{10} NAAQS. These exceedances occur approximately 65 m west and 58 m west, respectively of the facility. However, no receptors are located here.
  - The highest predicted offsite annual average PM_{10} concentrations from all scenarios are below the annual average PM_{10} NAAQS of 40 µg/m^3.
- Receptor Concentrations:
  - Predicted P99 24-hour and annual average PM_{10} concentrations for all scenarios are below their respective 24-hour and annual average PM_{10} NAAQS at all surrounding sensitive receptors.

Table 27: PM_{10} concentrations at specified sensitive receptors

No.	Sensitive Receptor	24-hour NAAQS (µg/m³)	Scenario 1	Scenario 2	Scenario 3	Annual NAAQS (µg/m³)	Scenario 1	Scenario 2	Scenario 3
			Existing P99 24-hour Average Concentration (µg/m³)	Cumulative P99 24-hour Average Concentration (µg/m³)	Cumulative P99 24-hour Average Concentration (µg/m³)		Existing Annual Average Concentration (µg/m³)	Cumulative Annual Average Concentration (µg/m³)	Cumulative Annual Average Concentration (µg/m³)
1	4D Scan Hospital	75	1.94	2.35	2.34	40	0.18	0.23	0.22
2	Aerorand		1.72	2.13	2.12		0.36	0.42	0.41
3	Dennesig		1.60	2.06	2.05		0.09	0.11	0.10
4	Hoerskool Middelburg		2.95	3.65	3.59		0.36	0.45	0.44
5	Industria		8.48	10.91	10.91		0.80	0.98	0.97
6	Laerskool Dennesig		1.66	2.15	2.14		0.09	0.11	0.11
7	Malope Village		1.42	1.49	1.42		0.28	0.30	0.29
8	Mhluzi		1.80	2.32	2.32		0.25	0.31	0.31
9	Middelburg - MP		3.28	3.92	3.92		0.37	0.45	0.45
10	Middelburg Hospital		3.29	4.07	4.03		0.57	0.70	0.69
11	Middelburg Town Masjid		2.74	3.39	3.38		0.29	0.36	0.35
12	Middelburg-Midmed PVT Hospital		2.40	3.01	2.99		0.25	0.31	0.31
13	Mineralia		8.10	10.53	10.53		1.97	2.41	2.38
14	Mphanama Secondary School		1.90	2.42	2.42		0.22	0.27	0.26
15	Nazareth		5.07	6.46	6.38		0.70	0.84	0.82
16	Rockdale		2.14	2.41	2.00		0.35	0.41	0.35
17	Sozama Secondary School		2.10	2.61	2.60		0.25	0.30	0.30
Highest Offsite Concentration			65.78	**85.73**	**85.70**		25.43	33.25	33.16

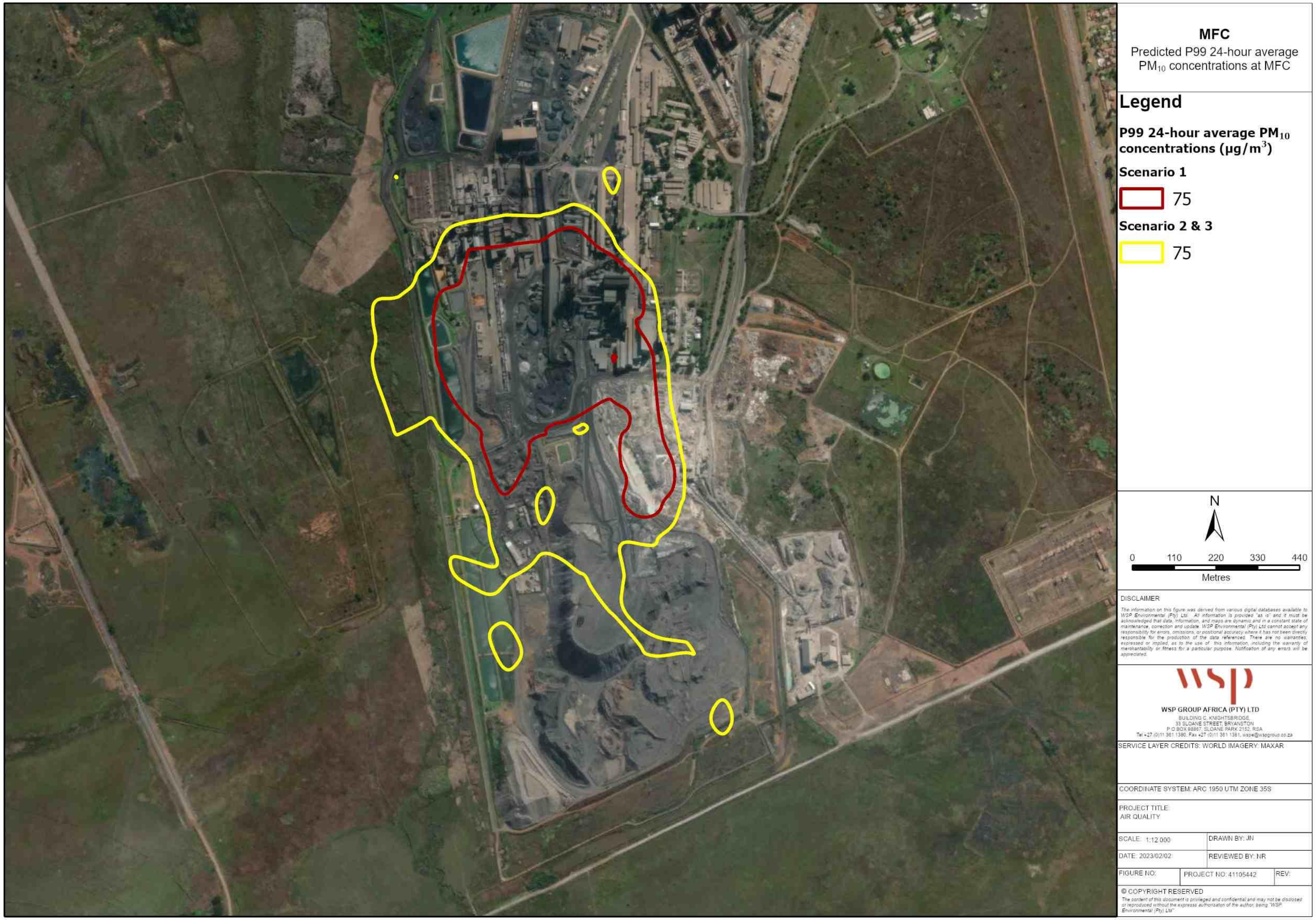


Figure 26: **Predicted P99 24-hour average PM$_{10}$ concentrations at MFC (µg/m^3)**

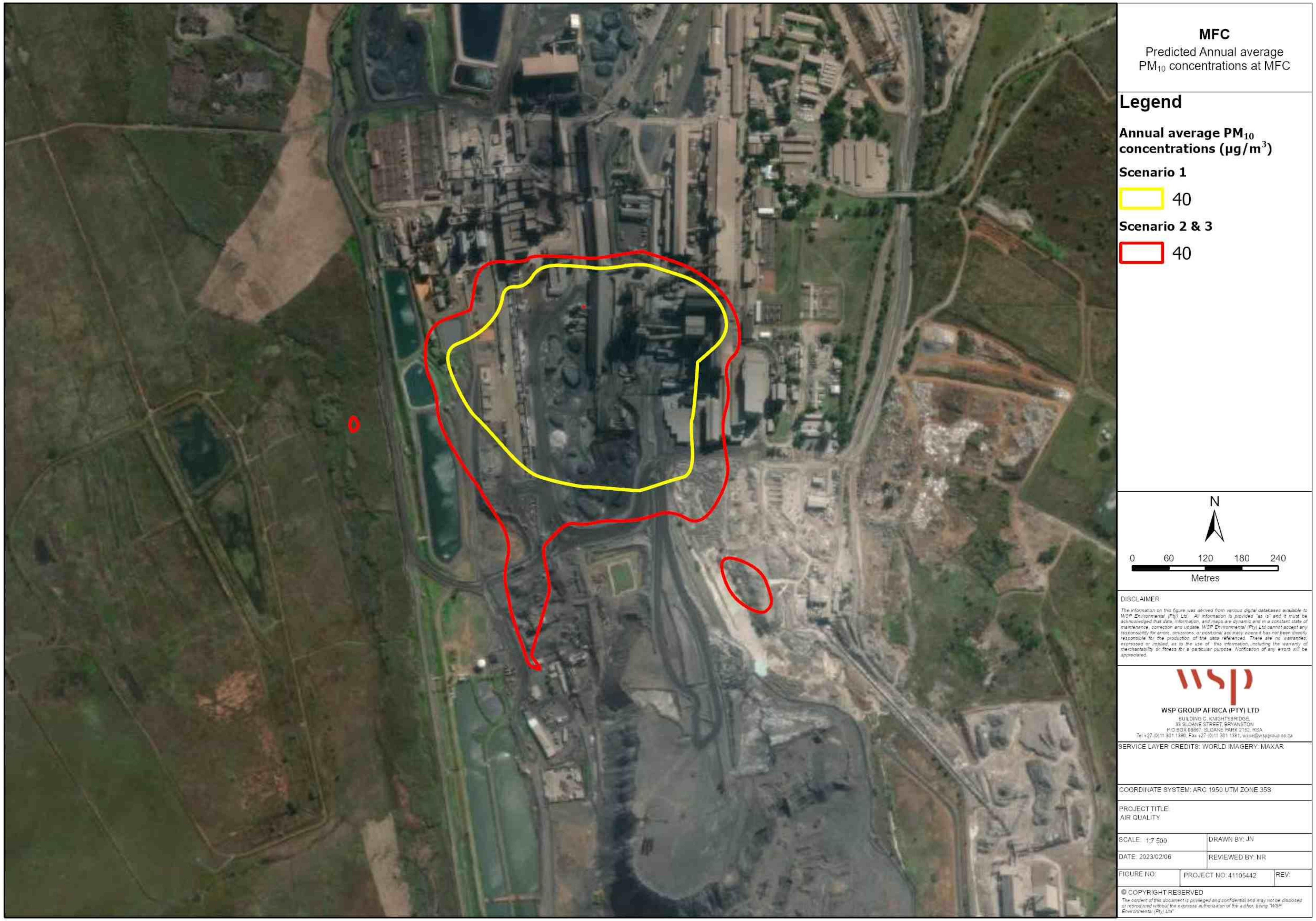


Figure 27: **Predicted annual average PM_{10} concentrations at MFC (µg/m^3)**

8.8.1.4.3 $PM_{2.5}$ concentrations

Predicted $PM_{2.5}$ concentrations associated with the existing and cumulative (existing and proposed) operating scenarios for the highest offsite concentration and at each discrete receptor are presented in Table 28. Figure 28 and Figure 29 shows the plume isopleths for the predicted P99 24-hour and annual average $PM_{2.5}$ concentrations for all three scenarios at the operations.

- Offsite Concentrations:
  - The highest predicted offsite P99 24-hour and annual average $PM_{2.5}$ concentrations from all scenarios are below the 24-hour and annual average $PM_{2.5}$ NAAQS of 40 µg/m^3 and 20 µg/m^3, respectively.
- Receptor Concentrations:
  - Predicted P99 24-hour and annual average $PM_{2.5}$ concentrations for all scenarios are below their respective 24-hour and annual average $PM_{2.5}$ NAAQS at all surrounding sensitive receptors.

Table 28: $PM_{2.5}$ concentrations at specified sensitive receptors

No.	Sensitive Receptor	24-hour NAAQS (µg/m³)	Scenario 1 Existing P99 24-hour Average Concentration (µg/m³)	Scenario 2 Cumulative P99 24-hour Average Concentration (µg/m³)	Scenario 3 Cumulative P99 24-hour Average Concentration (µg/m³)	Annual NAAQS (µg/m³)	Scenario 1 Existing Annual Average Concentration (µg/m³)	Scenario 2 Cumulative Annual Average Concentration (µg/m³)	Scenario 3 Cumulative Annual Average Concentration (µg/m³)
1	4D Scan Hospital	40	0.46	0.48	0.46	20	0.05	0.06	0.05
2	Aerorand		0.71	0.71	0.64		0.15	0.16	0.14
3	Dennesig		0.34	0.38	0.36		0.03	0.03	0.03
4	Hoerskool Middelburg		0.69	0.79	0.78		0.09	0.10	0.10
5	Industria		1.59	1.87	1.84		0.19	0.20	0.19
6	Laerskool Dennesig		0.34	0.40	0.39		0.03	0.03	0.03
7	Malope Village		0.81	0.60	0.54		0.13	0.11	0.10
8	Mhluzi		0.51	0.59	0.57		0.07	0.08	0.08
9	Middelburg - MP		0.70	0.85	0.82		0.09	0.10	0.10
10	Middelburg Hospital		0.88	0.93	0.85		0.15	0.16	0.16
11	Middelburg Town Masjid		0.64	0.76	0.74		0.07	0.08	0.08
12	Middelburg-Midmed PVT Hospital		0.53	0.65	0.62		0.07	0.08	0.07
13	Mineralia		2.18	2.38	2.15		0.55	0.61	0.57
14	Mphanama Secondary School		0.46	0.52	0.49		0.06	0.07	0.07
15	Nazareth		1.40	1.71	1.66		0.24	0.24	0.23
16	Rockdale		1.55	1.44	0.94		0.21	0.23	0.17
17	Sozama Secondary School		0.50	0.57	0.57		0.07	0.08	0.07
Highest Offsite Concentration			14.16	18.10	18.10		4.66	6.74	6.65

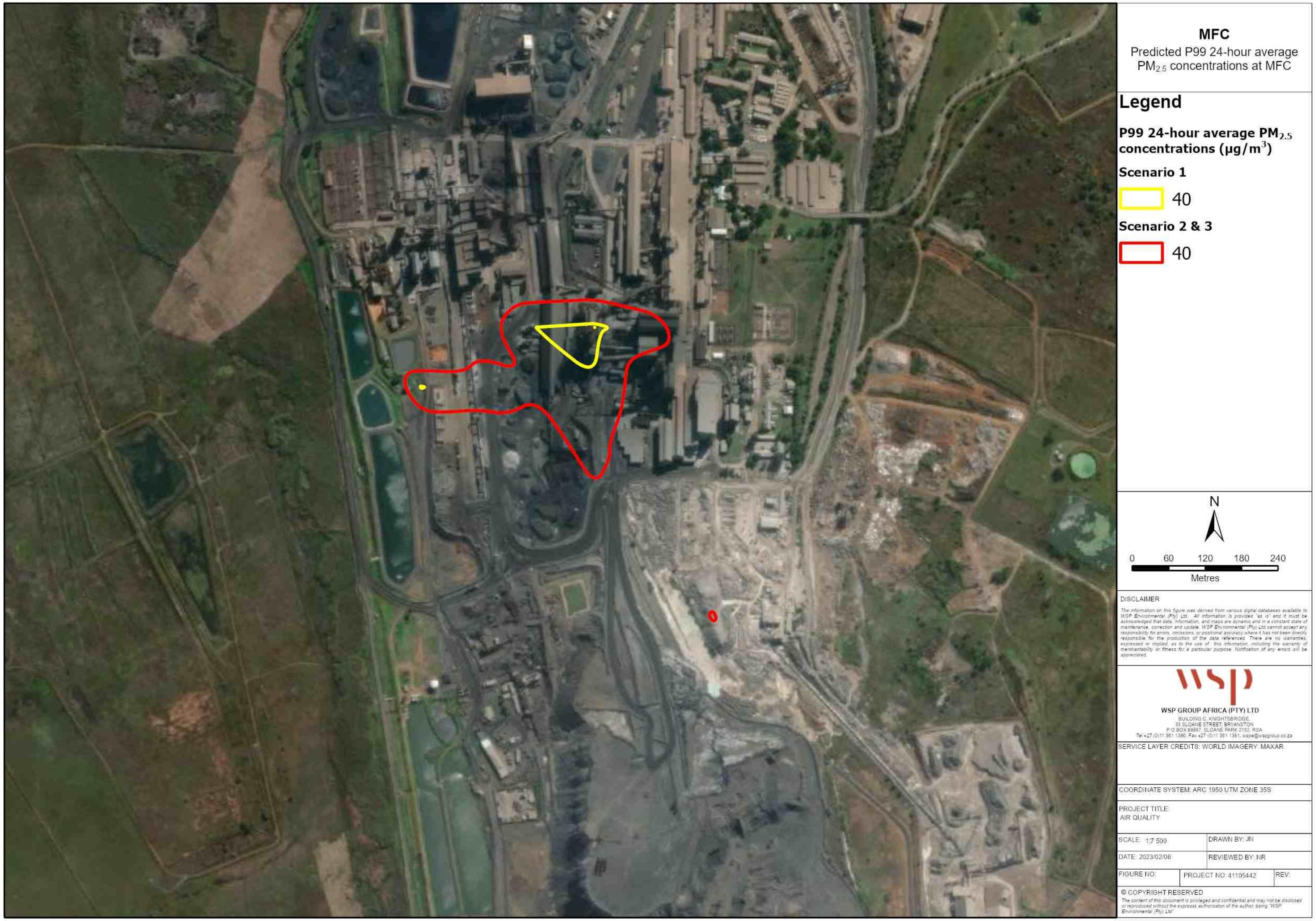


Figure 28: **Predicted P99 24-hour average $PM_{2.5}$ concentrations at MFC (µg/m³)**

Figure 29: **Predicted annual average $PM_{2.5}$ concentrations at MFC ($\mu g/m^3$)**

8.8.1.4.4 NO_2 concentrations

Predicted NO_2 concentrations associated with the existing and cumulative (existing and proposed) operating scenarios for the highest offsite concentration and at each discrete receptor are presented in Table 29. Figure 30 and Figure 31 shows the plume isopleths for the predicted P99 1-hour and annual average NO_2 concentrations for all scenarios at the operations.

- Offsite Concentrations:
  - The highest predicted offsite P99 1-hour average NO_2 concentration from all scenarios are below the 1-hour average NO_2 NAAQS of 200 µg/m^3.
  - The highest predicted offsite annual average NO_2 concentrations from all scenarios are below the annual average NO_2 NAAQS of 40 µg/m^3.
- Receptor Concentrations:
  - Predicted P99 1-hour and annual average NO_2 concentrations for all scenarios are below their respective 1-hour and annual average NO_2 NAAQS at all surrounding sensitive receptors.

Table 29: NO_2 concentrations at specified sensitive receptors

No.	Sensitive Receptor	1-hour NAAQS (µg/m³)	Scenario 1 Existing P99 1-hour Average Concentration (µg/m³)	Scenario 2 Cumulative P99 1-hour Average Concentration (µg/m³)	Scenario 3 Cumulative P99 1-hour Average Concentration (µg/m³)	Annual NAAQS (µg/m³)	Scenario 1 Existing Annual Average Concentration (µg/m³)	Scenario 2 Cumulative Annual Average Concentration (µg/m³)	Scenario 3 Cumulative Annual Average Concentration (µg/m³)
1	4D Scan Hospital	200	3.60	9.39	7.68	40	0.12	0.37	0.31
2	Aerorand		11.81	42.35	34.79		0.51	1.65	1.35
3	Dennesig		2.32	6.20	5.47		0.08	0.28	0.24
4	Hoerskool Middelburg		5.30	15.03	12.10		0.19	0.59	0.48
5	Industria		8.34	25.88	21.85		0.35	1.12	0.94
6	Laerskool Dennesig		2.45	6.13	5.66		0.08	0.28	0.24
7	Malope Village		11.94	31.75	23.70		0.48	1.22	0.93
8	Mhluzi		5.09	15.12	11.91		0.18	0.54	0.44
9	Middelburg - MP		5.20	13.91	11.19		0.19	0.58	0.48
10	Middelburg Hospital		8.07	26.25	20.40		0.32	0.92	0.75
11	Middelburg Town Masjid		4.74	11.80	9.44		0.16	0.50	0.41
12	Middelburg-Midmed PVT Hospital		4.36	11.04	8.50		0.15	0.46	0.38
13	Mineralia		22.75	83.43	67.86		1.33	3.82	3.06
14	Mphanama Secondary School		4.36	11.90	9.25		0.15	0.45	0.37
15	Nazareth		10.98	43.48	36.34		0.63	2.29	1.95
16	Rockdale		32.47	76.26	50.30		1.41	4.00	2.73
17	Sozama Secondary School		4.73	13.48	10.70		0.16	0.49	0.40
Highest Offsite Concentration			32.81	168.16	134.92		3.03	9.66	7.80

Figure 30: **Predicted P99 1-hour average NO_2 concentrations at MFC (µg/m^3)**

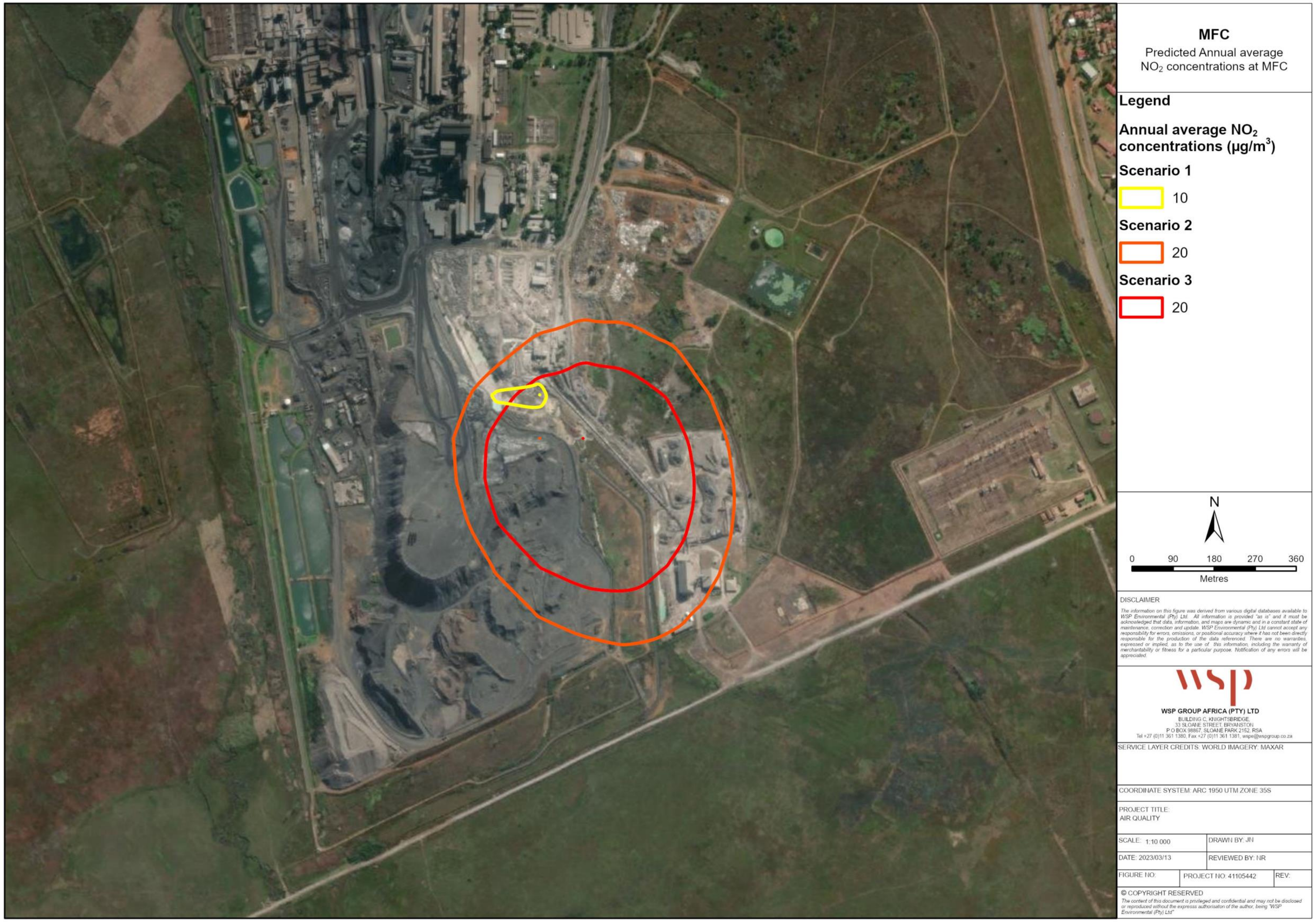


Figure 31: **Predicted annual average NO_2 concentrations at MFC (µg/m^3)**

SO_2 concentrations

Predicted SO_2 concentrations associated with the existing and cumulative (existing and proposed) operating scenarios for the highest offsite concentration and at each discrete receptor are presented in Table 30. Figure 32 to Figure 34 shows the plume isopleths for the predicted P99 1-hour, P99 24-hour and annual average SO_2 concentrations for all scenarios at the operations.

- Offsite Concentrations:
  - The highest predicted offsite P99 1-hour, P99 24-hour and annual average SO_2 concentrations for all scenarios are below the 1-hour, 24-hour and annual average SO_2 NAAQS of 350 µg/m3, 125 µg/m^3 and 50 µg/m^3, respectively.
- Receptor Concentrations:
  - Predicted P99 1-hour, P99 24-hour and annual average SO_2 concentrations for all scenarios are below their respective 1-hour, 24-hour and annual average SO_2 NAAQS at all surrounding sensitive receptors.

Table 30: SO_2 concentrations at specified sensitive receptors

No.	Sensitive Receptor	1-hour NAAQS (µg/m³)	Scenario 1 Existing 1-hour Average Concentration (µg/m³)	Scenario 2 Cumulative 1-hour Average Concentration (µg/m³)	Scenario 3 Cumulative 1-hour Average Concentration (µg/m³)	24-hour NAAQS (µg/m³)	Scenario 1 Existing 24-hour Average Concentration (µg/m³)	Scenario 2 Cumulative 24-hour Average Concentration (µg/m³)	Scenario 3 Cumulative 24-hour Average Concentration (µg/m³)	Annual NAAQS (µg/m³)	Scenario 1 Existing Annual Average Concentration (µg/m³)	Scenario 2 Cumulative Annual Average Concentration (µg/m³)	Scenario 3 Cumulative Annual Average Concentration (µg/m³)
1	4D Scan Hospital	350	0.59	1.94	1.89	125	0.33	0.82	0.81	50	0.03	0.07	0.07
2	Aerorand		3.15	8.72	8.49		0.86	2.43	2.38		0.11	0.32	0.32
3	Dennesig		0.41	1.34	1.32		0.26	0.66	0.64		0.02	0.06	0.06
4	Hoerskool Middelburg		1.06	3.05	2.99		0.53	1.29	1.26		0.04	0.11	0.11
5	Industria		2.39	5.50	5.38		0.88	2.04	2.02		0.10	0.23	0.22
6	Laerskool Dennesig		0.43	1.31	1.28		0.25	0.64	0.63		0.02	0.06	0.06
7	Malope Village		3.18	6.08	5.84		0.93	2.12	2.09		0.12	0.23	0.22
8	Mhluzi		1.00	3.03	2.94		0.47	1.24	1.23		0.04	0.10	0.10
9	Middelburg - MP		0.91	2.82	2.72		0.44	1.13	1.11		0.04	0.11	0.11
10	Middelburg Hospital		2.02	5.16	4.98		0.82	1.94	1.90		0.07	0.17	0.17
11	Middelburg Town Masjid		0.82	2.38	2.31		0.41	1.04	1.02		0.03	0.10	0.09
12	Middelburg-Midmed PVT Hospital		0.69	2.15	2.11		0.34	0.92	0.91		0.03	0.09	0.09
13	Mineralia		7.35	17.07	16.73		2.66	6.44	6.29		0.29	0.72	0.70
14	Mphanama Secondary School		0.78	2.33	2.28		0.36	0.97	0.95		0.03	0.08	0.08
15	Nazareth		3.06	9.18	9.01		0.99	3.11	3.06		0.19	0.48	0.47
16	Rockdale		5.16	12.96	12.49		2.06	4.30	3.90		0.25	0.71	0.68
17	Sozama Secondary School		0.92	2.69	2.61		0.41	1.04	1.03		0.03	0.09	0.09
Highest Offsite Concentration			11.76	33.73	32.91		5.12	12.73	12.46		0.59	1.77	1.72

Figure 32: **Predicted P99 1-hour average SO_2 concentrations at MFC (μg/m³)**

Figure 33: **Predicted P99 24-hour average SO_2 concentrations at MFC (µg/m^3)**

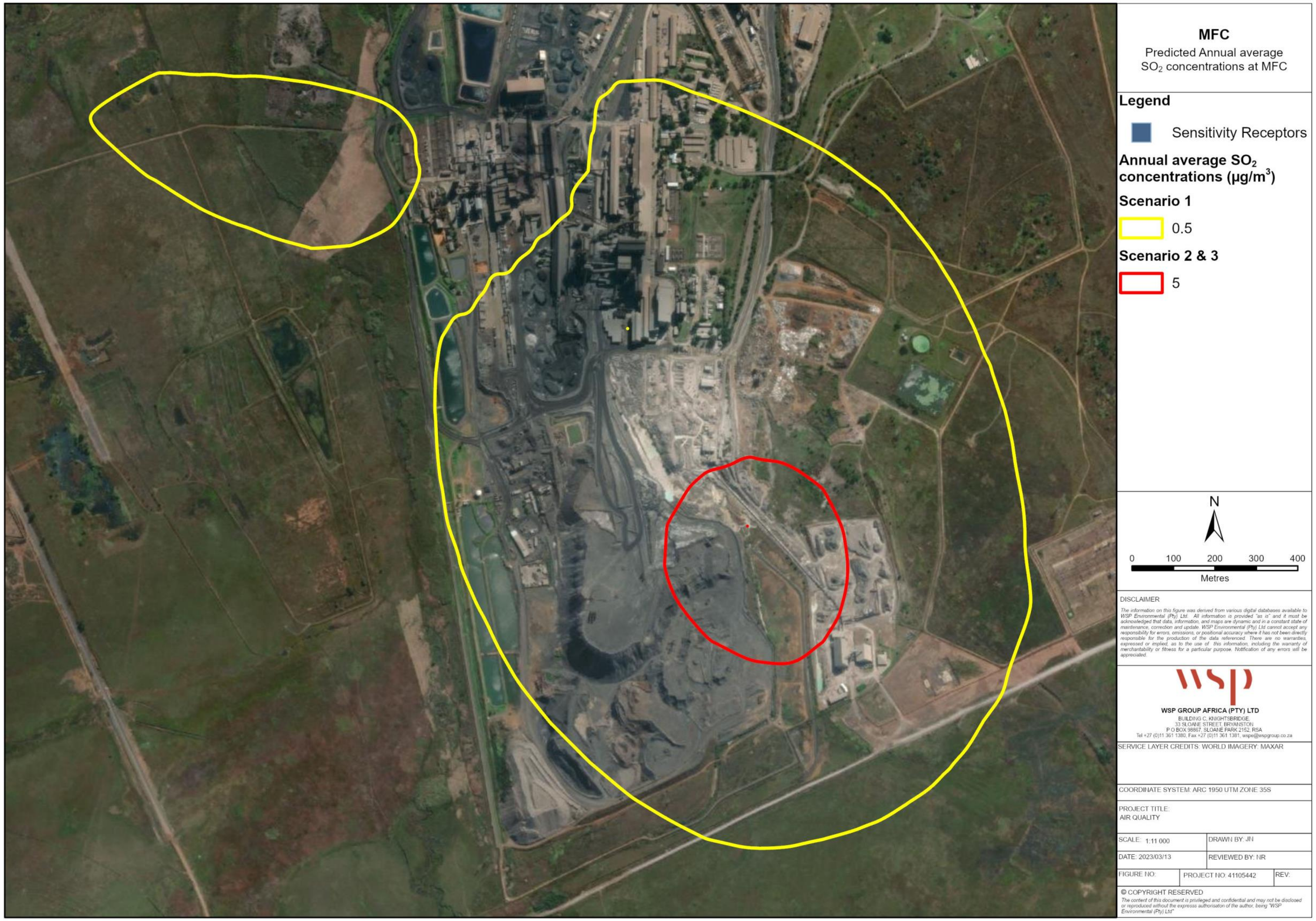


Figure 34: **Predicted annual average SO_2 concentrations at MFC ($\mu g/m^3$)**

Cr concentrations

Predicted Cr concentrations associated with the existing and cumulative (existing and proposed) operating scenarios for the highest offsite concentration and at each discrete receptor are presented in Table 31. Figure 35 shows the plume isopleths for the predicted annual average Cr concentrations for all scenarios at the operations.

- Offsite Concentrations:
  - The highest predicted offsite annual average Cr concentrations for all scenarios are minimal, below the relevant averaging period guidelines.
- Receptor Concentrations:
  - Predicted annual average Cr concentrations for all scenarios are minimal at all surrounding sensitive receptors, below the relevant averaging period guidelines.

Table 31: Cr concentrations at specified sensitive receptors

No.	Sensitive Receptor	Scenario 1	Scenario 2	Scenario 3
		Existing Annual Average Concentration (µg/m^3)	Cumulative Annual Average Concentration (µg/m^3)	Cumulative Annual Average Concentration (µg/m^3)
1	4D Scan Hospital	2.00E-05	3.00E-05	3.00E-05
2	Aerorand	1.10E-04	1.30E-04	1.30E-04
3	Dennesig	2.00E-05	2.00E-05	2.00E-05
4	Hoerskool Middelburg	3.00E-05	4.00E-05	4.00E-05
5	Industria	6.00E-05	8.00E-05	8.00E-05
6	Laerskool Dennesig	2.00E-05	2.00E-05	2.00E-05
7	Malope Village	1.10E-04	1.30E-04	1.30E-04
8	Mhluzi	3.00E-05	4.00E-05	4.00E-05
9	Middelburg - MP	3.00E-05	4.00E-05	4.00E-05
10	Middelburg Hospital	5.00E-05	6.00E-05	6.00E-05
11	Middelburg Town Masjid	3.00E-05	3.00E-05	3.00E-05
12	Middelburg-Midmed PVT Hospital	3.00E-05	3.00E-05	3.00E-05
13	Mineralia	2.50E-04	3.00E-04	3.00E-04
14	Mphanama Secondary School	3.00E-05	3.00E-05	3.00E-05
15	Nazareth	1.10E-04	1.30E-04	1.30E-04
16	Rockdale	3.10E-04	3.80E-04	3.80E-04
17	Sozama Secondary School	3.00E-05	3.00E-05	3.00E-05
Highest Offsite Concentration		5.50E-04	4.40E-04	4.40E-04

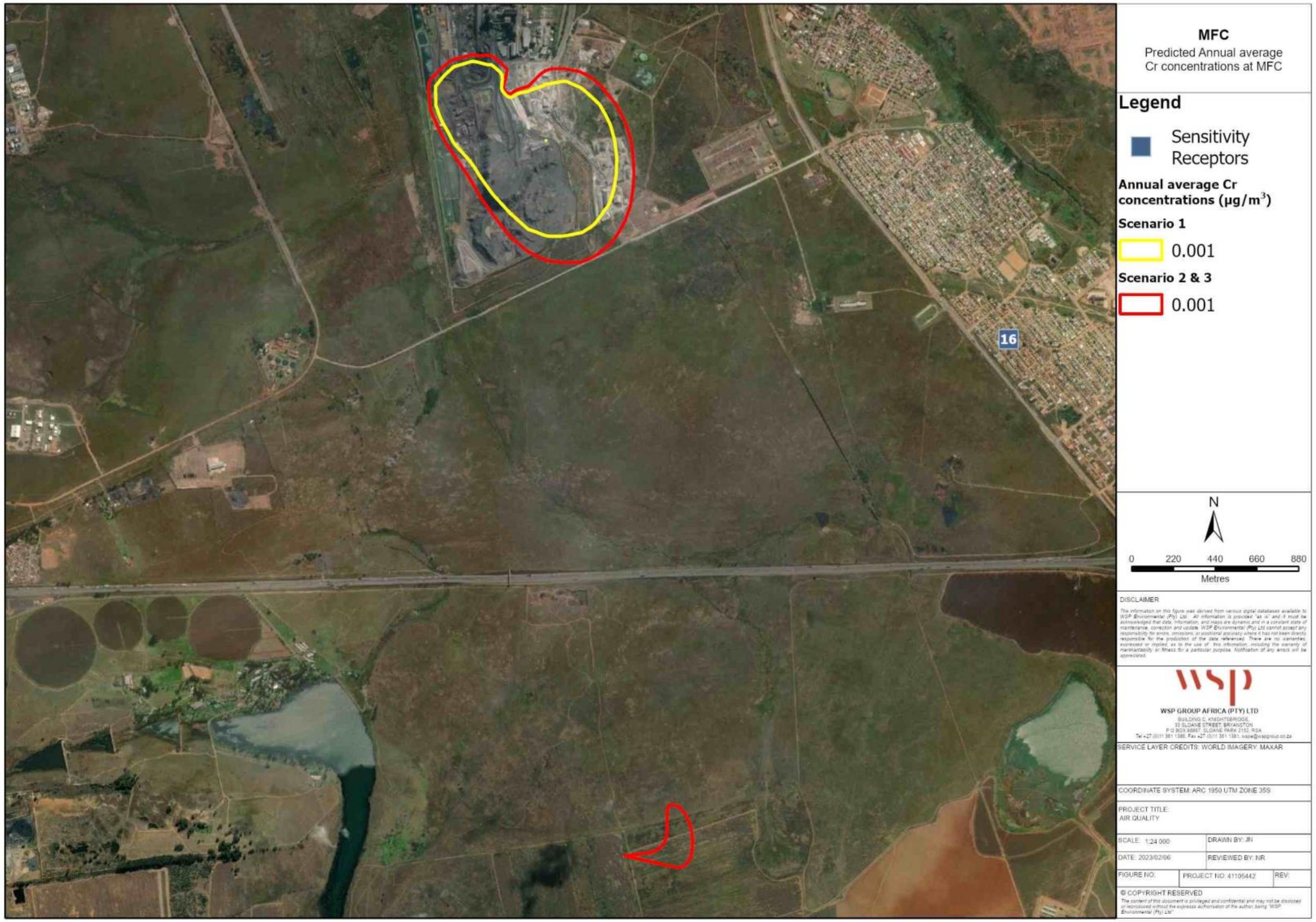


Figure 35: **Predicted annual average Cr concentrations at MFC (µg/m³)**

8.8.1.5 Summary of Environmental Impacts

Table 32: Summary of potential impacts on Air Quality

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
Construction Phase														
1.1	Impact on surrounding sensitive receptors due to increased dust and particulate matter as a result of upgrade activities.	6	2	2	3	**30**	**Moderate**	Apply wet suppression and road surface sweepers, where applicable.	4	2	1	2	**14**	**Low**
Operational Phase														
1.2	Cumulative impact on air quality as a result of the existing MFC operations, including the proposed production increase and new installations, plus the M3 abatement upgrade change.	6	3	3	3	**36**	**Moderate**	**Wind Erosion and Exposed Areas** Wind-blown dust can be minimised with the use of wet suppression and road sweepers, which have an estimated control efficiency of 50%. While wind-blown dust may not be a significant contributor to overall dust emissions, wind erosion can substantially increase dust entrainment at any site. It is understood that MFC, however, use both these measures on site and as such, ensure adequate mitigation from wind-blown dust. **Stockpiles** Dust emissions from stockpiles can occur during the loading of the piles, when wind disturbs the stockpile surface, and during reclamation (USEPA, 2006a). The following mitigation techniques are suggested to reduce wind erosion from stockpiles: Shape stockpiles, taking into consideration width to height ratio, nature of stockpiled	2	3	2	2	**14**	**Low**

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
								material, location, access and available area for the stockpile. Limit stockpile heights based on their stability, manageability, dust and amenity impacts. Store raw materials with high fines content in semi-enclosed bunkers, where possible. Investigate options for dust extraction at enclosed bunkers. More gentle slopes for unstable soils are recommended. Avoid building steep sided stockpiles that have sharp changes in shape. **Truck Loading and Unloading** Truck loading and unloading activities are also likely to contribute significantly to the amount of dust generated from materials handling activities. Loading and offloading activities are fairly difficult to mitigate, although the following techniques can be employed to assist with dust suppression (Katestonnee, 2011, as cited by (Reddy & Collet, 2023)): - Avoid double handling of material where possible. - Minimising the drop height of the material from truck loads. - Using road sweepers loading and unloading activities occur. **Crushing** Mitigation methods in these areas that can be implemented to reduce dust emissions include: - Tasking a team to be responsible for the removal of all deposited dust from machinery and enclosures within the						

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
								crushing plant and tip areas, resulting in less deposited dust available for wind entrainment. - Deploy a dust sweeper to the plant, capable of collecting all deposited fines, reducing the amount of dust available for wind entrainment. **Unpaved Roads** To adequately mitigate emissions of dust associated with unpaved roads, the following key recommendations are suggested: Application of water (potential of reducing emissions by 75% (COACOA, 2012), as cited by (Reddy & Collet, 2023)) as a dust suppressant to all haul roads and other roads experiencing high traffic volumes. If the costs associated with water application are high, and water is scarce, etc (i.e. many disadvantages of water are posed) then consider a dust-a-side or similar chemical suppressant, which has the potential of reducing dust emissions by approximately 99%. Implement vehicle speed and access restrictions within the site (approximately 30 km/h). Prevention of material deposition onto haul roads through avoiding the overloading of truck loads resulting in spillages on the roads; preventing wind erosion from adjacent open areas; and ensure adequate storm water drainage to prevent water erosion of the roads. Prioritising source reduction measures through the use of the most direct travel routes						

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
								on site and using larger capacity trucks to minimise the number of trips. Water bowser routes should align with the daily/weekly site plan schedule and a maintenance programme should be in place to ensure continuous availability of the water bowsers. **Paved Roads** To adequately mitigate emissions of dust associated with paved roads at the facility, the following key recommendations are suggested: - Ensure road sweeping is implemented. Implement vehicle speed and access restrictions within the site (approximately 30 km/h). - Prevention of material deposition onto haul roads through avoiding the overloading of truck loads resulting in spillages on the roads; preventing wind erosion from adjacent open areas; and ensure adequate storm water drainage to prevent water erosion of the roads. - Prioritising source reduction measures through the use of the most direct travel routes on site and using larger capacity trucks to minimise the number of trips. **Stacks** The following measures would assist in reducing impacts from NO_2 (Since concentrations from SO_2 and Cr are considered to be minimal, no additional measures are suggested):						

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
								- Maintain and service all furnaces, preheaters and PSP stacks regularly to ensure that emissions are kept to a minimum. - Investigate use of alternative fuels (cleaner fuels) supplied to the preheaters to assist in reducing NO_2 emissions. - Ensure on-going stack testing as per AEL conditions to monitor NOx emissions. - Given that the impacts of $PM_{2.5}$ and SO_2 are negligible, no further mitigation methods (other than the ones already implemented) are deemed necessary to reduce emissions from these pollutants.						
Decommissioning Phase														
1.3	Impact on surrounding sensitive receptors due to increased dust and particulate matter during demolition / removal of upgraded equipment.	6	2	2	3	**30**	**Moderate**	Apply wet suppression and road sweeping, where applicable.	4	2	1	2	**14**	**Low**

8.8.2 Groundwater

The construction (upgrade), operational and decommissioning phases will likely have a **low** to negligible impact on groundwater as the project areas are located within the existing MFC site. The project areas are in existing operational areas that are covered in hard standing, therefore minimising the potential for contamination of the groundwater.

8.8.2.1 Summary of Environmental Impacts

Table 33: Summary of potential impacts on Groundwater

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
Construction Phase														
2.1	A change in groundwater quality.	2	1	1	1	**4**	**Low**	No noticeable impact change expected during the construction phase, no mitigation required during construction phase. Groundwater monitoring (water levels and quality) should be used to confirm that the groundwater quality remains unchanged.	2	1	1	1	**4**	**Low**
2.2	A change in the volume or recharge of groundwater / change in water level.	2	1	1	1	**4**	**Low**		2	1	1	1	**4**	**Low**
2.3	Possible change in groundwater flow regime.	2	1	0	0	**3**	**Low**		2	1	0	0	**3**	**Low**
Operational Phase														
2.4	A change in groundwater quality.	2	1	1	1	**4**	**Low**	No noticeable impact change expected during the operational phase, no mitigation required during operational phase. Groundwater monitoring (water levels and quality) should be used to confirm that the groundwater quality remains unchanged.	2	1	1	1	**4**	**Low**
2.5	A change in the volume or recharge of groundwater / change in water level.	2	1	1	1	**4**	**Low**		2	1	1	1	**4**	**Low**
2.6	Possible change in groundwater flow regime.	2	1	0	0	**3**	**Low**		2	1	0	0	**3**	**Low**

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
Decommissioning Phase														
2.7	Spillage of hazardous substances during the dismantling of upgraded equipment which were in contact with hazardous substances may contaminate soils and groundwater.	2	1	1	1	**4**	**Low**	No noticeable impact change expected during the decommissioning phase, no mitigation required during decommissioning phase. Groundwater monitoring (water levels and quality) should be used to confirm that the groundwater quality remains unchanged.	2	1	1	1	**4**	**Low**

8.8.3 Surface Water

A seep wetland system is present on the western side of the MFC site and a channelled valley-bottom wetland towards the south (Figure 23). However, the construction (upgrade), operational and decommissioning phases will likely have a **low** to negligible impact on surface as the project areas are located within the existing MFC site. The project areas are in existing operational areas with existing surface water management structures that divert contaminated water to existing containment facilities.

8.8.3.1 Summary of Environmental Impacts

Table 34: Summary of potential impacts on Surface Water

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
Construction Phase														
3.1	Contamination of soils and downstream water resources by chemical pollutants.	4	1	1	2	**12**	**Low**	Contaminated water as a result of the construction, operation or decommissioning and demolition phases must be managed in accordance with the existing water management procedures and infrastructure at the MFC site to prevent any contaminated water from leaving the site. All pollution control mechanisms are to be in accordance with the conditions of the site's WUL. Continue the surface water monitoring programme.	2	1	1	1	**4**	**Low**
Operational Phase														

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
3.2	Contamination of soils and downstream water resources by chemical pollutants.	4	1	1	2	**12**	**Low**	Contaminated water as a result of the construction, operation or decommissioning and demolition phases must be managed in accordance with the existing water management procedures and infrastructure at the MFC site to prevent any contaminated water from leaving the site. All pollution control mechanisms are to be in accordance with the conditions of the site's WUL. Continue the surface water monitoring programme.	2	1	1	1	**4**	**Low**
Decommissioning Phase														
3.3	Spillage of hazardous substances during the dismantling of upgraded equipment which were in contact with hazardous substances may contaminate soils and surface water resources.	4	1	1	2	**12**	**Low**	Contaminated water as a result of the construction, operation or decommissioning and demolition phases must be managed in accordance with the existing water management procedures and infrastructure at the MFC site to prevent any contaminated water from leaving the site.	2	1	1	1	**4**	**Low**

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
								All pollution control mechanisms are to be in accordance with the conditions of the site's WUL. Continue the surface water monitoring programme.						

8.8.4 Soil, Land Use and Land Capability

The construction (upgrade), operational and decommissioning phases will likely have a **low** to negligible impact on soils, land use and land capability as the project areas are located within the existing MFC site. The project areas are in existing operational areas that covered in hard standing, therefore minimising the potential for contamination of soils or impacting on land use or land capability.

8.8.4.1 Summary of Environmental Impacts

Table 35: Summary of potential impacts on Soils, Land Use and Land Capability

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
Construction Phase														
4.1	Impact on soils due to potential spillage of hazardous substances, incorrect waste handling and storage or storm water contamination.	4	1	1	2	**12**	**Low**	All vehicles and machinery must be kept in good working order and inspected on a regular basis for possible leaks and shall be repaired as soon as possible if required. Repairs shall be carried out in a dedicated repair area only, unless in-situ repair is necessary as a result of a breakdown. Drip trays shall at all times be placed under vehicles that require in-situ repairs. Drip trays shall be emptied into designated containers only and should be send to an approved oil recycler.	2	1	1	1	**4**	**Low**

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE					
		Before mitigation							After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
								Ensure proper handling of hazardous chemicals and materials (e.g., fuel, oil, cement, concrete, reagents, etc.) as per their corresponding Safety Data Sheets (SDS) and the MFC spill response procedures. Accidental spills (concrete, chemicals, process water, hydrocarbons, waste) need to be reported immediately so that effective remediation and clean-up strategies and procedures can be implemented. Soil that is contaminated by fuel, chemical or oil spills, for example, from vehicles, or waste spillage will either be collected to be treated at a pre-determined and dedicated location, or will be cleaned up and treated in situ, using sand, soil or a suitable absorption medium. Ensure all general rubble, fugitive waste and hazardous waste is stored and removed in accordance with the site's Waste Management Plan. Ensure that spill kits are available at dedicated areas and that clean up procedures are followed at all times.						
Operational Phase														

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
4.2	Impact on soils due to potential spillage of hazardous substances, incorrect waste handling and storage or storm water contamination.	4	1	1	2	**12**	**Low**	All vehicles and machinery must be kept in good working order and inspected on a regular basis for possible leaks and shall be repaired as soon as possible if required. Repairs shall be carried out in a dedicated repair area only, unless in-situ repair is necessary as a result of a breakdown. Drip trays shall at all times be placed under vehicles that require in-situ repairs. Drip trays shall be emptied into designated containers only and should be send to an approved oil recycler.	2	1	1	1	**4**	**Low**

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
								Ensure proper handling of hazardous chemicals and materials (e.g., fuel, oil, cement, concrete, reagents, etc.) as per their corresponding Safety Data Sheets (SDS) and the MFC spill response procedures. Accidental spills (concrete, chemicals, process water, hydrocarbons, waste) need to be reported immediately so that effective remediation and clean-up strategies and procedures can be implemented. Soil that is contaminated by fuel, chemical or oil spills, for example, from vehicles, or waste spillage will either be collected to be treated at a pre-determined and dedicated location, or will be cleaned up and treated in situ, using sand, soil or a suitable absorption medium. Ensure all general rubble, fugitive waste and hazardous waste is stored and removed in accordance with the site's Waste Management Plan. Ensure that spill kits are available at dedicated areas and that clean up procedures are followed at all times.						

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
Decommissioning Phase														
4.3	Impact on soils due to potential spillage of hazardous substances, incorrect waste handling and storage or storm water contamination.	4	1	1	2	**12**	**Low**	All vehicles and machinery must be kept in good working order and inspected on a regular basis for possible leaks and shall be repaired as soon as possible if required. Repairs shall be carried out in a dedicated repair area only, unless in-situ repair is necessary as a result of a breakdown. Drip trays shall at all times be placed under vehicles that require in-situ repairs. Drip trays shall be emptied into designated containers only and should be send to an approved oil recycler.	2	1	1	1	**4**	**Low**

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
								Ensure proper handling of hazardous chemicals and materials (e.g., fuel, oil, cement, concrete, reagents, etc.) as per their corresponding Safety Data Sheets (SDS) and the MFC spill response procedures. Accidental spills (concrete, chemicals, process water, hydrocarbons, waste) need to be reported immediately so that effective remediation and clean-up strategies and procedures can be implemented. Soil that is contaminated by fuel, chemical or oil spills, for example, from vehicles, or waste spillage will either be collected to be treated at a pre-determined and dedicated location, or will be cleaned up and treated in situ, using sand, soil or a suitable absorption medium. Ensure all general rubble, fugitive waste and hazardous waste is stored and removed in accordance with the site's Waste Management Plan. Ensure that spill kits are available at dedicated areas and that clean up procedures are followed at all times.						

8.8.5 Biodiversity

The construction (upgrade), operational and decommissioning phases will likely have a **low** to negligible impact on biodiversity as the project areas are located within the existing MFC site. The project areas are in existing operational areas that covered in hard standing and filled with existing infrastructure, therefore minimising the potential on biodiversity of the wider area.

8.8.5.1 Summary of Environmental Impacts

Table 36: Summary of potential impacts on Biodiversity

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
Construction Phase														
5.1	Impact on fauna as a result of the construction activities.	2	1	1	1	**4**	**Low**	No noticeable impact change expected during the construction phase, no mitigation required during construction phase. Fauna monitoring (mortalities) should be used to confirm no impact on biodiversity.	2	1	1	1	**4**	**Low**
Operational Phase														
5.2	Impact on fauna as a result of the operational activities.	2	1	1	1	**4**	**Low**	No noticeable impact change expected during the operational phase, no mitigation required during construction phase. Fauna monitoring (mortalities) should be used to confirm no impact on biodiversity.	2	1	1	1	**4**	**Low**

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE					
		Before mitigation							After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
Decommissioning Phase														
5.3	Impact on fauna as a result of the decommissioning activities.	2	1	1	1	**4**	**Low**	No noticeable impact change expected during the construction phase, no mitigation required during decommissioning phase. Fauna monitoring (mortalities) should be used to confirm no impact on biodiversity.	2	1	1	1	**4**	**Low**

8.8.6 Noise

The construction (upgrade), operational and decommissioning phases will likely have a **low** to negligible impact on noise as the project areas are located within the existing MFC site. The project areas are in existing operational areas that already contribute to the noise levels in the area.

8.8.6.1 Summary of Environmental Impacts

Table 37: Summary of potential impacts on Noise

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
Construction Phase														
6.1	Upgrading of existing furnace and associated infrastructure.	4	2	1	1	**7**	**Low**	Selecting equipment with the lowest possible sound power levels, suitable for operational safety requirements. Ensure equipment utilised is maintained and operated as per manufacturers' specifications.	2	1	1	1	**4**	**Low**
Operational Phase														
6.2	Operation of upgraded furnace and associated infrastructure.	4	3	1	1	**8**	**Low**	Selecting equipment with the lowest possible sound power levels, suitable for operational safety requirements. Ensure equipment utilised is maintained and operated as per manufacturers' specifications.	2	1	1	1	**4**	**Low**
Decommissioning Phase														
6.3	Decommissioning and demolition of upgraded furnace and associated infrastructure.	4	2	1	1	**7**	**Low**	Selecting equipment with the lowest possible sound power levels, suitable for operational safety requirements.	2	1	1	1	**4**	**Low**

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
								Ensure equipment utilised is maintained and operated as per manufacturers' specifications.						

8.8.7 Palaeontology and Cultural Heritage

The construction, operational and decommissioning phases will likely have no impact on palaeontology or cultural heritage as the project areas are located within the existing MFC site. However, it is always possible that chance find fossils or heritage resources could be unearthed when excavations are being undertaken. In the event that a fossil or heritage resources are revealed during the development of the project, impact significance is considered to be **moderate**, but could be mitigated to **low**, should the chance find procedure be implemented.

8.8.7.1 Summary of Environmental Impacts

Table 38: Summary of potential impacts on palaeontology

EMPr Ref. No.	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
Construction Phase														
7.1	No impacts expected, but chance finds with potentially moderate impacts could occur.	8	5	1	1	**19**	**Low**	Chance Find procedure to be implemented immediately should any paleontological heritage resources be unearthed: ▪ Cease all work in the immediate vicinity of the find. ▪ Demarcate the area with barrier tape or other highly visible means. ▪ Notify the South African Heritage Resources Authority (SAHRA) immediately. ▪ Commission an archaeologist accredited with the Association for Southern African Professional Archaeologists (ASAPA) to assess the	4	1	1	1	**6**	**Low**

EMPr Ref. No.	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
								find and determine appropriate mitigation measures. These may include obtaining the necessary authorisation from SAHRA to conduct the mitigation measures. ■ Prevent access to the find by unqualified persons until the assessment and mitigation processes have been completed.						

8.8.8 Socio-economic

The construction (upgrade), and operational phases will result in a **positive** impact associated with the sustaining of current employment into the future and increased economic revenue as the upgrade of the furnace and associated infrastructure will result in the operation of the furnace at an increase throughput resulting in higher production.

The loss of employment will have a **moderate** negative impact during the decommissioning and closure phase of the MFC site.

8.8.8.1 Summary of Environmental Impacts

Table 39: Summary of potential impacts on socio-economic aspects

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
Construction Phase														
8.1	Sustain current employment into the future	2	2	2	4	**24**	**Positive**	None required	2	2	2	4	**24**	**Positive**
8.2	Increase economic revenue	4	2	2	3	**24**	**Positive**	None required	2	2	2	4	**24**	**Positive**
Operational Phase														
8.3	Sustain current employment into the future	2	2	2	4	**24**	**Positive**	None required	2	2	2	4	**24**	**Positive**
8.4	Increase economic revenue	4	2	2	3	**24**	**Positive**	None required	2	2	2	4	**24**	**Positive**
Decommissioning Phase														
8.5	Loss of employment	6	5	2	4	**52**	**Moderate**	Timely and adequate consultation with employees who are dependent on the operation for employment. Assisting employees in seeking alternative employment at other mining operations.	4	5	2	4	**44**	**Moderate**

EMPr Ref. Nr	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE Before mitigation						MITIGATION AND MANAGEMENT MEASURE	ENVIRONMENTAL SIGNIFICANCE After mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
								Training and education of employees to equip them with skills that could benefit them in other industries.						

9.0 ENVIRONMENTAL IMPACT STATEMENT

9.1 Key findings: Potential Cumulative Environmental Impacts

The following potential cumulative impacts were identified and assessed:

9.1.1 Air Quality

In order to assess the cumulative impacts, the existing and proposed operations were modelled together and are presented as Scenario 2 and Scenario 3. The following were concluded:

9.1.1.1 Dust fallout

- Offsite Concentrations:
  - The highest predicted offsite rates for all scenarios are below the residential and non-residential Dust Control Regulations standards.
- Receptor Concentrations:
  - Predicted dust fallout rates for all scenarios are below the residential and non-residential dust control regulation standards at all surrounding sensitive receptors.

9.1.1.2 PM_{10} Concentrations

- Offsite Concentrations:
  - The highest predicted offsite P99 24-hour average PM_{10} concentration from Scenario 1 is below the 24-hour average PM_{10} NAAQS of 75 µg/m^3.
  - The highest predicted offsite P99 24-hour average PM_{10} concentration from Scenario 2 and Scenario 3 are above the 24-hour average PM_{10} NAAQS. These exceedances occur approximately 65 m west and 58 m west, respectively of the facility. However, no receptors are located here.
  - The highest predicted offsite annual average PM_{10} concentrations from all scenarios are below the annual average PM_{10} NAAQS of 40 µg/m^3.
- Receptor Concentrations:
  - Predicted P99 24-hour and annual average PM_{10} concentrations for all scenarios are below their respective 24-hour and annual average PM_{10} NAAQS at all surrounding sensitive receptors.

9.1.1.3 $PM_{2.5}$ Concentrations

- Offsite Concentrations:
  - The highest predicted offsite P99 24-hour and annual average $PM_{2.5}$ concentrations from all scenarios are below the 24-hour and annual average $PM_{2.5}$ NAAQS of 40 µg/m^3 and 20 µg/m^3, respectively.
- Receptor Concentrations:
  - Predicted P99 24-hour and annual average $PM_{2.5}$ concentrations for all scenarios are below their respective 24-hour and annual average $PM_{2.5}$ NAAQS at all surrounding sensitive receptors.

9.1.1.4 NO_2 Concentrations

- Offsite Concentrations:
  - The highest predicted offsite P99 1-hour average NO_2 concentration from all scenarios are below the 1-hour average NO_2 NAAQS of 200 µg/m^3.

- The highest predicted offsite annual average NO_2 concentrations from all scenarios are below the annual average NO_2 NAAQS of 40 µg/m^3.

- Receptor Concentrations:
  - Predicted P99 1-hour and annual average NO_2 concentrations for all scenarios are below their respective 1-hour and annual average NO_2 NAAQS at all surrounding sensitive receptors.

9.1.1.5 SO_2 Concentrations

- Offsite Concentrations:
  - The highest predicted offsite P99 1-hour, P99 24-hour and annual average SO_2 concentrations for all scenarios are below the 1-hour, 24-hour and annual average SO_2 NAAQS of 350 µg/m3, 125 µg/m^3 and 50 µg/m^3, respectively.
- Receptor Concentrations:
  - Predicted P99 1-hour, P99 24-hour and annual average SO_2 concentrations for all scenarios are below their respective 1-hour, 24-hour and annual average SO_2 NAAQS at all surrounding sensitive receptors.

9.1.1.6 Cr Concentrations

- Offsite Concentrations:
  - The highest predicted offsite annual average Cr concentrations for all scenarios are minimal, below the relevant averaging period guidelines.
- Receptor Concentrations:
  - Predicted annual average Cr concentrations for all scenarios are minimal at all surrounding sensitive receptors, below the relevant averaging period guidelines.

9.2 Final Site Map

See Figure 8 for the final layout of the location of the project components at the MFC site.

10.0 ASPECTS FOR INCLUSION AS CONDITIONS OF AUTHORISATION

10.1 General conditions

MFC must:

- Implement all aspects of the EMPr in Section 14.5of this document.
- Comply with all relevant legislation at all times.
- Appoint a qualified Environmental Control Officer to oversee the implementation of the mitigation measures as detailed in the EMPr.
- Undertake annual internal auditing of environmental performance.

10.2 Site specific conditions

None currently identified. Section will be updated after the public review period, based on comments received.

11.0 DESCRIPTION OF ANY ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

11.1 Air Quality

- Data input into the model is based on the information provided by the Client. It is assumed that the information provided by the Client is accurate and complete at the time of modelling.
- It must be noted that the WRF meteorological data, although slightly outdated, still falls within the Modelling Regulation limits.
- Default emission factors from USEPA AP42 Chapter 13.2.4 Aggregate Handling and Storage Piles (USEPA, 1995) were used to calculate particulate emissions from material handling of raw material, sinter plant and smelting activities. A 50% control efficiency was applied to the materials handling activities (COACOA, 2012). Importantly, material handling from crushing activities (transfer of material) are excluded (to prevent double accounting of emissions) as the crushing emission factors include emissions from the screens, the crusher, feeder, and conveyor belt transfer points that are integral to the crusher (COACOA, 2012).
- The default particulate emission factors for wind erosion over open areas from Emission Estimation Technique Manual for Mining (COACOA, 2012) were used. $PM_{2.5}$ emissions were assumed to equal 15% of TSP (USEPA, 2006) in the absence of a $PM_{2.5}$ emission factor. A 50% control efficiency for the use of wet suppression was applied as an environmentally conservative approach (COACOA, 2012) for those stockpiles that will be mitigated.
- To estimate the particulate emissions from crushing, emission factors for crushing operations from the from Emission Estimation Technique Manual for Mining (COACOA, 2012) were utilised. Emissions were based on primary crushing of high moisture content ore (> 4%). Primary crushing activities include emissions from screens, the crusher, the surge bin, the apron feeder, and conveyor belt transfer points that are integral to the crusher. $PM_{2.5}$ emission rates were calculated by applying a factor of 30% (US EPA, 1995) to the TSP emission rates. A 50% mitigation efficiency (COACOA, 2012) was applied in the calculations for water sprays.
- Emission factors from USEPA AP42 Chapter 13.2.2 Unpaved Roads (USEPA, 2006) were used to calculate particulate emissions for unpaved roads. The number of hauls trucks on unpaved roads were provided by the Client. The road surface silt content of 4.8% for industrial unpaved roads (USEPA, 2011) was used and a mean vehicle weight of 37.5 tonnenes was provided by the Client. A control efficiency factor of 75% (wet suppression) (COACOA, 2012) was applied to the unpaved haul roads for wet suppression.
- Emission factors from USEPA AP42 Chapter 13.2.1 Paved Roads (USEPA, 2011) were used to calculate particulate emissions for paved roads. The number of hauls trucks on paved roads were provided by the Client. The road surface silt loading of 9.7 g/m^2 for iron and steel production (USEPA, 2011) was used (in the absence of a specific ferrochrome production silt content) and a mean vehicle weight of 44 tonnenes was provided by the Client. A control efficiency factor of 50% (wet sweeping) (COACOA, 2012) was applied to the paved haul roads.

11.2 Socio-economic

- No stakeholder consultation had been conducted yet at the time of compiling this impact assessment. Hence, the socio-economic impact assessment will be updated and finalised after the stakeholder engagement process.

12.0 REASONED OPINION AS TO WHETHER THE PROPOSED ACTIVITY SHOULD OR SHOULD NOT BE AUTHORISED

Provided that all the environmental management measures, described in the EMPr are applied diligently, it is expected that the proposed infrastructure upgrades will not result in any significant environmental impacts that cannot be mitigated to acceptable levels.

An impact assessment was undertaken, supported by an air quality specialist assessment to determine the impact of the proposed infrastructure upgrades and associated activities on the environment. These studies have not identified any fatal flows associated with the proposed project. Neither have any critical factors been identified which would warrant the proposed activities not to proceed.

Not granting this authorisation will impact on MFC's ability to utilise the furnaces and associated infrastructure at an optimal capacity and thereby improving the efficiency of the operations.

Accordingly, it is the opinion of the environmental assessment practitioner that the application for environmental authorisation, for the construction of the additional infrastructure and associated activities as described in this BA and EMPr report, should be granted, on the premise that:

- The project details in Section 3.3.1 remain unchanged.
- The commitments in this BA and EMPr report are implemented, adhered to and audited.

13.0 UNDERTAKING

It is confirmed that the undertaking required to meet the requirements of this section is provided at the end of the EMPr and is applicable to both the BA Report and the EMPr Report.

13.1 Other matters required in terms of section 24(4) of the NEMA

This section requires proof of compliance with section 24(4)(b)(i) of the National Environmental Management Act, which section reads as follows:

"24. Environmental authorisations

(4) Procedures for the investigation, assessment and communication of the potential consequences or impacts of activities on the environment -

(b) must include, with respect to every application for an environmental authorisation and where applicable-

(i) investigation of the potential consequences or impacts of the alternatives to the activity on the environment and assessment of the significance of those potential consequences or impacts, including the option of not implementing the activity;"

The above requirements are dealt with comprehensively in sections 8.8 to 9.0 of this BA/EMPr report.

PART B
ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

14.0 ENVIRONMENTAL MANAGEMENT PROGRAMME

14.1 Details of the Aspects of the Activity

The required details have been supplied in **PART A**, Section 2.2 of this report.

14.2 Description of the Aspects of the Activity

See section 3.0 of this document.

14.3 Composite Map

Figure 36 illustrates the location of the existing furnace, PSP and associated infrastructure as well as the gas abatement infrastructure areas for the proposed infrastructure upgrades and environmental features of the site. As indicated in the map, the proposed project areas are located within the footprint of the existing MFC site, which has been in operation since the 1960's. The proposed location of the proposed project areas therefore does not coincide with any protected or environmentally sensitive area.

14.4 Description of Impact Management Outcomes, including Management Statements

By committing to the implementation of the management measures described in the EMPr and the conditions stipulated in the environmental authorisation and the conditions of the amended AEL, MFC intends to ensure that the local environmental quality will not be adversely affected by the upgrades and operation of the M3 and M4 furnaces, PSP, pre-heaters and M3 and PSP abatement equipment and that the positive environmental impacts will be enhanced as far as practicable.

14.4.1 Planning and design

MFC is a going concern. The site was established in the 1960's and the current activities on the site have been ongoing since the plant was commissioned. Planning and design for the proposed upgrades to the infrastructure involves desktop activities only, with no environmental impacts.

14.4.2 Construction / Site Preparation Phase

As indicated in Section 3.0, the proposed project areas will be situated within the existing MFC site in an already developed area. No pre-construction activities such as site vegetation stripping, are necessary and there will not be any pre-construction environmental impacts.

The predicted impacts, recommended mitigation measures and expected outcomes are dealt with in Section 8.8 and 14.5

14.4.3 Operational Phase

The predicted impacts, recommended mitigation measures and expected outcomes are dealt with in Section 8.8 and 14.5 .

14.4.4 Decommissioning and Demolition Phase

The predicted impacts, recommended mitigation measures and expected outcomes are dealt with in Section 8.8 and 14.5.

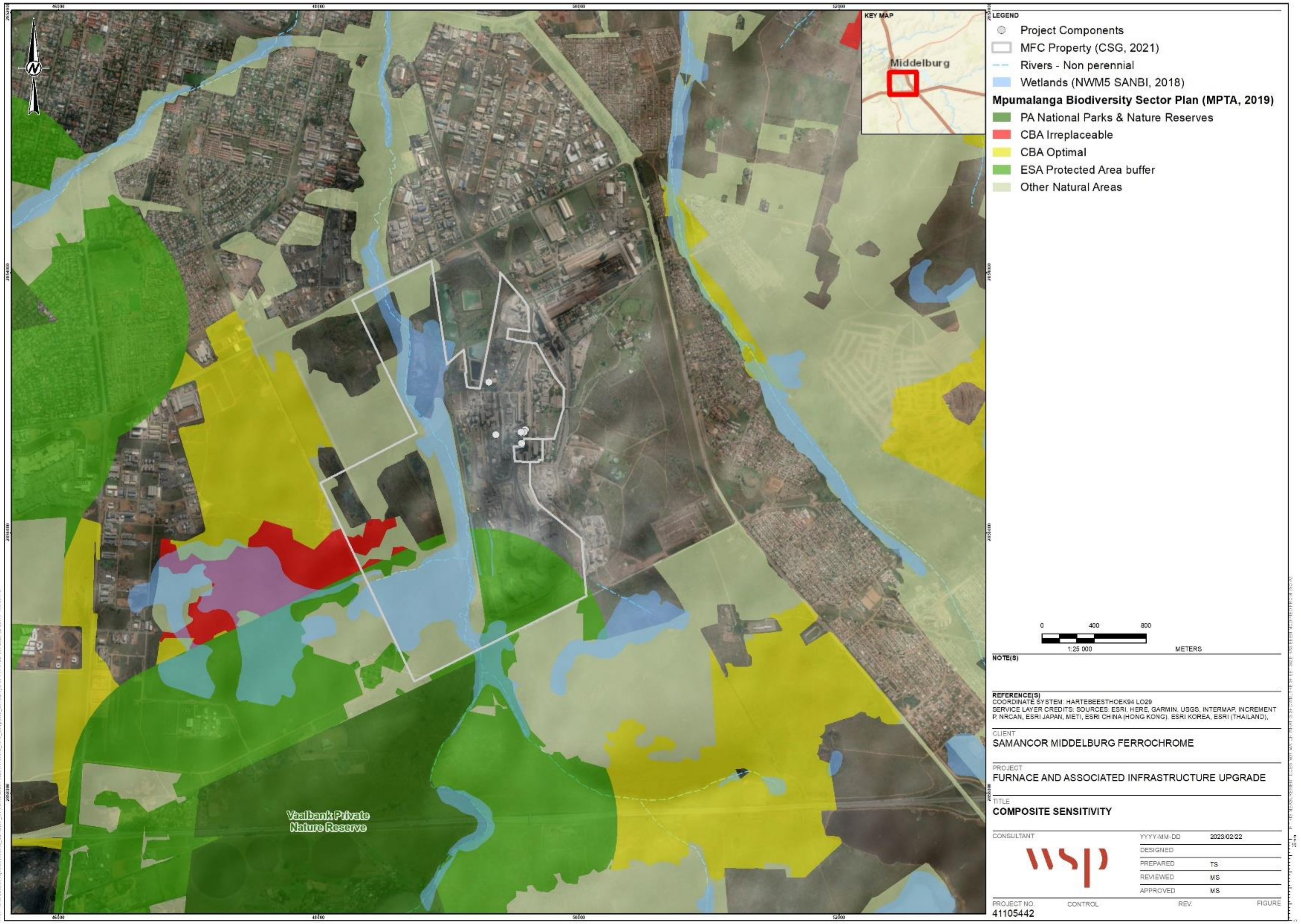


Figure 36: Composite Map

14.5 Impacts to be mitigated in their respective phases

This section summarises the potential impacts of the proposed furnace and associated infrastructure upgrade project on various environmental aspects during the site preparation / construction (upgrade), operational and closure phases, together with the appropriate mitigation measures to manage the identified impacts. Responsibilities for implementing the mitigation measures are identified and the frequencies with which the results of the various measures are to be monitored are stated. The responsibility for monitoring and reporting the results to the appropriate level of management rests with the Environmental Control Officer.

The potential impacts to be mitigated are described in detail in Section 8.8 and the mitigation measures associated are presented below in Table 40. The detailed Impact Management Table is contained in APPENDIX E.

Table 40: Project Phase Impacts and Mitigation Measures

EMPr Ref. Nr	ACTIVITY whether listed or not listed.	POTENTIAL IMPACT	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
AIR QUALITY								
Construction Phase								
1.1	Upgrade of existing furnaces and associated infrastructure, that includes the use of vehicles, equipment and machinery.	Impact on surrounding sensitive receptors due to increased dust and particulate matter as a result of upgrade activities.	Apply wet suppression and road surface sweepers, where applicable.	Minimise and control through impact management and monitoring.	Duration of construction phase	Compliance with NAAQA at the mine boundary.	By implementing dust control measures at significant emission sources, the cumulative ambient particulate load will be reduced.	MFC Logistics Superintendent
Operational Phase								
1.2	Operation of the upgraded furnaces and associated equipment.	Cumulative impact on air quality as a result of the existing MFC operations, including the proposed production increase and new installations, plus the M3 abatement upgrade change.	**Wind Erosion and Exposed Areas** Wind-blown dust can be minimised with the use of wet suppression and road sweepers, which have an estimated control efficiency of 50%. While wind-blown dust may not be a significant contributor to overall dust emissions, wind erosion can substantially increase dust entrainment at any site. It is understood that MFC, however, use both these measures on site and as such, ensure adequate mitigation from wind-blown dust. **Stockpiles** Dust emissions from stockpiles can occur during the loading of the piles, when wind disturbs the stockpile surface, and during reclamation (USEPA, 2006a). The following mitigation	Minimise and control through impact management and monitoring.	Duration of operational phase	Compliance with NAAQA at the mine boundary.	By implementing dust control measures at significant emission sources, the cumulative ambient particulate load will be reduced.	MFC Logistics Superintendent

EMPr Ref. Nr	ACTIVITY whether listed or not listed.	POTENTIAL IMPACT	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
			techniques are suggested to reduce wind erosion from stockpiles: Shape stockpiles, taking into consideration width to height ratio, nature of stockpiled material, location, access and available area for the stockpile. Limit stockpile heights based on their stability, manageability, dust and amenity impacts. Store raw materials with high fines content in semi-enclosed bunkers, where possible. Investigate options for dust extraction at enclosed bunkers. More gentle slopes for unstable soils are recommended. Avoid building steep sided stockpiles that have sharp changes in shape. **Truck Loading and Unloading** Truck loading and unloading activities are also likely to contribute significantly to the amount of dust generated from materials handling activities. Loading and offloading activities are fairly difficult to mitigate, although the following techniques can be employed to assist with dust suppression (Katestonnee, 2011), as cited by (Reddy & Collet, 2023): - Avoid double handling of material where possible. - Minimising the drop height of the material from truck loads. - Using road sweepers loading and unloading activities occur. **Crushing** Mitigation methods in these areas that can be implemented to reduce dust emissions include: - Tasking a team to be responsible for the removal of all deposited dust from machinery and enclosures within the crushing plant and tip areas, resulting in less					

EMPr Ref. Nr	ACTIVITY whether listed or not listed.	POTENTIAL IMPACT	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
			deposited dust available for wind entrainment. - Deploy a dust sweeper to the plant, capable of collecting all deposited fines, reducing the amount of dust available for wind entrainment. **Unpaved Roads** To adequately mitigate emissions of dust associated with unpaved roads, the following key recommendations are suggested: - Application of water (potential of reducing emissions by 75% (COACOA, 2012), as cited by (Reddy & Collet, 2023)) as a dust suppressant to all haul roads and other roads experiencing high traffic volumes. If the costs associated with water application are high, and water is scarce, etc (i.e. many disadvantages of water are posed) then consider a dust-a-side or similar chemical suppressant, which has the potential of reducing dust emissions by approximately 99%. - Implement vehicle speed and access restrictions within the site (approximately 30 km/h). - Prevention of material deposition onto haul roads through avoiding the overloading of truck loads resulting in spillages on the roads; preventing wind erosion from adjacent open areas; and ensure adequate storm water drainage to prevent water erosion of the roads. - Prioritising source reduction measures through the use of the most direct travel routes on site and using larger capacity trucks to minimise the number of trips. - Water bowser routes should align with the daily/weekly site plan schedule and a maintenance programme should be in place					

EMPr Ref. Nr	ACTIVITY whether listed or not listed.	POTENTIAL IMPACT	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
			to ensure continuous availability of the water bowsers. **Paved Roads** To adequately mitigate emissions of dust associated with paved roads at the facility, the following key recommendations are suggested: - Ensure road sweeping is implemented. - Implement vehicle speed and access restrictions within the site (approximately 30 km/h). - Prevention of material deposition onto haul roads through avoiding the overloading of truck loads resulting in spillages on the roads; preventing wind erosion from adjacent open areas; and ensure adequate storm water drainage to prevent water erosion of the roads. - Prioritising source reduction measures through the use of the most direct travel routes on site and using larger capacity trucks to minimise the number of trips. **Stacks** The following measures would assist in reducing impacts from NO_2 (Since concentrations from SO_2 and Cr are considered to be minimal, no additional measures are suggested): - Maintain and service all furnaces, preheaters and PSP stacks regularly to ensure that emissions are kept to a minimum. - Investigate use of alternative fuels (cleaner fuels) supplied to the preheaters to assist in reducing NO_2 emissions. - Ensure on-going stack testing as per AEL conditions to monitor NOx emissions. - Given that the impacts of $PM_{2.5}$ and SO_2 are negligible, no further mitigation methods					

EMPr Ref. Nr	ACTIVITY whether listed or not listed.	POTENTIAL IMPACT	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
			(other than the ones already implemented) are deemed necessary to reduce emissions from these pollutants.					
Decommissioning and Demolition Phase								
1.3		Impact on surrounding sensitive receptors due to increased dust and particulate matter during demolition / removal of upgraded equipment.	Apply wet suppression and road sweeping, where applicable.	Minimise and control through impact management and monitoring.	Duration of decommissioning and demolition phase	Compliance with NAAQA at the mine boundary.	By implementing dust control measures at significant emission sources, the cumulative ambient particulate load will be reduced.	MFC Logistics Superintendent
GROUNDWATER								
Construction Phase								
2.1	Upgrade of existing furnaces and associated infrastructure, that includes the use of vehicles, equipment and machinery.	A change in groundwater quality.	No noticeable impact change expected during all phases of the project, no mitigation required during construction phase. Groundwater monitoring (water levels and quality) should be used to confirm that the groundwater quality remains unchanged.	Minimise and control through impact management and monitoring.	During construction phase	Groundwater quality limits in MFC WUL	N/A	MFC SHEQ Specialist Environment
2.2		A change in the volume or recharge of groundwater / change in water level.						

EMPr Ref. Nr	ACTIVITY whether listed or not listed.	POTENTIAL IMPACT	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
2.3		Possible change in groundwater flow regime.						
Operational Phase								
2.4	Operation of the upgraded furnaces and associated equipment.	A change in groundwater quality.	No noticeable impact change expected during all phases of the project, no mitigation required during operational phase. Groundwater monitoring (water levels and quality) should be used to confirm that the groundwater quality remains unchanged.	Minimise and control through impact management and monitoring.	During operational phase	Groundwater quality limits in MFC WUL	N/A	MFC SHEQ Specialist Environment
2.5		A change in the volume or recharge of groundwater / change in water level.						
2.6		Possible change in groundwater flow regime.						

EMPr Ref. Nr	ACTIVITY whether listed or not listed.	POTENTIAL IMPACT	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
Decommissioning and demolition Phase								
2.7	Decommissioning and demolition of the upgraded equipment	Spillage of hazardous substances during the dismantling of upgraded equipment which were in contact with hazardous substances may contaminate soils and groundwater.	No noticeable impact change expected during all phases of the project, no mitigation required during decommissioning and demolition phase. Groundwater monitoring (water levels and quality) should be used to confirm that the groundwater quality remains unchanged.	Minimise and control through impact management and monitoring.	During decommissioning and demolition phase	Groundwater quality limits in MFC WUL	N/A	MFC SHEQ Specialist Environment
SURFACE WATER								
Construction Phase								
3.1	Upgrade of existing furnaces and associated infrastructure, that includes the use of vehicles, equipment and machinery.	Contamination of soils and downstream water resources by chemical pollutants.	Contaminated water as a result of the construction phase must be managed in accordance with the existing water management procedures and infrastructure at the MFC site to prevent any contaminated water from leaving the site. All pollution control mechanisms are to be in accordance with the conditions of the site's WUL. Continue the surface water monitoring programme.	Minimise and control through impact management and monitoring.	During construction phase	Surface water quality limits in MFC WUL	N/A	MFC SHEQ Specialist Environment

EMPr Ref. Nr	ACTIVITY whether listed or not listed.	POTENTIAL IMPACT	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
Operational Phase								
3.2	Operation of the upgraded furnaces and associated equipment.	Contamination of soils and downstream water resources by chemical pollutants.	Contaminated water as a result of the operational phase must be managed in accordance with the existing water management procedures and infrastructure at the MFC site to prevent any contaminated water from leaving the site. All pollution control mechanisms are to be in accordance with the conditions of the site's WUL. Continue the surface water monitoring programme.	Minimise and control through impact management and monitoring.	During operational phase	Surface water quality limits in MFC WUL	N/A	MFC SHEQ Specialist Environment
Decommissioning and Demolition Phase								
3.3	Decommissioning and demolition of the upgraded equipment	Spillage of hazardous substances during the dismantling of upgraded equipment which were in contact with hazardous substances may contaminate soils and surface water resources.	Contaminated water as a result of the decommissioning and demolition phase must be managed in accordance with the existing water management procedures and infrastructure at the MFC site to prevent any contaminated water from leaving the site. All pollution control mechanisms are to be in accordance with the conditions of the site's WUL. Continue the surface water monitoring programme.	Minimise and control through impact management and monitoring.	During decommissioning and demolition phase	Surface water quality limits in MFC WUL	N/A	MFC SHEQ Specialist Environment

EMPr Ref. Nr	ACTIVITY whether listed or not listed.	POTENTIAL IMPACT	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
SOILS, LAND USE AND LAND CAPABILITY								
Construction Phase								
4.1	Upgrade of existing furnaces and associated infrastructure, that includes the use of vehicles, equipment and machinery.	Impact on soils due to potential spillage of hazardous substances, incorrect waste handling and storage or storm water contamination.	All vehicles and machinery must be kept in good working order and inspected on a regular basis for possible leaks and shall be repaired as soon as possible if required. Repairs shall be carried out in a dedicated repair area only, unless in-situ repair is necessary as a result of a breakdown. Drip trays shall at all times be placed under vehicles that require in-situ repairs. Drip trays shall be emptied into designated containers only and should be send to an approved oil recycler. Ensure proper handling of hazardous chemicals and materials (e.g., fuel, oil, cement, concrete, reagents, etc.) as per their corresponding Safety Data Sheets (SDS) and the MFC spill response procedures. Accidental spills (concrete, chemicals, process water, hydrocarbons, waste) need to be reported immediately so that effective remediation and clean-up strategies and procedures can be implemented. Soil that is contaminated by fuel, chemical or oil spills, for example, from vehicles, or waste spillage will either be collected to be treated at a pre-determined and dedicated location, or will be cleaned up and treated in situ, using sand, soil or a suitable absorption medium.	Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided	Implementing the requirements of GNR. 331. Norms and Standards for Remediation of Contaminated Land & Soil Quality will reduce the impact on soils in the immediate area.	MFC SHEQ Specialist Environment

EMPr Ref. Nr	ACTIVITY whether listed or not listed.	POTENTIAL IMPACT	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
			Ensure all general rubble, fugitive waste and hazardous waste is stored and removed in accordance with the site's Waste Management Plan. Ensure that spill kits are available at dedicated areas and that clean up procedures are followed at all times.					
Operational Phase								
4.2	Operation of the upgraded furnaces and associated equipment.	Impact on soils due to potential spillage of hazardous substances, incorrect waste handling and storage or storm water contamination.	All vehicles and machinery must be kept in good working order and inspected on a regular basis for possible leaks and shall be repaired as soon as possible if required. Repairs shall be carried out in a dedicated repair area only, unless in-situ repair is necessary as a result of a breakdown. Drip trays shall at all times be placed under vehicles that require in-situ repairs. Drip trays shall be emptied into designated containers only and should be send to an approved oil recycler. Ensure proper handling of hazardous chemicals and materials (e.g., fuel, oil, cement, concrete, reagents, etc.) as per their corresponding Safety Data Sheets (SDS) and the MFC spill response procedures. Accidental spills (concrete, chemicals, process water, hydrocarbons, waste) need to be reported immediately so that effective remediation and clean-up strategies and procedures can be implemented. Soil that is contaminated by fuel, chemical or oil spills, for example, from vehicles, or waste	Minimise and control through impact management and monitoring.	Duration of operational phase	Impact avoided	Implementing the requirements of GNR. 331. Norms and Standards for Remediation of Contaminated Land & Soil Quality will reduce the impact on soils in the immediate area.	MFC SHEQ Specialist Environment

EMPr Ref. Nr	ACTIVITY whether listed or not listed.	POTENTIAL IMPACT	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
			spillage will either be collected to be treated at a pre-determined and dedicated location, or will be cleaned up and treated in situ, using sand, soil or a suitable absorption medium. Ensure all general rubble, fugitive waste and hazardous waste is stored and removed in accordance with the site's Waste Management Plan. Ensure that spill kits are available at dedicated areas and that clean up procedures are followed at all times.					
Decommissioning and Demolition Phase								
4.3	Decommissioning and demolition of the upgraded equipment	Impact on soils due to potential spillage of hazardous substances, incorrect waste handling and storage or storm water contamination.	All vehicles and machinery must be kept in good working order and inspected on a regular basis for possible leaks and shall be repaired as soon as possible if required. Repairs shall be carried out in a dedicated repair area only, unless in-situ repair is necessary as a result of a breakdown. Drip trays shall at all times be placed under vehicles that require in-situ repairs. Drip trays shall be emptied into designated containers only and should be send to an approved oil recycler. Ensure proper handling of hazardous chemicals and materials (e.g., fuel, oil, cement, concrete, reagents, etc.) as per their corresponding Safety Data Sheets (SDS) and the MFC spill response procedures.	Minimise and control through impact management and monitoring.	Duration of decommissioning and demolition phase	Impact avoided	Implementing the requirements of GNR. 331. Norms and Standards for Remediation of Contaminated Land & Soil Quality will reduce the impact on soils in the immediate area.	MFC SHEQ Specialist Environment

EMPr Ref. Nr	ACTIVITY whether listed or not listed.	POTENTIAL IMPACT	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
			Accidental spills (chemicals, process water, hydrocarbons, waste) need to be reported immediately so that effective remediation and clean-up strategies and procedures can be implemented. Soil that is contaminated by fuel, chemical or oil spills, for example, from vehicles, or waste spillage will either be collected to be treated at a pre-determined and dedicated location, or will be cleaned up and treated in situ, using sand, soil or a suitable absorption medium. Ensure all general rubble, fugitive waste and hazardous waste is stored and removed in accordance with the site's Waste Management Plan. Ensure that spill kits are available at dedicated areas and that clean up procedures are followed at all times.					
BIODIVERSITY								
Construction Phase								
5.1	Upgrade of existing furnaces and associated infrastructure, that includes the use of vehicles, equipment and machinery.	Impact on fauna as a result of the construction activities.	No noticeable impact change expected during the construction phase, no mitigation required during construction phase. Fauna monitoring (mortalities) should be used to confirm no impact on biodiversity.	Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided	N/A	MFC SHEQ Specialist Environment

EMPr Ref. Nr	ACTIVITY whether listed or not listed.	POTENTIAL IMPACT	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
Operational Phase								
5.2	Operation of the upgraded furnaces and associated equipment.	Impact on fauna as a result of the operational activities.	No noticeable impact change expected during the construction phase, no mitigation required during operational phase. Fauna monitoring (mortalities) should be used to confirm no impact on biodiversity.	Minimise and control through impact management and monitoring.	Duration of operational phase	Impact avoided	N/A	MFC SHEQ Specialist Environment
Decommissioning and Demolition Phase								
5.3	Decommissioning and demolition of the upgraded equipment	Impact on fauna as a result of the decommissioning activities.	No noticeable impact change expected during the construction phase, no mitigation required during Decommissioning and demolition phase. Fauna monitoring (mortalities) should be used to confirm no impact on biodiversity.	Minimise and control through impact management and monitoring.	Duration of decommissioning and demolition phase	Impact avoided	N/A	MFC SHEQ Specialist Environment
NOISE								
Construction Phase								
6.1	Upgrade of existing furnaces and associated infrastructure, that includes the use of vehicles, equipment and machinery.	Impact on surrounding sensitive receptors due to increased noise as a result of upgrade activities.	Selecting equipment with the lowest possible sound power levels, suitable for operational safety requirements. Ensure equipment utilised is maintained and operated as per manufacturers' specifications.	Minimise and control through impact management and monitoring.	Duration of construction phase	SANS 10103:2008[4]	By implementing noise control measures at significant sources, the cumulative noise levels will be reduced.	MFC SHEQ Specialist Environment

[4] SANS 10103:2008 – The measurement and rating of environmental noise with respect to annoyance and to speech communication.

EMPr Ref. Nr	ACTIVITY whether listed or not listed.	POTENTIAL IMPACT	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
Operational Phase								
6.2	Operation of the upgraded furnaces and associated equipment.	Cumulative impact on noise as a result of the existing MFC operations, including the proposed production increase and new installations, plus the M3 abatement upgrade change.	Selecting equipment with the lowest possible sound power levels, suitable for operational safety requirements. Ensure equipment utilised is maintained and operated as per manufacturers' specifications.	Minimise and control through impact management and monitoring.	Duration of operational phase	SANS 10103:2008[5]	By implementing noise control measures at significant sources, the cumulative noise levels will be reduced.	MFC SHEQ Specialist Environment
Decommissioning and Demolition Phase								
6.3	Decommissioning and demolition of the upgraded equipment	Impact on surrounding sensitive receptors due to increased noise during demolition / removal of upgraded equipment.	Selecting equipment with the lowest possible sound power levels, suitable for operational safety requirements. Ensure equipment utilised is maintained and operated as per manufacturers' specifications.	Minimise and control through impact management and monitoring.	Duration of demolition phase	SANS 10103:2008[6]	By implementing noise control measures at significant sources, the cumulative noise levels will be reduced.	MFC SHEQ Specialist Environment

[5] SANS 10103:2008 – The measurement and rating of environmental noise with respect to annoyance and to speech communication.

[6] SANS 10103:2008 – The measurement and rating of environmental noise with respect to annoyance and to speech communication.

EMPr Ref. Nr	ACTIVITY whether listed or not listed.	POTENTIAL IMPACT	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
PALAEONTOLOGICAL AND HERITAGE RESOURCES								
Construction Phase								
7.1	Possible site clearance during the upgrade of the infrastructure	No impacts expected, but chance finds with potentially moderate impacts could occur	Chance Find Procedure to be implemented immediately should any paleontological or heritage resources be unearthed: - Cease all work in the immediate vicinity of the find. - Demarcate the area with barrier tape or other highly visible means. - Notify the South African Heritage Resources Authority (SAHRA) immediately. Commission an archaeologist accredited with the Association for Southern African Professional Archaeologists (ASAPA) to assess the find and determine appropriate mitigation measures. These may include obtaining the necessary authorisation from SAHRA to conduct the mitigation measures. Prevent access to the find by unqualified persons until the assessment and mitigation processes have been completed.	Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided	By monitoring construction activities and implementing the chance find procedure, damage to heritage resources can be avoided.	MFC SHEQ Specialist Environment, ECO, appointed contractor(s)
SOCIO-ECONOMIC								
Construction Phase								
8.1	Upgrade of existing furnaces and associated infrastructure, that includes the use of vehicles, equipment and machinery.	Sustain current employment into the future	None required	N/A	N/A	N/A	N/A	N/A
8.2		Increase economic revenue	None required	N/A	N/A	N/A	N/A	N/A

EMPr Ref. Nr	ACTIVITY whether listed or not listed.	POTENTIAL IMPACT	Detailed Mitigation Measures	Mitigation Type	Time period for implementation	Standards to be Achieved	Compliance with Standards	Responsible person
Operational Phase								
8.3	Operation of the upgraded furnaces and associated equipment.	Sustain current employment into the future	None required	N/A	N/A	N/A	N/A	N/A
8.4		Increase economic revenue	None required	N/A	N/A	N/A	N/A	N/A
Decommissioning and Demolition Phase								
8.5	Decommissioning and demolition of the upgraded equipment	Loss of employment	Timely and adequate consultation with employees who are dependent on the operation for employment. Assisting employees in seeking alternative employment at other industrial operations. Training and education of employees to equip them with skills that could benefit them in other industries.	Minimise and control through impact management and monitoring.	Duration of decommissioning and demolition phase	Impact avoided	Implement the proposed mitigation measures to reduce the health and safety risks.	HR Manager

Table 41: Monitoring Plan

Aspect	Impact Requiring Monitoring Programmes	Functional Requirements for Monitoring	Monitoring Locations	Parameters	Roles and Responsibilities	Monitoring and Reporting Frequency and Time Period for Implementing Impact Management Actions
Air Quality	Emissions concentrations causing exceedances of the NAAQS beyond the mine boundary	Continued dust fallout monitoring using single direction dust buckets.	Continued dust fallout monitoring using single direction dust buckets.	As per the National Dust Control Regulations	MFC SHEQ Specialist Environmental	Monthly monitoring and quarterly internal reporting during all phases of the project should be used to identify problem areas/ activities to target mitigation.
	Emissions concentrations causing exceedances of PM_{10}, SO_2 and NO_2.	Continued PM_{10}, SO_2 and NO_2. background concentrations monitoring at the onsite station.	MFC onsite station.	As per National Ambient Air Quality Standards	MFC SHEQ Specialist Environmental	Monthly monitoring and quarterly internal reporting during all phases of the project should be used to identify problem areas/ activities to target mitigation.
	Emissions concentrations causing exceedances of PM_{10}, SO_2 and NO_2.	Continue to evaluate, model and monitor the efficiency of the existing M4 abatement to identify when an upgrade may be required.	M4 abatement equipment	As per National Ambient Air Quality Standards	MFC SHEQ Specialist Environmental	Monthly monitoring and quarterly internal reporting during all phases of the project should be used to identify problem areas/

Aspect	Impact Requiring Monitoring Programmes	Functional Requirements for Monitoring	Monitoring Locations	Parameters	Roles and Responsibilities	Monitoring and Reporting Frequency and Time Period for Implementing Impact Management Actions
						activities to target mitigation.
Groundwater	To understand possible impacts on groundwater quality as a result of the project activities.	Continue with existing groundwater monitoring conducted as stipulated in the MFC WUL.	As per the existing MFC WUL requirements.	Groundwater quality parameters as stipulated in the WUL.	MFC SHEQ Specialist Environmental	As per WUL requirements
Surface Water	To understand possible impacts on surface water quality as a result of the project activities.	Continue with existing surface water monitoring conducted as stipulated in the MFC WUL.	As per the existing MFC WUL requirements.	Surface water quality parameters as stipulated in the WUL.	MFC SHEQ Specialist Environmental	As per WUL requirements.
Noise	Noise levels that could cause disturbance at nearby sensitive receptors.	Period noise monitoring at neighbouring sensitive receptors.	Dependent on complaint(s) received.	As per SANS 10103:2008.	MFC SHEQ Specialist Environmental	When specific noise complaint(s) received.
All Environmental Aspects	▪ Dust emissions ▪ Noise ▪ Surface and groundwater	Maintaining a complaint register. Complaints should be investigated immediately and mitigative action	N/A	N/A	MFC SHEQ Specialist Environmental	Monthly internal reporting on complaints received, including mitigation actions taken and feedback to complainants.

Aspect	Impact Requiring Monitoring Programmes	Functional Requirements for Monitoring	Monitoring Locations	Parameters	Roles and Responsibilities	Monitoring and Reporting Frequency and Time Period for Implementing Impact Management Actions
	quality and quantity ▪ Visual intrusion ▪ Traffic ▪ Socio-economic considerations	taken where possible/ necessary.				

15.0 ENVIRONMENTAL AWARENESS PLAN

MFC has an existing induction programme that includes environmental awareness training. The induction training is attended by all employees and contractors whose work may impact on the environment and training is received to the level of responsibility.

Conditions pertaining to environmental management will be included in all operational contracts, where applicable, thereby making contractors aware of the potential environmental risks associated with the project and the necessity of implementing good environmental and housekeeping practices.

The following principles will apply to the Environmental Awareness Plan training and the Environmental Management System (EMS) training:

- All personnel, including contactors will undergo general safety, health and environmental (SHE) induction and environmental management system (EMS) training.
- The Safety, Health, Environmental and Quality (SHEQ) Manager will identify the SHE training requirements for MFC's personnel and contractors. The training requirements will be recorded in a training needs matrix indicating particular training that must be undertaken by identified personnel and contractors. The training matrix will be administered by MFC's Human Resources (HR) Department.
- Development of the Training Programme, which will include:
    - Job-specific training – training for personnel performing tasks which could cause potentially significant environmental impacts.
    - Assessment of extent to which personnel are equipped to manage environmental impacts.
    - Basic environmental training.
    - Training on emergency response, spill management, etc.
    - Training verification and record keeping.
    - Periodic re-assessment of training needs, with specific reference to new developments, newly identified issues and impacts and associated mitigation measures.

15.1 General Awareness Training

- The HR Manager, together with the SHEQ Manager, will be responsible for the development of, or facilitating the development of, the required general SHE induction and awareness training. A general environmental awareness training module will be developed and integrated into the general induction programme. The general awareness training must include the Environmental Policy, a description of the environmental impacts and aspects and the importance of conformance to requirements, general responsibilities of MFC personnel and contractors with regard to the environmental requirements and a review of the emergency procedures and corrective actions; and
- A Training Practitioner or the Environmental Control Officer (ECO) will conduct the general awareness training. The training presenter will keep a record of the details of all persons attending general awareness training. Such attendance registers shall indicate the names of attendants and their organisations, the date and the type of training received.

15.2 Specific Environmental Training

- Specific environmental training will be in line with the requirements identified in the training matrix.
- Personnel whose work tasks can impact on the environment will be made aware of the requirements of appropriate procedures/work instructions. The SHEQ Manager will communicate training requirements to responsible supervisors to ensure that personnel and contractors are trained accordingly.

15.3 Training Evaluation and Re-training

- The effectiveness of the environmental training will be reflected by the degree of conformance to EMPr requirements, the results of internal audits and the general environmental performance achieved at the mine.
- Incidents and non-conformances will be assessed through an internal incident investigation and reporting system, to determine the root cause, including the possible lack of awareness/training.
- Should it be evident that re-training is required, the SHEQ Manager will inform the Heads of Departments of the need and take the appropriate actions.
- General awareness training of all personnel shall be repeated annually.
- The re-induction shall take into consideration changes made in the EMPr, changes in legislation, the site's current levels of environmental performance and areas of improvement.

15.4 Emergency Procedures

The following emergency procedures are relevant to the project:

- The SHEQ Manager shall define emergency reporting procedures for the site.
- All personnel shall be made aware of emergency reporting procedures and their responsibilities.
- Any spills will be cleaned up immediately in accordance with relevant legislation.
- Telephone numbers of emergency services, including the local firefighting service, shall be conspicuously displayed.

16.0 UNDERTAKING

The environmental assessment practitioner hereby confirms:

- The correctness, to the best of her knowledge, of the information provided in the specialist reports and of information provided by MFC. The information was accepted as being as reliable as information generated during a Basic Assessment, and provided in good faith, can be.
- The inclusion of comments and inputs from stakeholders and I&APs.
- The inclusion of inputs and recommendations from the specialist reports where relevant.
- That the information provided to I&APs and the responses to comments and inputs made by the I&APs are correctly reflected herein.

Signature Page

WSP Group Africa (Pty) Ltd

Digitally signed by Schlechter, Marie (gld_mschlechter)
Location: Registered EAP (2020/1430)
Date: 14-Mar-23

Digitally signed by Ashlea Strong
DN: cn=Ashlea Strong, c=ZA, o=WSP Group Africa, ou=Earth and Environment, email=ashlea.strong@wsp.com
Date: 2023.03.14 17:03:52 +02'00'

Marié Schlechter	Ashlea Strong
Environmental Assessment Practitioner	*Project Reviewer*

MS/ASc/ms

Reg. No. 2002/007104/07
Directors: RGM Heath, MQ Mokulubete, MC Mazibuko (Mondli Colbert), GYW Ngoma

\\corp.pbwan.net\za\central_data\projects\41100xxx\41105442 - mfc proposed upgrade\41 pa\01-reports\01-draft\21487939_report_mfc_m3&m4_furnaces_14mar2023_final.docx

APPENDIX A

Environmental Assessment Practitioner CV

Marié Schlechter

Planning and Advisory, Principal Associate

CAREER SUMMARY

Marié Schlechter has worked in the mining industry and environmental consultancy for over twenty years, gaining experience in the implementation of environmental management systems and mitigation of environmental impacts from mining and industrial activities. Marié has experience in managing environmental impacts on mining and industrial sites as well as the implementation, maintenance and internal auditing of environmental management systems and compliance audits. Marié has ICMI registration as a Lead and Mining Technical Expert Auditor as well as an Affiliate Member and Registered Environmental Auditor with the Institute of Environmental Management and Assessment (IEMA) and has conducted audits in South Africa, Mali, Guinea, Ghana, Tanzania and Mozambique.

11 years with WSP

22 years of experience

Area of expertise

Environmental Authorisation Projects

Environmental Management Programme Report Consolidations and Amendments

Environmental Compliance Projects

Environmental Compliance / Risk Auditing

International Cyanide Management Code Auditing

Due Diligence Auditing

Management Programme Report Performance Assessments

Project and Finance Management Integrated

Consultation with Interested and Affected Parties and Government Departments

Language

English – Fluent

Afrikaans - Fluent

EDUCATION

B.Sc. (Hons) Geography and Environmental Management, University of Johannesburg, Johannesburg, South Africa 1999

B.Sc. Earth Science, University of Johannesburg, Johannesburg, South Africa 1998

Marié Schlechter

Planning and Advisory, Principal Associate

ADDITIONAL TRAINING

Environmental Management Systems Understanding the Transition to SANS 14001:2015	2017
ISO 14001:2015 Environmental Management Systems Auditing Based on ISO 19011 and ISO 17021 (SAATCA Approved)	2017
Project Management Fundamentals	2012
Microsoft Project 2007 Essentials	2011
IEMA Approved Foundation Course in Environmental Auditing (SA)	2012
Management Review	2009
Causal Analysis Technique	2009
Technical Report Writing	2007
Occupational Health and Safety Law for Managers	2003
Project Management	2003
Internal Environmental Management Auditor Training Course	2001
Environmental Law	2001
Environmental Management Systems (SABS/ISO 14001)	2000

PROFESSIONAL MEMBERSHIPS

Registered Environmental Assessment Practitioner: EAP Number 2020/1430

Lead and Mining Technical Expert Auditor - Cyanide Management Institute (ICMI)

Affiliate Member and Environmental Auditor - Institute of Environmental Management and Assessment (IEMA)

PROFESSIONAL HISTORY

WSP Group Africa (Pty) Ltd	October 2011 - present
AngloGold Ashanti	April 2006 – September 2011
Oryx Environmental	July 2002 – April 2006
Gold Fields Limited	January 2000 –June 2002

PROFESSIONAL EXPERIENCE – ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROJECTS

Kelvin Power Limited, Decommissioning Project, South Africa
Environmental Assessment Practitioner / Project Manager
Conduct an Environmental Authorisation process for the proposed decommissioning and demolition of the Kelvin Power A-Station Power Plant infrastructure.

Black Mountain Mining (Pty) Ltd, Gamsberg Zinc Mine Additional Infrastructure, South Africa
Environmental Assessment Practitioner / Project Manager

Marié Schlechter

Planning and Advisory, Principal Associate

Conduct an Environmental Authorisation process for the proposed construction of additional infrastructure at the Gamsberg Zinc Mine.

Exxaro Resources - Grootegeluk Coal Mine, Turfvlakte Project, Limpopo, South Africa
Environmental Assessment Practitioner / Project Manager
Conduct an Environmental Authorisation processes for the proposed Turfvlakte Opencast Mine at Grootegeluk Coal Mine.

Grindrod Terminals, Environmental Authorisation, Permit and Licence Gap Assessment, South Africa,
Environmental Assessment Practitioner / Project Manager
Assessment of the required environmental authorisation process required for the operation of the terminal facilities.

South 32 Middelburg Colliery, Mpumalanga, South Africa
Environmental Assessment Practitioner / Project Manager
Environmental Authorisation application process for the continuation of activities which commenced unlawfully in terms of Environmental Legislation.

ACWA, Power Bokoort II Solar Development, Northern Cape, South Africa
Environmental Assessment Practitioner / Project Manager
Environmental Authorisation process for a proposed Solar Development near Groblershoop, Northern Cape.

Palabora Copper, Magnetite Expansion Project, Limpopo, South Africa
Environmental Assessment Practitioner / Project Manager
Environmental Authorisation process for the proposed Magnetite Expansion and Additional Infrastructure Project.

Scaw South Africa (Pty) Ltd, Gauteng, South Africa
Environmental Assessment Practitioner / Project Manager
Various projects to ensure environmental compliance at a number of Scaw South Africa sites.

Exxaro Resources - Grootegeluk Coal Mine, Limpopo, South Africa
Environmental Assessment Practitioner / Project Manager
Compilation of a Consolidated Environmental Management Programme Report for Grootegeluk Coal Mine.

Exxaro Resources - Grootegeluk Coal Mine, Limpopo, South Africa
Environmental Assessment Practitioner / Project Manager
Environmental Authorisation process for the proposed New Gate at the Grootegeluk Mine. Project

Palabora Mining Company, Iron Beneficiation Plant Project, Limpopo, South Africa
Environmental Assessment Practitioner / Project Manager
Compilation of an Environmental Management Plan (EMP) Addendum for the proposed Iron Beneficiation Plant for Palabora Mining Company.

Palabora Mining Company, South Paddock Project, Limpopo , South Africa
Environmental Assessment Practitioner / Project Manager
Compilation of an Environmental Management Programme Report Addendum for the South Paddock for Palabora Mining Company.

Palabora Mining Company, Limpopo, South Africa
Environmental Assessment Practitioner / Project Manager
Compilation of a Consolidated Environmental Management Programme (EMP) for Palabora Mining Company.

Marié Schlechter

Planning and Advisory, Principal Associate

PROFESSIONAL EXPERIENCE – INTERNATIONAL CYANIDE MANAGEMENT CODE AUDITING

Agnico Eagle Kittila Gold Plant, Finland
ICMI Mining Technical Auditor
International Cyanide Management Institute Cyanide Code Re-Certification Audit.

AngloGold Ashanti Geita Gold Plant, Tanzania
ICMI Lead and Mining Technical Auditor
International Cyanide Management Institute Cyanide Code Re-Certification Audit.

Barrick Gold North Mara, Bulyanhulu and Buzwagi Gold Plants, Tanzania
ICMI Mining Technical Auditor
International Cyanide Management Institute Cyanide Code Re-Certification Audit.

Newmont Akyem and Ahafo Gold Plants, Ghana
ICMI Lead and Mining Technical Auditor
International Cyanide Management Institute Cyanide Code Re-Certification Audit.

Goldfields Tarkwa and Damang Gold Plants, Ghana
ICMI Lead and Mining Technical Auditor
International Cyanide Management Institute Cyanide Code Re-Certification Audit.

AngloGold Ashanti Sadiola and Yatela Gold Plants, Kayes Region, Mali
ICMI Mining Technical Auditor
International Cyanide Management Institute Cyanide Code Re-Certification Audit.

AngloGold Ashanti Siguiri Gold Plant, Guinea
ICMI Mining Technical Auditor
International Cyanide Management Institute Cyanide Code Re-Certification Audit.

AngloGold Ashanti Vaal River and West Wits Operations, South Africa
ICMI Mining Technical Auditor
International Cyanide Management Institute Cyanide Code Re-Certification Audit.

PROFESSIONAL EXPERIENCE – EHS AUDITING

Total E&P Mozambique Area 1 Ltd, Mozambique
Lead Auditor
Environmental Compliance Audit of the LNG Project and associated infrastructure against the conditions as detailed in the project's environmental licenses (Area 1 Exclusive Facilities, Area 1 and Area 4 Onshore Shared Facilities, Resettlement Village (RV) and Marine Offloading Facility (MOF).

Karpowership, Mozambique
Environmental Auditor
Private Environmental Compliance Audit against regulatory requirements pertaining to the Floating Power Station off the coast of Nacala.

Oiltanking GmbH, Kuriman, Indonesia
Environmental Auditor
Evaluation of an Environmental and Social Action Plan to determine compliance to IFC Performance Standards and World Bank EHS Guidelines.

Samancor Chrome, Operational Sites, South Africa
Lead Auditor
Independent Environmental Audit of the Samancor Chrome Operations.

GammaTec NDT Supplies (Proprietary) Limited, Phase 1 ESA, Gauteng, South Africa
Lead Auditor
Phase I Environmental Site Assessment.

Nedbank Capital, South Africa, South Africa
Environmental Auditor
Environmental Assessment in terms of Equator Principles and IFC Standards as part of a comprehensive technical due diligence for the Greenfields mining project in Mpumalanga.

Lonmin Marikana Operations, Northwest, South Africa
Lead Auditor
Annual Performance Assessment of the Lonmin Marikana Operations' Environmental Management Programme Report.

Lonmin Marikana Concentrator, Northwest, South Africa
Lead Auditor
Audit in terms of evaluation of compliance for the "Other Requirements" as identified in the Environmental Management System.

Anglo American Platinum, South Africa
Environmental Auditor
Independent Group Tailings Environmental Risk Audit of the Anglo-American Platinum Tailings Storage Facilities.

Glencore Wonderkop Smelter, South Africa
Lead Environmental Auditor
Environmental Compliance Audit against the conditions of the Wonderkop Smelter Environmental Management Programmes.

APPENDIX B

Air Quality Impact Assessment

REPORT

AIR FOR THE PROPOSED UPGRADING OF THE M3 AND M4 FURNACES, PSP AND ASSOCIATED INFRASTRUCTURE AT SAMANCOR MIDDELBURG FERROCHROME, MIDDELBURG, MPUMALANGA PROVINCE

Submitted to:

Hendrina Road Middelburg
Steve Tshwete Local Municipality
Nkangala District Municipality
Mpumamlanga
1050

Submitted by:

WSP Group Africa (Pty) Ltd

Building 1, Maxwell Office Park, Magwa Crescent West, Waterfall City, Midrand, 1685, South Africa
P.O. Box 6001, Halfway House, 1685

+27 11 254 4800

41105442

March 2023

Distribution List

1 x electronic copy to Samancor Middelburg Ferrochrome

Record of Issue

Company	Author	Reviewer	Version	Date Issued	Method of Delivery
WSP	Novania Reddy	Kirsten Collett	Draft	23 February 2023	Electronic Copy
WSP	Novania Reddy	Kirsten Collett	Final	14 March 2023	Electronic Copy

Executive Summary

Samancor Middelburg Ferrochrome (MFC) is an existing operation situated in Middelburg, Mpumalanga. MFC produces charge chrome in two complete submerged arc furnaces (SAFs) and two complete direct current (DC) furnaces with associated air abatement and other related equipment. The products are produced from the smelting of a combination of chrome ore, reductants and fluxes. The production facilities at the MFC site also comprises a pelletising and sintering plant (PSP), in which chrome ore fines and furnace dust are agglomerated and sintered to produce pellets which join lumpy chrome ore as feed to the SAFs. Slag tapped from the furnaces contains entrained ferrochrome. It is allowed to cool, then crushed and fed to a metal recovery plant. The barren slag is disposed on a site located on the southern side of the MFC site.

MFC are now proposing to increase the capacity of the existing M3 and M4 furnaces and PSP in order to increase the production rate. Additional to the production increase, MFC also propose to include preheaters to the M3 and M4 furnaces as well as an upgrade of the M3 abatement equipment to increase the efficiency of the equipment.

MFC was issued with an Atmospheric Emission Licence (AEL) by Nkangala District Municipality on 31 May 2019. The AEL was issued to authorise a number of listed activities which may result in atmospheric emissions, as per GNR. 893 of 22 November 2013. Activities at the existing MFC operations are classified, as a listed activity in terms of Category 4: Metallurgical Industry, Subcategory 4.1 Drying and Calcining, Subcategory 4.5 Sinter Plant and Subcategory 4.9 Ferro-alloy Production. The proposed increase in production rate will hence require the amendment of their existing AEL. Additionally, the facility contains a storage and handling location designed to hold more than 100000 tonnes, and as such subcategory 5.1 Storage and Handling of Ore and Coal will be triggered. Given the above, an Air Quality Impact Assessment (AQIA), in the prescribed Atmospheric Impact Report (AIR) format, for the proposed production increase and upgrades, is required in support of the AEL amendment.

As such, MFC have requested WSP Group Africa (Pty) Ltd (WSP) to undertake the AIR in order to assess the air quality impacts associated with the proposed upgrade on the surrounding environment. This report therefore presents the AIR undertaken in support of the process. The AIR comprised a baseline assessment, impact assessment and recommended mitigation measures.

The baseline assessment included a geographic overview of the operations and a review of available meteorological and ambient air quality data for the study area. Key pollutants associated with the project operations included dust fallout, particulate matter of aerodynamic diameter of 10 and 2.5 microns (PM_{10} and $PM_{2.5}$), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and chromium (Cr).

To assess ambient meteorological conditions, site-specific modelled Weather Research and Forecasting (WRF) meteorological data was purchased from Lakes Environmental Software for the period January 2018 to December 2020 to provide an understanding of surface and upper air dispersion characteristics, in the absence of a complete on-site meteorological data set (i.e only wind data was available from the onsite station). The data coverage is centred over the MFC facility (Latitude: 25.80621°S – Longitude: 29.49335°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 South African Regulations Regarding Air Dispersion Modelling (2014). The South African National Accreditation System (SANAS, 2012) TR 07-03 standards stipulate a minimum data recovery of 90% for the dataset to be deemed representative of conditions during a specific reporting period. The percentage recovery for parameters recorded is 100% and is thus considered reliable for use in this assessment. Further, site specific meteorological data from the MFC station was also obtained for comparisons of the wind conditions. The station data recovery was 98% and was thus also reliable for this assessment. The meteorological conditions for the site using the modelled WRF and station data (where applicable) is discussed below.

- Over the period January 2018 to December 2020, average summer and winter temperatures recorded were approximately 21 and 11 °C, respectively using modelled WRF data. Minimum monthly average temperatures ranged from -4 to 2°C in winter, with maximum monthly average temperatures ranging from 30 to 35 °C in summer;
- MFC receives most of its rainfall during summer as indicated by the modelled WRF data. The lowest rainfall levels are experienced during the winter months (June - August). Total rainfall received for 2018, 2019 and 2020 was 585 mm, 374 mm and 586 mm, respectively. Relative humidity is generally moderate, with values ranging from 54 to 66 % during summer and 35 to 52 % during winter; and
- Light to strong winds from the east southeast prevailed in the region as indicated in the modelled WRF and station data, with calm conditions occurring frequently (5.3% and 7.3% of the time, from the WRF and station data, respectively) during the full periods for each dataset.

Dust fallout monitoring at MFC is currently conducted at four on-site monitoring locations. Recent results indicated that all dust fallout monitoring locations were compliant with the National Dust Control Regulations.

MFC also continuously monitors background concentrations of PM_{10}, SO_2 and NO_2 via their onsite station. Background concentrations of these pollutants were assessed below for the period August 2018 to August 2021.

- Measured PM_{10} concentrations were compliant with the annual average NAAQS for PM_{10} (40 µg/m^3) for the entire monitoring period. Ambient PM_{10} concentrations exceeded the 24-hour NAAQS (75 µg/m^3) twenty times and five times during 2019 and 2020 respectively. Since only four exceedances of the 24-hour NAAQS are permitted per annum, PM_{10} concentrations at MFC were non-compliant for 2019 and 2020. PM_{10} concentrations were above the 24-hour NAAQS in 2021 but remained compliant, with less than four exceedances of the 24-hour NAAQS recorded per annum. Given the low data recovery of PM_{10} in 2018 and 2019, these datasets were excluded to obtain an average across all years from the station.
- Measured NO_2 concentrations were compliant with the annual averaging period for NO_2 (40 µg/m^3) for 2018, 2020 and 2021, however in 2019 concentrations were above the annual NAAQS (61 µg/m^3). Ambient NO_2 concentrations exceeded the 1-hour NAAQS (40 µg/m^3) 441 times and 106 times during 2019 and 2020 respectively. Since only 88 exceedances of the 1-hour NAAQS are permitted per annum, NO_2 concentrations at MFC were non-compliant for 2019 and 2020. The P99 1-hour concentration in 2019 was noted to be significantly high and this should be viewed with caution. Such a concentration could likely be a result of inaccurate data recordings from the equipment. Importantly, the data recovery in 2018 and 2020 for NO_2 was a slightly below the recommended data recovery of 90% but has been used in this assessment as it still represents a valuable dataset.
- Measured SO_2 concentrations were compliant with the annual, 24-hour and 1-hour averaging periods for SO_2 (350 µg/m^3, 125 µg/m^3 and 50 µg/m^3 respectively) for the entire period. Importantly, the data recovery in 2018 and 2019 for SO_2 was a little below the recommended data recovery of 90% but has been used in this assessment as it still represents a suitable dataset.

The impact assessment comprised of an emissions inventory and subsequent dispersion modelling simulations. An emissions inventory for the project operations was developed using the United States Environmental Protection Agency (USEPA AP-42) and the Australian Government National Pollutant Inventory (NPI) emission factors. This emissions inventory was input into a Level 2 atmospheric dispersion model, AERMOD, together with prognostic WRF meteorological data, to calculate ambient air concentrations at specified sensitive receptors of key pollutants associated with the project operations. Sensitive receptors were identified as areas that may be impacted negatively due to emissions from the project operations. Seventeen sensitive receptors were selected for this assessment.

Modelled predicted long-term and short-term average concentrations were compared with the respective National Ambient Air Quality Standards (NAAQS) as applicable for the project.

Three modelling scenarios have been considered for this assessment:

- Scenario 1: Existing operations.
- Scenario 2: Existing operations and the proposed production increase operations (with new installed preheaters)., otherwise considered as the cumulative operations
- Scenario 3: Existing operations, the proposed production increase operations (with new installed preheaters) and the change of the M3 abatement upgrade. Also referred to as the cumulative operations, with abatement upgrade.

Results indicated that:

- All predicted dust fallout rates, PM_{10}, $PM_{2.5}$, NO_2, SO_2 and Cr concentrations for all averaging periods for all scenarios were below their relevant standards at all surrounding sensitive receptors.

Based on the findings of the assessment, it is of our opinion that the proposed changes can be authorised, with the necessary mitigation measures, as discussed in Section 7.0, be implemented to effectively control emissions.

List of Abbreviations and Terms	
AEL	Atmospheric Emission License
AIR	Atmospheric Impact Report
AQIA	Air Quality Impact Assessment
AQMP	Air Quality Management Plan
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
Cr	Chromium
DC	Direct Current
HCFeCr	Ferrochrome High Carbon
HP	High Pressure
HPA	Highveld Priority Area
IFC	International Finance Corporation
LP	Low Pressure
MES	Minimum Emission Standard
MFC	Middelburg Ferrochrome
MSP	Metal Separation Plant
NAAQS	National Ambient Air Quality Standard
NEM:AQA	National Environmental Management: Air Quality Act (Act no. 39 of 2004)
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
PAH	Polycyclic Aromatic Hydrocarbons
PM_{10}	Particulate matter of aerodynamic diameter 10 microns
$PM_{2.5}$	Particulate matter of aerodynamic diameter 2.5 microns
PSP	Pelletising and Sintering Plant
SAF	Submerged-Arc furnaces
SANAS	South African National Accreditation System
SO_2	Sulphur Dioxide
SRTM	Shuttle Radar Topography Mission
USEPA	United States Environmental Protection Agency
WRF	Weather Research and Forecasting
WSP	WSP Group Africa (Pty) Ltd

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

Samancor Middelburg Ferrochrome (MFC) is an existing operation situated in Middelburg, Mpumalanga. MFC produces charge chrome in two complete submerged arc furnaces (SAFs) and two complete direct current (DC) furnaces with associated air abatement and other related equipment. The products are produced from the smelting of a combination of chrome ore, reductants and fluxes. The production facilities at the MFC site also comprises a pelletising and sintering plant (PSP), in which chrome ore fines and furnace dust are agglomerated and sintered to produce pellets which join lumpy chrome ore as feed to the SAFs. Slag tapped from the furnaces contains entrained ferrochrome. It is allowed to cool, then crushed and fed to a metal recovery plant. The barren slag is disposed on a site located on the southern side of the MFC site. MFC are now proposing to increase the capacity of the existing M3 and M4 furnaces and PSP in order to increase the production rate. Additional to the production increase, MFC also wish to include preheaters to the M3 and M4 furnaces as well as an upgrade of the M3 abatement equipment to increase the efficiency of the equipment.

MFC was issued with an Atmospheric Emission Licence (AEL) by Nkangala District Municipality on 31 May 2019. The AEL was issued to authorise a number of listed activities which may result in atmospheric emissions, as per Government Notice 893 of 22 November 2013. Activities at the existing MFC operations are classified, as a listed activity in terms of Category 4: Metallurgical Industry, Subcategory 4.1 Drying and Calcining, Subcategory 4.5 Sinter Plant and Subcategory 4.9 Ferro-alloy Production. The proposed upgrade to increase the production rate will hence require an amendment of their existing AEL. Additionally, the facility now contains a storage and handling location designed to hold more than 100,000 tonnenes, and as such subcategory 5.1 Storage and Handling of Ore and Coal will need to be included. Given the above, an Air Quality Impact Assessment (AQIA), in the prescribed Atmospheric Impact Report (AIR) format, for the proposed production increase and upgrades, is required in support of the AEL amendment.

MFC have requested WSP Group Africa (Pty) Ltd (WSP) to undertake the AIR in order to assess the air quality impacts associated with the proposed changes on the surrounding environment. This report therefore presents the AIR undertaken in support of the process.

2.0 ENTERPRISE DETAILS

2.1 Enterprise and contact details

Details of the MFC operations are provided in Table 1.

Table 1: Enterprise and contact details

Enterprise Name	Samancor Middelburg Ferrochrome
Trading As	Samancor Middelburg Ferrochrome
Name of Operation	Samancor Middelburg Ferrochrome
Enterprise Registration Number (Registration Numbers if Joint Venture)	1926/00888/06
Registered Address	Hendrina Road Middelburg, Steve Tshwete Municipality, Nkangala District Municipality, Mpumalanga, 1050
Postal Address	Private Bag x251845, Middelburg, Mpumalanga, South Africa, 1050
Telephone Number (General)	013 249 4471
Industry Sector	24101-8 (Production of ferro-alloys)
Name of Responsible Officer	Heather Booysen

Enterprise Name	Samancor Middelburg Ferrochrome
Name of Emission Control Officer	Heather Booysen
Telephone Number	013 249 4471
Cell Phone Number	082 923 3530
Fax Number	013 249 4894
Email Address	Liesel.Ehlers@SamancorCr.com
After Hours Contact Details	082 923 3530
Land Use Zoning as per Town Planning Scheme	Industrial

2.2 Location and extent of plant

The location and extent of the facility is described in Table 2 and illustrated in Figure 1.

Table 2: Location and extent of plant

Enterprise Name	Samancor Middelburg Ferrochrome
Physical Address of the Premises	Hendrina Road Middelburg
Description of Site (Erf)	The site lies about 4.5 km southeast of the centre of Middelburg on the eastern bank of the Vaalbankspruit and covers approximately 362 hectares. The highest point on the property is in the eastern corner at an elevation of 1,520 m above MSL and slopes down to 1,460 m MSL towards the Vaalbankspruit
Coordinates of Approximate Centre of Operations	Latitude: -25.802927°E Longitude 29.492938°S
Extent (km²)	3.62
Elevation Above Mean Sea Level (m)	1,500
Province	Mpumalanga
Metropolitan/District Municipality	Nkangala District Municipality
Local Municipality	Steve Tshwete Local Municipality
Designated Priority Area	Highveld Priority Area

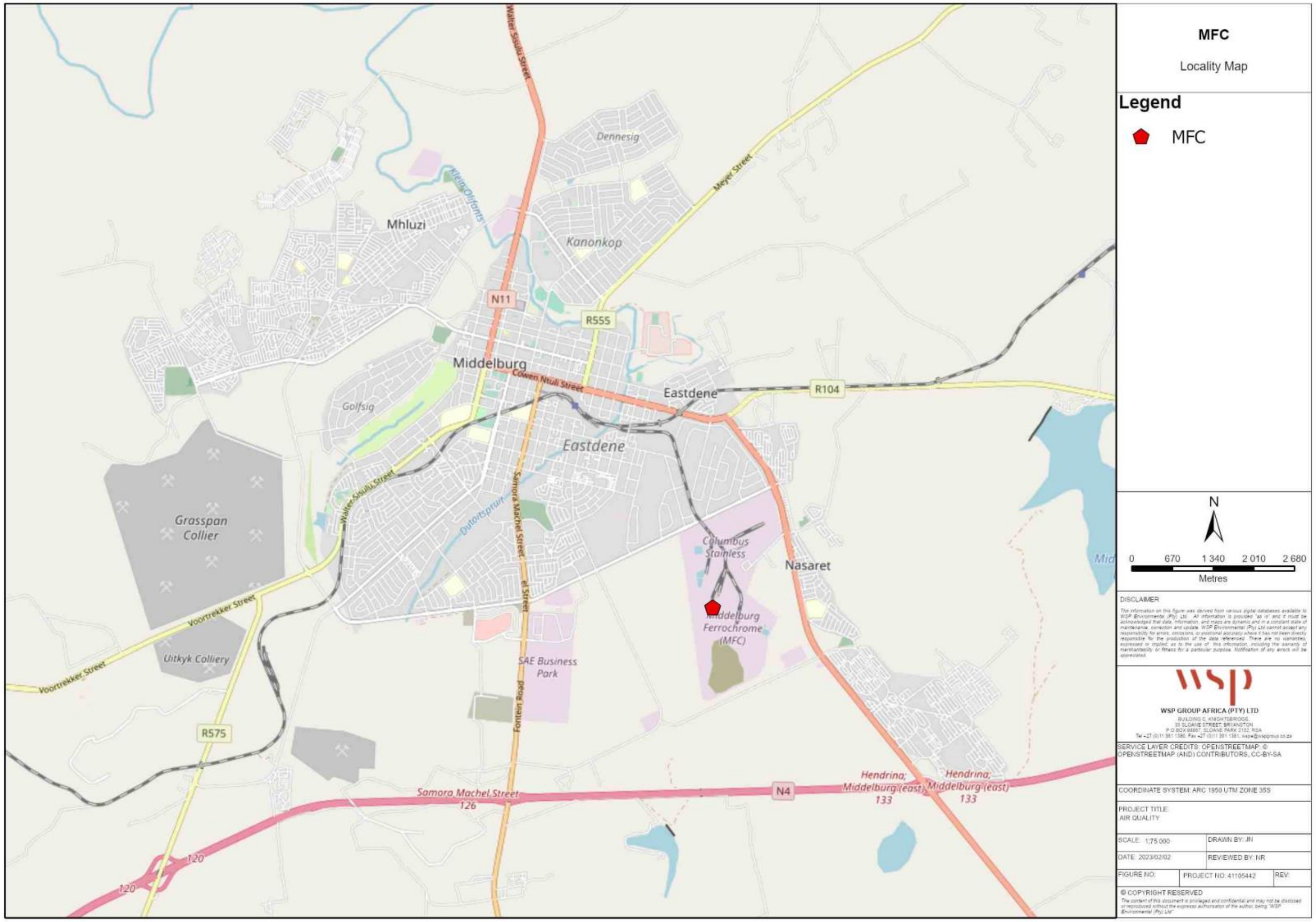


Figure 1: Locality map of MFC

2.3 Description of surrounding land use

MFC lies within the Steve Tshwete Local Municipality, 1.5 km north of the N4 highway. Various land uses surround the MFC operations, these include:

- Residential areas: The nearest residential area is Nazareth on the eastern boundary of the site within 1 km of the closest Middelburg Ferrochrome Installation. Middelburg suburb areas are within 2 km north and 2.5 km west of the site.
- Industrial areas: Calmisil and Harsco operating to the east and southeast of MFC with Columbus Stainless operating east and northeast of the site. Infrabuild is also situated between Columbus Stainless and MFC on the northern side of the plant boundary. Several small industries are included in the Industrial Zone to the north of the property. West of the MFC site are several newly established industrial and commercial zones with Steve Tshwete water works located to the southwest of the site.

Sensitive receptors are defined by the United Stated Environmental Protection Agency (USEPA) as areas where occupants are more susceptible to the adverse effects of exposure to pollutants. These areas include but are not limited to residential areas, hospitals/clinics, schools and day care facilities and elderly housing.

The following sensitive receptors within a 10 km radius of the MFC operations were identified for this assessment and are presented in Table 3 and Figure 2.

Table 3: Sensitive receptors within a 10 km radius of the MFC operations

No.	Sensitive Receptor Name	Coordinates		Distance from Site Boundary (km)	Direction from Site
		Longitude (°S)	Latitude (°E)		
1	4D Scan Hospital	29.4377	-25.7493	7.52	North-northwest
2	Aerorand	29.4325	-25.8041	5.62	West
3	Dennesig	29.4736	-25.7354	6.94	North
4	Hoerskool Middelburg	29.4564	-25.7698	4.73	North-northwest
5	Industria	29.4905	-25.7853	0.87	North
6	Laerskool Dennesig	29.4784	-25.7332	6.92	North
7	Malope Village	29.4129	-25.7734	8.31	Northwest
8	Mhluzi	29.4266	-25.7573	7.83	Northwest
9	Middelburg - MP	29.4684	-25.7725	3.52	North northwest
10	Middelburg Hospital	29.4504	-25.7760	4.63	Northwest
11	Middelburg Town Masjid	29.4585	-25.7662	4.84	North-northwest
12	Middelburg-Midmed PVT Hospital	29.4578	-25.7635	5.13	North-northwest
13	Mineralia	29.4673	-25.7963	2.11	West-northwest
14	Mphanama Secondary School	29.4304	-25.7531	7.95	North-northwest

No.	Sensitive Receptor Name	Coordinates		Distance from Site Boundary (km)	Direction from Site
		Longitude (°S)	Latitude (°E)		
15	Nazareth	29.5083	-25.7990	0.93	East
16	Rockdale	29.5209	-25.8191	1.86	Southeast
17	Sozama Secondary School	29.4317	-25.7564	7.64	North-northwest

2.4 Atmospheric emission licence

MFC was issued with an AEL by Nkangala District Municipality on 31 May 2019. The AEL was issued to authorise a number of listed activities triggered, as per Government Notice 893 of 22 November 2013. Activities at the existing MFC operations are classified as a listed activity in terms of Category 4: Metallurgical Industry, Subcategory 4.1 Drying and Calcining, Subcategory 4.5 Sinter Plant and Subcategory 4.9 Ferro-alloy Production. The proposed increase in the production rate will hence require the amendment of the existing AEL. Additionally, the facility containsentails a storage and handling location designed to hold more than 100,000 tonnes, and as such subcategory 5.1 Storage and Handling of Ore and Coal will be triggered. This AIR has therefore been compiled in accordance with the prescribed AIR format in terms of Government Notice 747, dated 11 October 2013 as amended, in support of the AEL application.

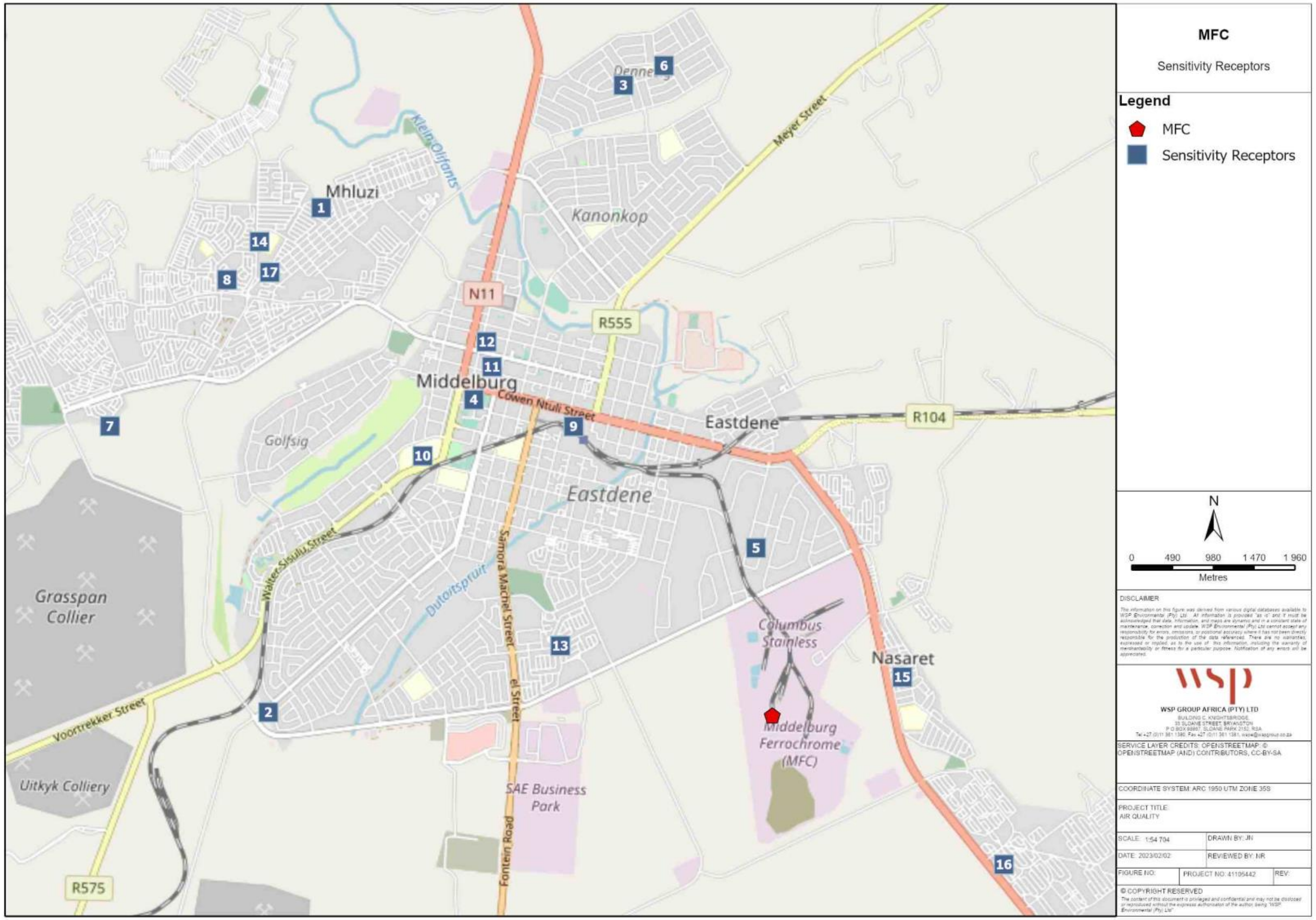


Figure 2: Sensitive receptors within a 10 km radius of MFC

3.0 NATURE OF PROCESS

3.1 Listed activities

Listed activities and associated minimum emission standards (MES) were published in Government Notice 248 of 2010, Government Gazette 33064 in-line with Section 21 of the National Environmental Management: Air Quality Act 39 of 2004 (NEM:AQA). An amended list of activities was published in Government Notice 893 of 2013, Government Gazette 37054, Government Notice 551 of 2015, Government Gazette 38863 and further in Government Notice 1207 of 2018, Government Gazette 42013. Activities at the MFC operations are classified, as a listed activity in terms of Category 4: Metallurgical Industry, Subcategory 4.1 Drying and Calcining, Subcategory 4.5 Sinter Plant and Subcategory 4.9 Ferro-alloy Production. Additionally, the facility contains a storage and handling location designed to hold more than 100,000 tonnes, and as such subcategory 5.1 Storage and Handling of Ore and Coal will need to be included within the AEL amendment. The listed activities are detailed in Table 4.

Table 4: Listed activities applicable to MFC

Category of Listed Activity	Sub-category of Listed Activity	Description of the Listed Activity
4 – Metallurgical Industry	4.1 – Drying and Calcining	Drying and calcining of mineral solids including ore
	4.5 – Sinter Plant	Sinter plants for agglomeration of fine ores using a heating process, including sinter cooling where applicable
	4.9 – Ferro-alloy Production	Production of alloys of iron with chromium, manganese, silicon or vanadium, the separation of titanium slag from iron-containing minerals using heat
5 – Mineral Processing, Storage and Handling	5.1 – Storage and Handling of Ore and Coal	Storage and handling of ore and coal not situated on the premises of a mine or works as defined in the Mines Health and Safety Act 29/1996

3.2 Process description

MFC produces two grades of ferrochrome: charge chrome and intermediate carbon ferrochrome. Ferrochrome is a carbo-thermic reduction operation, taking place at high temperatures. The ore (an oxide of chromium and iron) is reduced by reductants to form an iron-chromium alloy called ferrochrome.

3.2.1 Current operations

3.2.1.1 Pelletising and Sintering Plant

The PSP produces pellets through sintering of chromite ore fines. The chromite ore and reductants are agglomerated to produce pellets. The pellets are passed through the sintering plants to ensure they remain intact during handling. The PSP produces filter cakes from the main stack scrubber system.

3.2.1.2 M1 and M2 furnaces

Chromite ore, reductants and fluxes are stored in raw material stockpile bunkers. Chromite ore from the raw material stockpiles and the reductants and fluxes are pre-mixed into a recipe, which is then fed into the open furnaces (M1 and M2, furnaces). The key furnace inputs are pellets, chromite ore, reductants and fluxes. The furnaces then produce alloy-slag, which is taken to the licenced slag disposal site, dust from the filter bag plant (baghouse), which is disposed at a licenced hazardous landfill site. Final product is then produced and transported to various customers.

3.2.1.3 M3 and M4 furnaces

The M3 and M4 furnaces input dried raw materials from the chromite ore dryers as well as the reductant dryer. The chromite ore dryers are fed raw materials from the raw material stockpiles and output “dried” chromite ore material. The heat for the reaction at M3 and M4 comes from the electric arc formed between the tip of the electrode in the bottom of the furnace and the furnace hearth. Tapping takes place intermittently at all the furnaces. When enough smelted ferrochrome has accumulated in the furnace, the tap hole is drilled and lanced open and a stream of molten metal and/or slag flows down a trough into a casting bay or ladle. The ferrochrome solidifies in large casting bays, while the slag is separated and stockpiled for further processing. The bulk of the slag is transported by slag carriers and hot tipped at the hot tip on the slag disposal site. When cooled the alloy-slag is temporarily stockpiled before it is directed to the metal separation plant (MSP) to separate slag from alloy.

3.2.2 Proposed operations

MFC now wishes to increase their production rate, install new preheaters and upgrade the M3 furnace abatement equipment. The following infrastructure changes are noted below.

3.2.2.1 Pelletising and Sintering Plant

The proposed change to the PSP involves an improved operating philosophy resulting in an increased production throughput. This will result in a higher consumption of raw materials and other plant utilities and an increase in the gas stack volumetric flow. Additionally, the abatement equipment will be upgraded to accommodate this production increase, to reach an efficiency of 99%.

3.2.2.2 M3 and M4 furnace

The proposed changes to the M3 Furnace will include the upgrade of the current furnace off gas abatement equipment to ensure environmental compliance to the latest air emissions requirements. Additional infrastructure will also be incorporated in the process feed stream of the furnace. This will improve the furnace electrical efficiency and will result in the furnace producing more ferrochrome high carbon (HCFeCr), consuming more raw materials and other utilities. It will increase the gas stack volumetric flow.

The proposed changes to the M4 furnace will entail additional infrastructure to be incorporated in the process feed stream of the furnace. This will improve the furnace electrical efficiency and will result in the furnace producing more HCFeCr, consuming more raw materials and other utilities. It will increase the gas stack volumetric flow.

3.2.2.3 M3 and M4 preheaters

Two new preheaters will be installed before the M3 and M4 furnaces to improve the efficiency of the process.

3.2.2.4 M3 abatement upgrade

The proposed change to the M3 furnace will involve an upgrade of the abatement equipment to reach an efficiency of 99%.

The block flow, process flow diagrams and layout of the facility are illustrated from Figure 3 to Figure 6.

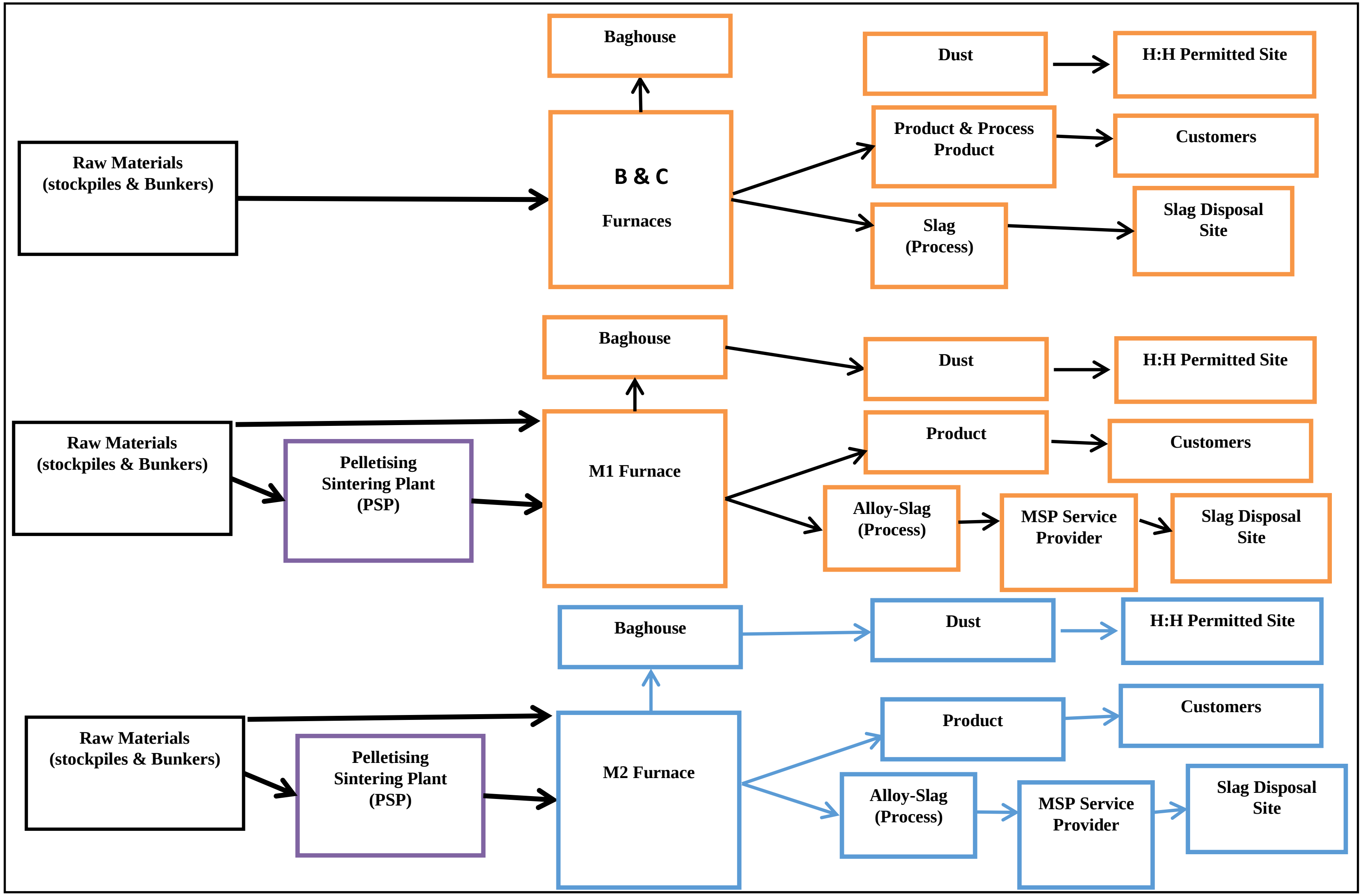


Figure 3: Block flow diagram of the flow furnaces B&C, M1 and M2

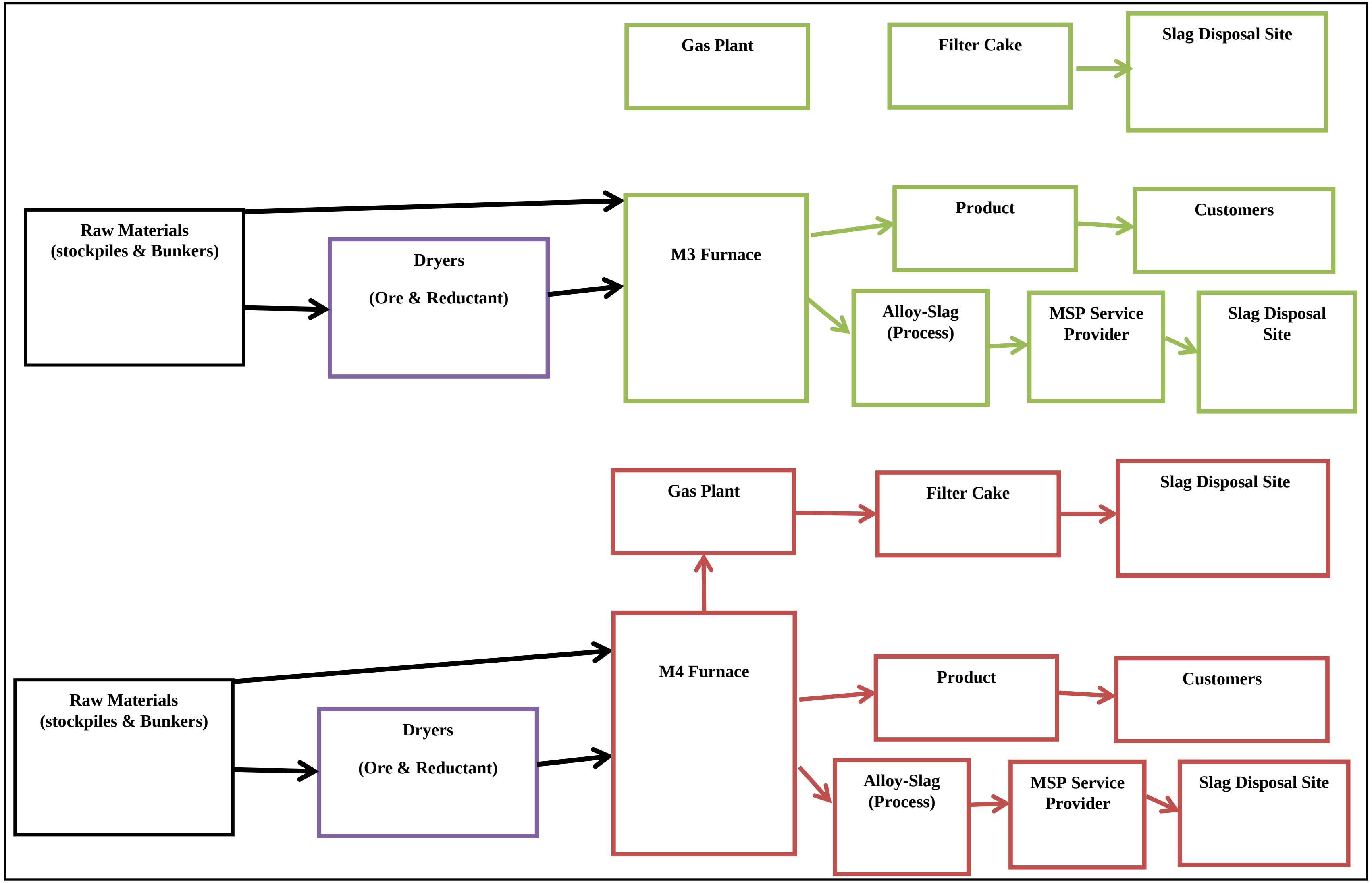


Figure 4: Block flow diagram of the flow dryers

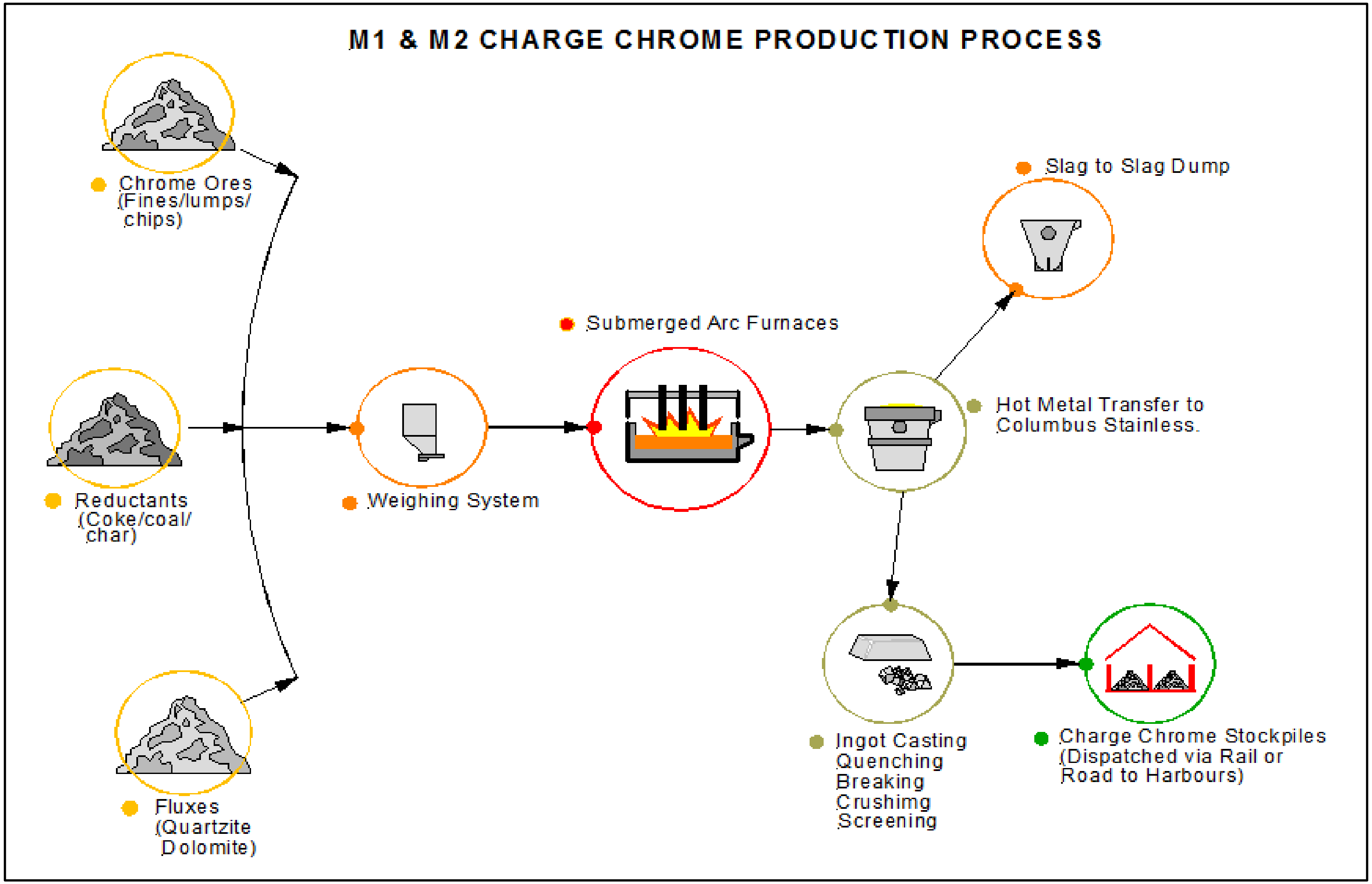


Figure 5: Process flow diagram of furnace M1 and M2

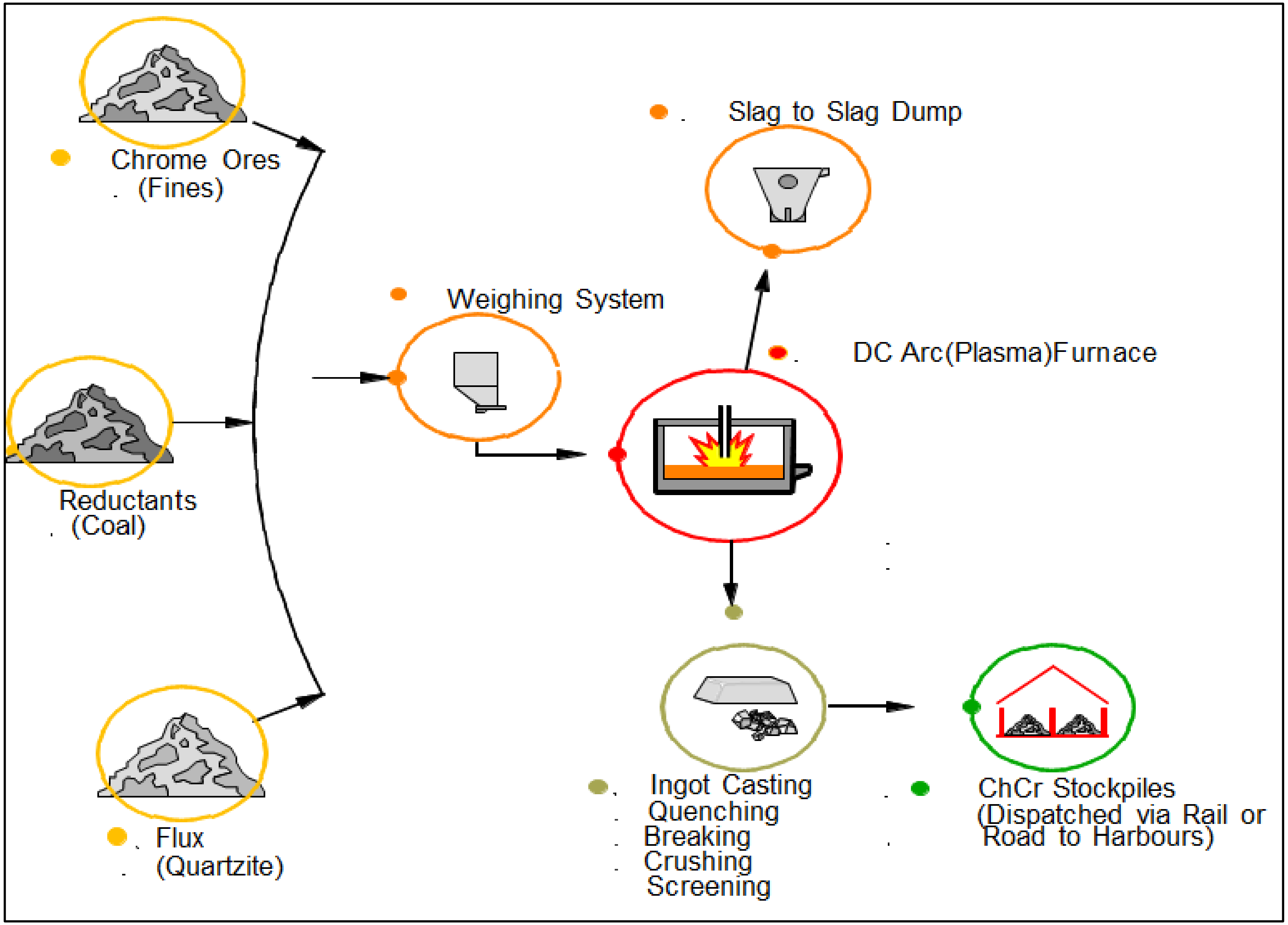


Figure 6: Process flow diagram of furnace M3 and M4

The processes associated with the MFC operations are tabulated below in Table 5.

Table 5: Unit processes at MFC

Unit Process	Unit Process Function	Batch or Continuous Process
RMS1, RMS2, RMS3	Raw materials storage and conveyance	Continuous
M1 Furnace	Heat is generated and transferred to materials with the objective of bringing about physical and chemical changes	Continuous
M2 Furnace	Heat is generated and transferred to materials with the objective of bringing about physical and chemical changes	Continuous
M3 Furnace	Heat is generated and transferred to materials with the objective of bringing about physical and chemical changes	Continuous
M4 Furnace	Heat is generated and transferred to materials with the objective of bringing about physical and chemical changes	Continuous
PSP	Pelletising sintering plant – agglomerate iron ore fines (dust) with other fine materials at high temperature, to create a product that can be used in a furnace	Continuous
Chromite Ore Dryer (M3)	Drying of chromite ore	Continuous
Chromite Ore Dryer (M4)	Drying of chromite ore	Continuous
Sub Arc (B&C)	Furnace – heat is generated and transferred to materials with the objective of bringing about physical and chemical changes	Continuous
Crusher Plant	Crushing and screening of final product	Continuous
MSP	Metal separation plant	Continuous
Reductant Dryer (RD)	Drying reductants	Continuous
Slag Dump	Slag disposal	Continuous
M3 Preheater	Preheater	Continuous
M4 Preheater	Preheater	Continuous

4.0 TECHNICAL INFORMATION

4.1 Raw material used

Table 6 provides the raw materials used at MFC.

Table 6: Raw materials used at MFC

Raw Material Type	Maximum Permitted Consumption Rate (Quantity)	Units (Quantity / period)
Chromite ore (M1)	288,000	Tonnes/annum
Fluxes – limestonnee and quartz (M1)	55,300	Tonnes/annum
Reductant – coal, coke and anthracite (M1)	85,000	Tonnes/annum
Chromite ore (M2)	288,000	Tonnes/annum
Fluxes – limestonnee and quartz (M2)	55,300	Tonnes/annum
Reductant – coal, coke and anthracite (M2)	85,000	Tonnes/annum
Chromite ore (M3)	392,123	Tonnes/annum
Fluxes – limestonnee, burnt lime and quartz (M3)	68,475	Tonnes/annum
Reductant – coal, coke and anthracite (M3)	105,346	Tonnes/annum
Chromite ore (M4)	441,648	Tonnes/annum
Fluxes – limestonnee, burnt lime and quartz (M4)	75,878	Tonnes/annum
Reductant – coal, coke and anthracite (M4)	113,925	Tonnes/annum
Chromite ore sub arc (B and C furnaces)	99,000	Tonnes/annum
Fluxes sub arc – quartz (B and C furnaces)	48,000	Tonnes/annum
Reductant sub arc – char, coal, coke and briquettes (B and C furnaces)	18,000	Tonnes/annum
Chromite ore (PSP)	744,600	Tonnes/annum
Reductant – anthracite, coke and char (PSP)	48,000	Tonnes/annum
Pellets (PSP)	730,000	Tonnes/annum
Chromite ore (M3 ore dryer)	407,000	Tonnes/annum
Chromite ore (M4 ore dryer)	481,800	Tonnes/annum

Raw Material Type	Maximum Permitted Consumption Rate (Quantity)	Units (Quantity / period)
Reductant – coal, coke and anthracite (reductant dryer)	525,600	Tonnes/annum

4.2 Appliances and abatement equipment control technology

Appliances and abatement equipment control technology to be installed at MFC are presented in Table 7.

Table 7: Appliances and abatement equipment control technology

Appliance Name	Appliance Type/Description	Appliance Function/Purpose
M1 Baghouse	Brandt cyclone and bag filter	Decrease atmospheric emissions
M2 Baghouse	Flakt cyclone and bag filter	Decrease atmospheric emissions
M3 Gasplant	Howden airpol	Decrease atmospheric emissions
M4 Gasplant	Theissen disintegrator scrubber	Decrease atmospheric emissions
PSP Main	Autotech scrubber	Decrease atmospheric emissions
Reductant Dryer	Drytech dryer	Decrease atmospheric emissions
MTC Dust Plant	Gebaire reverse jet	Decrease atmospheric emissions
MTC Dust Plant	Gebaire reverse jet	Decrease atmospheric emissions
M3 Ore Dryer	Drytech dryer	Decrease atmospheric emissions
M4 Ore Dryer	Drytech dryer	Decrease atmospheric emissions

5.0 ATMOSPHERIC EMISSIONS

During the operations at MFC, stationary emissions are likely to arise from the PSP, preheaters, furnaces and dryers whilst fugitive emissions are likely to arise from material handling, wind erosion, crushing and paved and unpaved roads. Three modelling scenarios were considered for this assessment, namely:

- Scenario 1: Existing operations.
- Scenario 2: Existing operations and the proposed production increase operations (with upgraded PSP abatement equipment and new installed preheaters), otherwise considered as the cumulative operations.
- Scenario 3: Existing operations, the proposed production increase operations (as above) and the change of the M3 abatement upgrade. Also referred to as the cumulative operations, with abatement upgrade.

The following sections detail these emissions for each scenario.

5.1 Point sources

Physical parameters of the stacks for each scenario were obtained, either through the current AEL (for stack parameters) and stack testing reports (for flow rates, temperatures, velocities and emission rates where provided) or directly supplied information from the design engineers (Table 8 and Table 10). The variables were used to calculate the emissions rates (where information was not provided) from the stacks and are presented in Table 9, Table 11 and Table 12.

Table 8: Physical parameters of the stacks at MFC for Scenario 1

EU Code	Source Name	Latitude (°E)	Longitude (°S)	Height of Release above Ground (m)	Height Above Nearby Building	Diameter at Stack Tip/Vent Exit (m)	Actual Gas Exit Temperature (°C)	Actual Gas Volumetric Flow (m^3/hr)	Actual Gas Velocity (m/s)
EU0001	EUM1	-25.8032	29.4904	26	20	2.70	79.50	4,826.77	14.34
EU0002	EUM2	-25.8034	29.4904	22	15	2.70	71.90	5,100.84	14.32
EU0003	EUM3	-25.8041	29.4944	55	45	0.75	34.74	37,833.00	14.46
EU0004	EUM4	-25.8050	29.4944	60	50	0.81	36.25	29,820.24	10.55
EU0005	EU PSP MAIN	-25.8007	29.4917	40	28	2.18	77.83	367,008.00	26.77
EU0009	EU RD	-25.8059	29.4932	15	2	0.52	66.10	31,814.23	11.25
EU00010[1]	EU B FURNACE[1]	-25.803006°	29.494457°	25	20	2.70	146.00	177,000.00	4.50
EU00011[1]	EU C FURNACE[1]	-25.802920°	29.494467°	25	20	2.70	146.00	177,000.00	4.50
EU00013	EU OD1	-25.8042	29.4923	14	12	0.91	88.97	35,662.39	26.11
EU00014	EU OD2	-25.8045	29.4922	14	12	0.91	81.60	34,591.05	15.10

Note: [1]These units are shut down and thus have not been considered further in this assessment

Table 9: Emission rates of the stacks at MFC for Scenario 1

EU Code	Source Name	Emission Rate (g/s)				
		PM_{10}	$PM_{2.5}$	NO_2	SO_2	Cr
EU0001	EUM1	0.02	0.01	0.02	0.01	0.003
EU0002	EUM2	0.07	0.07	0.01	0.01	-
EU0003	EUM3	0.21	0.19	9.67	0.02	-
EU0004	EUM4	0.05	0.04	1.09	0.003	0.003
EU0005	EU PSP MAIN	6.04	5.60	15.56	9.41	-
EU0009	EU RD	0.15	0.14	0.71	0.003	-
EU00013	EU OD1	0.03	0.02	0.04	0.05	-
EU00014	EU OD2	0.26	0.24	0.19	0.002	-

Table 10: Physical parameters of the stacks at MFC for Scenario 2 and Scenario 3

EU Code	Source Name	Latitude (°S)	Longitude (°E)	Height of Release above Ground (m)	Height Above Nearby Building	Diameter at Stack Tip/Vent Exit (m)	Actual Gas Exit Temperature (°C)	Actual Gas Volumetric Flow (m^3/hr)	Actual Gas Velocity (m/s)
EU0001	EUM1	-25.8032	29.4904	26	20	2.7	79.50	4,826.77	14.34
EU0002	EUM2	-25.8034	29.4904	22	15	2.7	71.88	5,100.84	14.32
EU0003	EUM3	-25.8041	29.4944	55	45	0.75	55.00	30,000.00	18.90
EU0004	EUM4	-25.8050	29.4944	60	50	0.813	55.00	34,000.00	18.20
EU0005	EU PSP MAIN	-25.8007	29.4917	40	28	2.18	80.00	430,000.00	32.00
EU0009	EU RD	-25.8059	29.4932	15	2	0.52	66.10	31,814.23	11.25
EU00010	EU B FURNACE[1]	-25.803006°	29.494457°	25	20	2.7	146.00	177,000.00	4.50
EU00011	EU C FURNACE[1]	-25.802920°	29.494467°	25	20	2.7	146.00	177,000.00	4.50
EU00013	EU OD1	-25.8042	29.4923	14	12	0.912	88.97	35,662.39	26.11
EU00014	EU OD2	-25.8045	29.4922	14	12	0.912	81.60	34,591.05	15.10
EU00015	Preheater to M3	-25.8032	29.4904	55	45	1.70	200.00	140,000.00	17.10
EU00016	Preheater to M4	-25.8034	29.4904	60	50	1.70	200.00	160,000.00	19.60

Note: [1]These units are shut down and thus have not been considered further in this assessment

Table 11: Emission rates of the stacks at MFC for Scenario 2

EU Code	Source Name	Emission Rate (g/s)				
		PM_{10}	$PM_{2.5}$	NO_2	SO_2	Cr
EU0001	EUM1	0.02	0.01	0.02	0.01	0.003
EU0002	EUM2	0.07	0.07	0.01	0.01	-
EU0003	EUM3	0.01	0.01	13.87	0.003	-
EU0004	EUM4	0.75	0.70	15.72	3.93	0.004
EU0005	EU PSP MAIN	0.09	0.08	1.85	0.46	-
EU0009	EU RD	0.15	0.14	0.71	0.003	-
EU00013	EU OD1	0.03	0.02	0.07	0.05	-
EU00014	EU OD2	0.26	0.24	0.19	0.002	-
EU00015	Preheater to M3	2.16	2.00	44.90	11.23	-
EU00016	Preheater to M4	2.46	2.28	15.32	12.83	-

Table 12: Emission rates of the stacks at MFC for Scenario 3

EU Code	Source Name	Emission Rate (g/s)				
		PM_{10}	$PM_{2.5}$	NO_2	SO_2	Cr
EU0001	EUM1	0.02	0.01	0.02	0.01	0.003
EU0002	EUM2	0.07	0.07	0.01	0.01	-
EU0003[1]	**EUM3**	**0.01**	**0.01**	**0.14**	**0.003**	-
EU0004	EUM4	0.75	0.70	15.72	3.93	0.004
EU0005	EU PSP MAIN	0.09	0.08	1.85	0.46	-
EU0009	EU RD	0.15	0.14	0.71	0.003	-
EU00010	EU B FURNACE	0.03	0.02	0.07	0.05	-
EU00011	EU C FURNACE	0.26	0.24	0.19	0.002	-
EU00013	EU OD1	2.16	2.00	44.90	11.23	-
EU00014	EU OD2	2.46	2.28	15.32	12.83	-
EU00015	Preheater to M3	0.02	0.01	0.02	0.01	-
EU00016	Preheater to M4	0.07	0.07	0.01	0.01	-

Note: [1]Only change to this scenario is that of the M3 abatement upgraded equipment, all other stack emission rates remain the same as Scenario 2, as such this row is highlighted in bold

5.2 Point source maximum emission rates (normal operating conditions)

As per Section 21 of the NEM:AQA, the maximum permitted emission rates for point sources at MFC are presented in Table 13.

Table 13: Point source emission rates under normal operating conditions

Point Source Code	Pollutant Name	Maximum Release Rate			Duration of Emissions
		(mg/Nm^3)	Date to be Achieved By	Average Period	
Sub Arc Furnace B and C and Furnaces M1 to M4	PM	100	Immediately	Daily	24
		30	1st April 2020	Daily	24
	SO_2	500	Immediately	Daily	24
		500	1st April 2020	Daily	24
	NO_x expressed as NO_2	750	Immediately	Daily	24
		400	1st April 2020	Daily	24
PSP	PM	100	Immediately	Daily	24
		50	1st April 2020	Daily	24
	SO_2	1000	Immediately	Daily	24
		500	1st April 2020	Daily	24
	NO_x expressed as NO_2	1200	Immediately	Daily	24
		700	1st April 2020	Daily	24
Reductant Drier and M3 and M4 Ore Dryers	PM	100	Immediately	Daily	24
		50	1st April 2020	Daily	24
	SO_2	1000	Immediately	Daily	24
		1000	1st April 2020	Daily	24
	NO_x expressed as NO_2	1200	Immediately	Daily	24
		500	1st April 2020	Daily	24

5.3 Point source maximum emission rates (start-up, shut-down, upset and maintenance conditions)

A start-up duration of 96 hours is expected during short shutdowns. The availability of the open and closed furnaces are both predicted to be 48 hours. Long shut down procedures are expected to have a start-up duration of 120 hours. The availability of the open and closed furnaces are predicted to be 120 hours and 96 hours, respectively. Point source maximum emissions rates are as above in Figure 12.

5.4 Fugitive emissions (area/line sources)

Fugitive emissions at MFC originate from the following sources:

- Materials handling activities.
- Wind erosion from stockpiles.
- Crushing activities.

- Paved and unpaved roads.

5.4.1 Material handling

Materials handling operations predicted to result in fugitive emissions include the transfer of material by means of tipping, loading and offloading. The quantity of dust which will be generated from such loading and off-loading operations will depend on various climatic parameters (such as wind speed and precipitation) andnon-climatic parameters (such as the nature (moisture content) and volume of the material handled). Fine particulates are more readily disaggregated and released to the atmosphere during the material transfer process as a result of exposure to strong winds. Increase in the moisture content of the material being transferred would decrease the potential for dust emissions since moisture promotes the aggregation and cementation of fines to the surfaces of larger particles (USEPA, 2006).

The following default emission factors from USEPA AP42 Chapter 13.2.4 Aggregate Handling and Storage Piles (USEPA, 1995) were used to calculate particulate emissions:

Raw material:

$PM_{2.5}$ Loading/Offloading emission factor: 0.00018 kg/tonnene

PM_{10} Loading/Offloading emission factor: 0.0012 kg/tonnene

TSP Loading/Offloading emission factor: 0.002 kg/tonnene

Sinter:

$PM_{2.5}$ Loading/Offloading emission factor: 0.00003 kg/tonnene

PM_{10} Loading/Offloading emission factor: 0.0002 kg/tonnene

TSP Loading/Offloading emission factor: 0.0004 kg/tonnene

Smelting/Final Product:

$PM_{2.5}$ Loading/Offloading emission factor: 0.00002 kg/tonnene

PM_{10} Loading/Offloading emission factor: 0.0001 kg/tonnene

TSP Loading/Offloading emission factor:0.0003 kg/tonnene

A 50% control efficiency was applied to the materials handling activities (COACOACoA, 2012) for various mitigation methods implemented as per Client data. Importantly, material handling from crushing activities (transfer of material) are excluded (to prevent double accounting of emissions) as the crushing emission factors include emissions from the screens, the crusher, feeder, and conveyor belt transfer points that are integral to the crusher (COACOACoA, 2012). Physical parameters and calculated emission rates for materials handling are given in Table 14 and Table 15.

Table 14: Source parameters for materials handling activities

Source	Scenario 1	Scenario 2 and Scenario 3
	Total Throughput (Tonnes/hr)	
Raw Materials:		
Offload raw materials from truck onto raw material stockpile 1	49.63	67.50
Offload raw materials from truck onto raw material stockpile 2	49.63	67.50

Source	Scenario 1	Scenario 2 and Scenario 3
	Total Throughput (Tonnes/hr)	
Load front end loader (FEL) from raw material stockpile 1	33.09	45.00
Offload raw material stockpile 1 from FEL onto bunker 1	33.09	45.00
Load FEL from raw material stockpile 2	33.09	45.00
Offload raw material stockpile 2 from FEL onto bunker 2	33.09	45.00
Load FEL from raw material stockpile 1 /2	33.09	45.00
Offload raw material stockpile 3 from FEL onto bunker 3	33.09	45.00
Sinter Plant:		
Offload from bunker to PSP	90.35	102.10
Smelting/Final Product:		
Offload from bunker to M1 Furnace	36.88	50.15
Offload from bunker to M2 Furnace	34.41	46.80
Offload filter cake from M3 and M4	59.00	76.70
Offload onto slag disposal site	63.00	85.68
Offload onto landfill site	122.00	165.92
Offload onto final product	52.00	70.72
Load final product for road transport	52.00	70.72
Offload onto dryer 1	32.24	43.85
Offload onto dryer 2	33.78	45.94
Offload onto M3 Furnace	35.78	44.01
Offload onto M4 Furnace	37.45	50.94
Offload into crusher	52.10	70.86

Table 15: Emission rates for materials handling activities

Source	Scenario 1			Scenario 2 and Scenario 3		
	Emission Rate (g/s)					
	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
Raw Materials:						
Offload raw materials from truck onto raw material stockpile 1	1.70E-02	8.03E-03	1.22E-03	2.31E-02	1.65E-03	1.09E-02
Offload raw materials from truck onto raw material stockpile 2	1.70E-02	8.03E-03	1.22E-03	2.31E-02	1.65E-03	1.09E-02
Load FEL from raw material stockpile 1	1.13E-02	5.35E-03	8.10E-04	1.54E-02	1.10E-03	7.28E-03
Offload raw material stockpile 1 from FEL onto bunker 1	1.13E-02	5.35E-03	8.10E-04	1.54E-02	1.10E-03	7.28E-03
Load FEL from raw material stockpile 2	1.13E-02	5.35E-03	8.10E-04	1.54E-02	1.10E-03	7.28E-03
Offload raw material stockpile 2 from FEL onto bunker 2	1.13E-02	5.35E-03	8.10E-04	1.54E-02	1.10E-03	7.28E-03
Load FEL from raw material stockpile 1 /2	1.13E-02	5.35E-03	8.10E-04	1.54E-02	1.10E-03	7.28E-03
Offload raw material stockpile 3 from FEL onto bunker 3	1.13E-02	5.35E-03	8.10E-04	1.54E-02	1.10E-03	7.28E-03
Sinter Plant:						
Offload from bunker to PSP	5.16E-03	2.44E-03	3.70E-04	5.83E-03	4.18E-04	2.76E-03
Smelting/Final Product:						
Offload from bunker to M1 Furnace	1.48E-03	7.01E-04	1.06E-04	2.02E-03	1.44E-04	9.53E-04

Source	Scenario 1			Scenario 2 and Scenario 3		
	Emission Rate (g/s)					
	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
Offload from bunker to M2 Furnace	1.38E-03	6.54E-04	9.91E-05	1.88E-03	1.35E-04	8.90E-04
Offload filter cake from M3 and M4	2.37E-03	1.12E-03	1.70E-04	3.08E-03	2.21E-04	1.46E-03
Offload onto slag disposal site	2.53E-03	1.20E-03	1.81E-04	3.44E-03	2.47E-04	1.63E-03
Offload onto landfill site	4.90E-03	2.32E-03	3.51E-04	6.67E-03	4.78E-04	3.15E-03
Offload onto final product	2.09E-03	9.88E-04	1.50E-04	2.84E-03	2.04E-04	1.34E-03
Load final product for road transport	2.09E-03	9.88E-04	1.50E-04	2.84E-03	2.04E-04	1.34E-03
Offload onto dryer 1	1.30E-03	6.13E-04	9.28E-05	1.76E-03	1.26E-04	8.33E-04
Offload onto dryer 2	1.36E-03	6.42E-04	9.72E-05	1.85E-03	1.32E-04	8.73E-04
Offload onto M3 Furnace	1.44E-03	6.80E-04	1.03E-04	1.77E-03	1.27E-04	8.36E-04
Offload onto M4 Furnace	1.51E-03	7.12E-04	1.08E-04	2.05E-03	1.47E-04	9.68E-04
Offload into crusher	2.09E-03	9.90E-04	1.50E-04	2.85E-03	2.04E-04	1.35E-03

5.4.2 Wind erosion

Fugitive emissions due to the erosion of open storage piles and exposed areas occur when the threshold wind speed is exceeded (Cowherd *et al*., 1988; EPA, 1995). The threshold wind speed is dependent on the erosion potential of the exposed surface, which is expressed in terms of the availability of erodible material per unit area (mass/area). Any factor which binds the erodible material or otherwise reduces the availability of erodible material on the surface, thus decreases the erosion potential of the surface. Studies have shown that when the threshold wind speeds are exceeded, emission rates tend to decay rapidly due to the reduced availability of erodible material (Cowherd *et al*., 1988).

The default particulate emission factors for wind erosion over open areas from the Emission Estimation Technique Manual for Mining (COACOA, 2012) were used to calculate particulate emissions:

$$E_{PM10} = 0.2 \text{ kg}/ha/hour$$

$$E_{TSP} = 0.4 \text{ kg}/ha/hour$$

$PM_{2.5}$ emissions were assumed to equal 15% of TSP (USEPA, 2006) in the absence of a $PM_{2.5}$ emission factor. A 50% control efficiency for the use of wet suppression was applied as an environmentally conservative approach (COACOA, 2012) for those stockpiles that will be mitigated, as per Client data. Source parameters for areas subject to wind erosion are given in Table 16. Emission rates were applied to the various stockpiles and are presented in Table 17.

Table 16: Area sources applicable to all scenarios[1]

Source	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Control Efficiency (%)
Raw Material Stockpiles 1	0 - 20	575	245	50
Raw Material Stockpiles 2	0 - 20	290	115	50
Raw Material Stockpiles 3	0 - 20	355	160	50
Raw Material Stockpiles 4	0 - 20	47	49	50
Raw Material Stockpiles 5	0 - 20	75	35	50
Slag Disposal Site	0 - 20	845	740	50
Final Products Stockpile	0 - 20	345	61	50
Kloof Dump[2]	-	-	-	-

Note:

[1]Area sources will remain the same for all scenarios

[2]Historical, not being used

Table 17: Emission rates for wind erosion from stockpiles applicable to all scenarios

Source	Emission Rate (g/s/m^2)		
	TSP	PM_{10}	$PM_{2.5}$
Raw Material Stockpiles 1	5.56E-06	2.78E-06	4.17E-07
Raw Material Stockpiles 2	5.56E-06	2.78E-06	4.17E-07
Raw Material Stockpiles 3	5.56E-06	2.78E-06	4.17E-07
Raw Material Stockpiles 4	5.56E-06	2.78E-06	4.17E-07
Raw Material Stockpiles 5	5.56E-06	2.78E-06	4.17E-07
Slag Disposal Site	5.56E-06	2.78E-06	4.17E-07
Final Products Stockpile	5.56E-06	2.78E-06	4.17E-07

5.4.3 Crushing

To estimate the particulate emissions from crushing, emission factors for crushing operations from the Emission Estimation Technique Manual for Mining (COACOA, 2012) was utilised. Emissions were based on primary crushing of high moisture content ore (> 4%). Primary crushing activities include emissions from screens, the crusher, the surge bin, the apron feeder, and conveyor belt transfer points that are integral to the crusher.

The following equations were used to calculate particulate emissions from such activities:

$$E_{PM10} = 0.004 \frac{kg}{ton}$$

$$E_{TSP} = 0.01 \frac{kg}{ton}$$

The $PM_{2.5}$ emission rate was calculated by applying a factor of 30% (US EPA, 1995) to the PM_{10} emission rate. A 50% mitigation efficiency (COACOA, 2012) was applied in the calculations for water sprays as per Client data. The emission rates calculated are presented in Table 18 and Table 19.

Table 18: Crushing statistics for Scenario 1

Location	Tonnes/hour	Emission Rate (g/s)		
		TSP	PM_{10}	$PM_{2.5}$
Primary crushing	52.10	0.07	0.03	0.01

Table 19: Crushing statistics for Scenario 2 and Scenario 3

Location	Tonnes/hour	Emission Rate (g/s)		
		TSP	PM_{10}	$PM_{2.5}$
Primary crushing	70.86	0.10	0.04	0.01

5.4.4 Vehicle entrainment on unpaved roads

The equation used to determine particulate emissions from vehicles travelling on unpaved roads is presented below from USEPA AP-42 Chapter 13.2.2 Unpaved Roads (USEPA, 2006):

$$E = \left(k\left(\frac{s}{12}\right)^a \left(\frac{W}{3}\right)^b\right)(281.9)\ \ g/VKT$$

Where:

s = surface material silt content (4.8% used for industrial unpaved roads);

W = mean vehicle weight (37.5 tonnenes); and

a, b and k = empirical constants.

These emission factors relate the amount of particulate emissions (in grams) to the number of kilometres travelled by vehicles on site (VKT). Table 20 presents the empirical constants used in the equation for different particle sizes.

Table 20: Empirical constants for different particle sizes

Constant	TSP	PM_{10}	$PM_{2.5}$
a	0.7	0.9	0.9
b	0.45	0.45	0.45
k	4.9	1.5	0.15

The source parameters and estimated emission rates for haul trucks are presented in Table 21. The number of hauls trucks were provided by the Client. A control efficiency factor of 75% (wet suppression) (COACOA, 2012) was applied to the haul roads for wet suppression, as per Client data.

Table 21: Haul road statistics

Location	Length of Road (m)	Width of Road (m)	Vehicle kilometres travelled per day	Emission Rate (g/s)		
				TSP	PM_{10}	$PM_{2.5}$
Scenario 1 - Existing unpaved roads	9,370	10	497	3.48E-05	8.86E-06	8.86E-07
Scenario 2 and Scenario 3 - Proposed upgrade unpaved roads	9,370	10	646	4.52E-05	1.15E-05	1.15E-06

5.4.5 Vehicle entrainment on paved roads

Particulate matter emissions associated with trucks travelling on paved roads to site were calculated using USEPA AP-42 Chapter 13.2.1 Paved Roads (USEPA, 2011). Particulate matter emissions from paved roads are due to direct emissions from vehicles in the form of exhaust, brake wear, tire wear emissions and the re-suspension of loose material on the road surface (USEPA, 2011). The equation used to determine particulate emission rates from vehicles travelling on paved roads is presented below:

$$E = k(sL)^{0.91} X\, (W)^{1.02}(281.9) \qquad g/VKT$$

Where:

k = particle size multiplier;

sL = road surface silt loading (9.7 g/m^2 for iron and steel production (USEPA, 2011)); and

W = mean vehicle weight (44 tonnenes).

These emission factors relate the amount of particulate emissions (in grams) to the number of kilometres travelled by vehicles on site (VKT). The particulate matter emissions rates for haul roads are provided in Table 22. A control efficiency factor of 50% (wet sweeping) (COACOA, 2012) was applied to the haul roads, as per Client data.

Table 22: Empirical constants for different particle sizes

Constant	TSP	PM_{10}	$PM_{2.5}$
k	0.0110	0.0022	0.00054

Table 23: Haul Road statistics

Location	Length of Road (m)	Width of Road (m)	Vehicle kilometres travelled per day	Emission Rate (g/s)		
				TSP	PM_{10}	$PM_{2.5}$
Scenario 1 - Existing paved roads	2560	10	474	1.25E-04	2.49E-05	6.12E-06

Location	Length of Road (m)	Width of Road (m)	Vehicle kilometres travelled per day	Emission Rate (g/s)		
				TSP	PM_{10}	$PM_{2.5}$
Scenario 2 and Scenario 3 - Proposed upgrade paved roads	2560	10	616	1.62E-04	3.24E-05	7.95E-06

5.5 Emergency incidents

In the last two years, MFC have not recorded any air quality related emergency incidents.

6.0 IMPACT OF THE ENTERPRISE ON THE RECEIVING ENVIRONMENT

6.1 Analysis of emissions impact on human health

6.1.1 General overview of key pollutants and associated health effects

A description of the key pollutants of concern identified in this assessment, as well as the associated health effects are provided in Table 24.

Table 24: Key pollutants and associated health effects

Pollutant	Description	Health effects
Dust, PM_{10} and $PM_{2.5}$	Particulate matter comprises solid or liquid particles suspended in the air. These vary in size from particles that are only visible under an electron microscope to soot or smoke particles that are visible to the human eye. Ambient particulates contribute to deteriorations in visibility, as well as posing health risks since small particles (PM_{10}) 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, and in more extreme exposure cases, cancer and premature death (WHO, 2000; US EPA, 2011).	Dust fallout is a nuisance and is unlikely to result in health effects. PM_{10} and $PM_{2.5}$ area associated with: Airway allergic inflammatory reactions & a wide range of respiratory problems Increase in medication usage related to asthma, nasal congestion and sinuses problems Adverse effects on the cardiovascular system
NO_2	Formed though the oxidation of nitric oxide in the atmosphere, it is a primary pollutant emitted from the combustion of stationary point sources and from motor vehicles. It is toxic by inhalation. However, as the compound is acrid and easily detectable by smell at low concentrations, inhalation exposure can generally be avoided.	Effects on pulmonary function, especially in asthmatics Increase in airway allergic inflammatory reactions
SO_2	One of a group of highly reactive gasses known as “oxides of sulphur.” Anthropogenic sources include; fossil fuel combustion (particularly coal burning power plants) industrial processes such as wood	Reduction in lung function Respiratory symptoms (wheeze and cough)

Pollutant	Description	Health effects
	pulping, paper manufacture, petroleum and metal refining, metal smelting (particularly from sulphide containing ores, e.g. lead, silver and zinc ores) and vehicle tailpipe emissions.	
Cr	Chromium (Cr) is a trace element critical to human health and well-being. In the last few decades, its contamination, especially hexavalent chromium [Cr(VI)] form in both terrestrial and aquatic ecosystems, has amplified as a result of various anthropogenic activities. Cr pollution is a significant environmental threat, severely impacting our environment and natural resources.	When inhaled, chromium compounds are respiratory tract irritants and can cause pulmonary sensitization. Chronic inhalation of Cr(VI) compounds increases the risk of lung, nasal, and sinus cancer. Severe dermatitis and usually painless skin ulcers can result from contact with Cr(VI) compounds (Agency for Toxic Substances and Disease Registry, 2013)

6.1.2 Applicable Legislation, Guidelines and Standards

6.1.2.1 National Environmental Management: Air Quality Act (Act No. 39 of 2004)

The NEM: AQA approach to air quality management is based on the control of the receiving environment. The main objectives of the act are to protect the environment by providing reasonable legislative and other measures that (i) prevent air pollution and ecological degradation, (ii) promote conservation and (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development alignment with Sections 24a and 24b of the Constitution of the Republic of South Africa.

6.1.2.1.1 South African ambient air quality legislation

The South African ambient air quality standards for common pollutants prescribe the allowable ambient concentrations of pollutants which are not to be exceeded during a specified time period in a defined area (Table 25).

Table 25: South African Ambient Air Quality Standards for criteria pollutants

Pollutant	Averaging Period	Limit Value (µg/m^3)	Frequency of Exceedance	Compliance Date
NO_2	1 hour	200	88	Immediate
	1 year	40	0	Immediate
PM_{10}	24 hours	75	4	Immediate
	1 year	40	0	Immediate
$PM_{2.5}$	24 hours	40	4	1 January 2016 – 31 December 2029
	24 hours	25	4	1 January 2030
	1 year	20	0	1 January 2016 – 31 December 2029
	1 year	15	0	1 January 2030
O_3	8 hours	120	11	Immediate
Pb	1 year	0.5	0	Immediate

Pollutant	Averaging Period	Limit Value ($\mu g/m^3$)	Frequency of Exceedance	Compliance Date
CO	1 hour	30000	88	Immediate
	8 hours	10000	11	Immediate
C_6H_6	1 year	5	0	Immediate
SO_2	10 minutes	500	526	Immediate
	1 hour	350	88	Immediate
	24 hours	125	4	Immediate
	1 year	50	0	Immediate

The National Dust Control Regulations were published on 25th May 2018, Government Gazette no. 41650. The dust fall standard, applicable to this study, defines acceptable dust fallout rates in terms of the presence of residential and non-residential areas (Table 26).

Table 26: Acceptable dust fallout rates

Restriction Areas	Dust Fall Rate (mg/m^2/day over a 30-day average)	Permitted Frequency of Exceedance
Residential areas	Dust fall <600	Two per annum (not in sequential months)
Non-residential areas	600 < Dust fall <1 200	Two per annum (not in sequential months)

Note: The method to be used for measuring dust fall rate and the standard for locating sampling points shall be ASTM D1739

6.1.2.1.1 International ambient air quality legislation

In the absence of local standards for Cr, international guidance has been sourced, from the 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 (TCEQ, 2006).

The short-term ESL for Cr (VI) is 0.39 $\mu g/m^3$, whilst the long-term ESL is 0.0043 $\mu g/m^3$.

6.1.2.2 Highveld Priority Area Air Quality Management Plan

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

The primary motive of the HPA declaration and the HPA Air Quality Management Plan (HPA AQMP) is to achieve and maintain compliance with the national ambient air quality standards (NAAQS) across the HPA, using the constitutional principal of progressive realisation of air quality improvements (DEAT, 2007). The HPA

AQMP thus allows for the alignment of air quality practices with legal and regulatory requirements to ensure air quality management planning is implemented effectively (DEAT, 2007). As the MFC operations are located within the HPA and is thus required to operate within the air quality requirements of the HPA AQMP.

6.1.2.3 Nkangala District Municipality: Air Quality Management By-Law

MFC is located within the Nkangala District Municipality which has a by-law pertaining to air quality management. The air quality management by-law for the Nkangala District Municipality was issued in June 2016 (Provincial Gazette No. 2701 of June 2016). The purpose and objective of the by-law is to enable the council and its local municipalities to protect, intervene, regulate and control activities which emit emissions and promote the long-term health, well-being and safety of people and environment within its jurisdiction area. The by-law states that any person who is responsible for causing air pollution or creating a risk of air pollution within the municipality must take reasonable measures to:

a) Prevent any potential air pollution from occurring; or

b) Where the causing of any air pollution is permitted, not prohibited, or cannot be reasonably avoided or stopped, to minimise that pollution.

Reasonable measures, as provided by the by-law, include the following:

a) Investigate, assess and evaluate the impact of air pollution on the environment.

b) Inform and educate employees about the environmental risks of their work and how they can perform their work in order to avoid air pollution.

c) Cease, modify or control any act, activity or process causing the air pollution.

d) Contain or prevent the movement of pollutants or remedy the effects of the air pollution.

The municipality may direct any person causing significant air pollution either to cease the activity; investigate, evaluate and assess the impact of such; implement specific measures before a given date and continue with those measures in place. The municipality also has the authority to issue a directive. Should the person fail to comply with the directive, the municipality may take reasonable steps to remedy the situation or apply to court for appropriate relief.

The by-law has identified 26 substances (air pollutants) which may present a threat on the health and well-being of people in the municipal area. The municipality may add more substances to the list in the future. The by-law makes provision for the Nkangala District Municipality to develop and adopt local emissions standards for any of the identified substances. A person emitting any of the identified substances must comply with the relevant emission standards.

Under the air quality management by-law for the Nkangala District Municipality there are specific provisions pertaining to the several activities or emissions sources that need to be complied with. In most instances, authorisation from the Municipality is required before the emitting activities can take place and in other instances the activity is prohibited. The relevant activities or emissions sources are summarised below:

a) Emissions from compressed ignition powered vehicles.

b) Operation of small boilers including the installation, alteration, extension and/or replacement of the boiler.

c) Any activity resulting in dust emissions.

d) Sand blasting emissions.

e) Open burning emissions.

f) Emissions caused by burning of industrial waste, domestic waste and garden waste.

g) Emissions caused by pesticide spraying.

h) Spray painting emissions.

i) Emissions that cause a nuisance.

6.1.2.4 Listed activities and minimum emissions standards

The NEM:AQA makes provision for the setting and formulation of national ambient air quality and emission standards. On a provincial and local level, these standards can be set more stringently if the need arises. The control and management of emissions in NEM:AQA relates to the listing of activities that are sources of emission and the issuing of AELs. In terms of Section 21 of the NEM:AQA, a listed activity is an activity which 'results in atmospheric emissions that are regarded to have a significant detrimental effect on the environment, including human health'. Listed activities for the MFC operations are provided in Table 27 to Table 30.

Table 27: Minimum emission standards for Subcategory 4.1: Drying and Calcining

Description:	Drying and calcining of mineral solids including ore		
Applications:	Facilities with capacity of more than 100 tonnes/month product		
Substance or Mixture of Substances		Plant Status	mg/Nm^3 under normal conditions of 10% O_2, 273 Kelvin and 101.3 kPa.
Common Name	Chemical Symbol		
Particulate matter	N/A	New	50
		Existing	100
Sulphur dioxide	SO_2	New	1000
		Existing	1000
Oxides of nitrogen	NO_x expressed as NO_2	New	500
		Existing	1200

Table 28: Minimum emission standards for Subcategory 4.5: Sinter Plants

Description:	Sinter plants for agglomeration of fine ores using a heating process, including sinter cooling where applicable		
Applications:	All installations		
Substance or Mixture of Substances		Plant Status	mg/Nm^3 under normal conditions of 10% O_2, 273 Kelvin and 101.3 kPa.
Common Name	Chemical Symbol		
Particulate matter	N/A	New	50
		Existing	100
Sulphur dioxide	SO_2	New	500
		Existing	1000
Oxides of nitrogen	NO_x expressed as NO_2	New	700
		Existing	1200

Table 29: Minimum emission standards for Subcategory 4.9: Ferro-alloy Production

Description:	Production of alloys of iron with chromium, manganese, silicon or vanadium, the separation of titanium slag from iron-containing minerals using heat		
Applications:	All installations		
Substance or Mixture of Substances		Plant Status	mg/Nm³ under normal conditions of 10% O_2, 273 Kelvin and 101.3 kPa.
Common Name	Chemical Symbol		
Sulphur dioxide	N/A	New	500
		Existing	500
Oxides of nitrogen	NO_x expressed as NO_2	New	400
		Existing	750
Particulate matter from primary fume capture system, open and semi-closed furnaces			
Particulate matter	N/A	New	30
		Existing	100
Particulate matter from primary fume capture system, closed furnaces			
Particulate matter	N/A	New	50
		Existing	100
Particulate matter from secondary fume capture system, all furnaces			
Particulate matter	N/A	New	50
		Existing	100

a) The following special arrangements shall apply –

i) Secondary fume capture installations shall be fitted to all new furnace installations; and

ii) Emission of Cr(VI), Mn and V from primary fume capture systems of ferrochrome, ferromanganese and ferrovanadium furnaces respectively to be measured and reported to licensing authority annually

Table 30: Minimum emission standards for Subcategory 5.1: Storage and Handling of Ore and Coal

Description:	Storage and handling of ore and coal not situated on the premises of a mine or works as defined in the Mines Health and Safety Act 29/1996		
Applications:	Locations designed to hold more than 100 000 tonnes		
Substance or Mixture of Substances		Plant Status	mg/Nm³ under normal conditions of 10% O_2, 273 Kelvin and 101.3 kPa.
Common Name	Chemical Symbol		
Dustfall	N/A	New	a
		Existing	a

[a] three months running average not to exceed limit value for adjacent land use according to dust control regulations promulgated in terms of section 32 of NEM:AQA, 2004 (Act No. 39 of 2004), in eight principal wind directions

6.1.3 Baseline assessment

6.1.3.1 Climatic overview

The climate experienced along the south-western coastline and adjacent interior of South Africa is controlled predominantly by subtropical high pressure, with temporary disruptions by low pressure cells or fronts. This high-pressure zone is located along 33°S latitude and is associated with strong divergence at the surface and convergence in the upper atmosphere (Tyson and Preston-Whyte, 2000). Figure 7 shows the predominant macroscale atmospheric circulations over the subcontinent. Easterly waves and lows tend to be summer phenomena, while the westerly wave and lows tend to be autumn to spring phenomena.

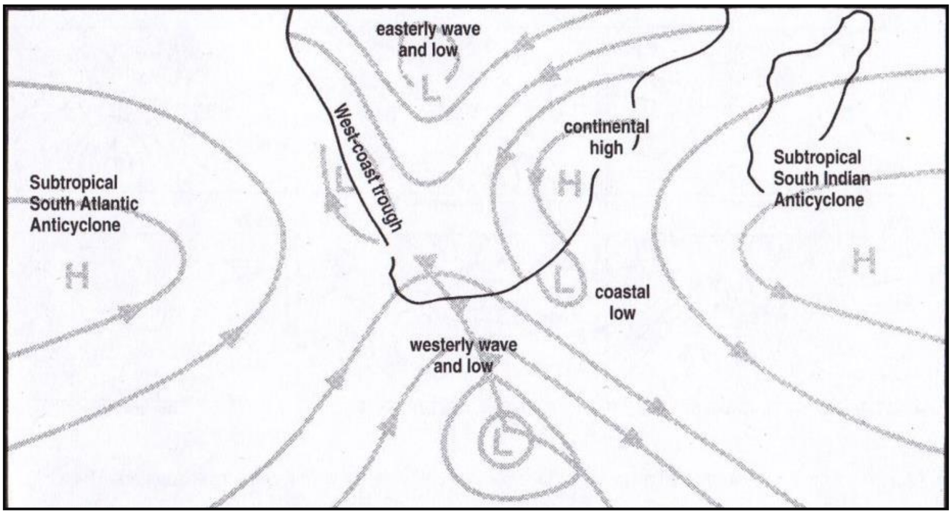


Figure 7: South African meteorological phenomena (Tyson and Preston-Whyte, 2000).

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

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

6.1.3.2 Meteorological overview

To assess ambient meteorological conditions, site-specific modelled Weather Research and Forecasting (WRF) meteorological data was purchased from Lakes Environmental Software for the period January 2018 to December 2020 to provide an understanding of surface and upper air dispersion characteristics. The data coverage is centred over the MFC facility (Latitude: 25.80621°S – Longitude: 29.49335°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 meteorological conditions experienced onsite and is further recommended in terms of the South

African Regulations Regarding Air Dispersion Modelling (2014). The South African National Accreditation System (SANAS, 2012) TR 07-03 standards stipulate a minimum data recovery of 90% for the dataset to be deemed representative of conditions during a specific reporting period. The percentage recovery for parameters recorded is 100 % and is thus considered reliable for use in this assessment. Further, site-specific meteorological data from the MFC station was also obtained for comparisons of the wind conditions. Importantly, temperature and rainfall data from the station was not useful and was not used for this assessment. The station data recovery for wind conditions was 98% and was thus also reliable for this assessment. The meteorological conditions for the site using the modelled WRF and station data (where applicable) is discussed in the following sections.

6.1.3.2.1 Temperature, rainfall and humidity

Temperature, rainfall and humidity are key influencing factors in ambient air quality:

- Ambient air temperature affects both plume buoyancy and the development of mixing and inversion layers. Furthermore, the greater the difference in temperature between the plume and the ambient air, the higher the plume is able to rise.
- Over the period January 2018 to December 2020, average summer and winter temperatures recorded were approximately 21 and 11 °C, respectively (Figure 8) using modelled WRF data. Minimum monthly average temperatures ranged from -4 to 2°C in winter, with maximum monthly average temperatures ranging from 30 to 35 °C in summer.
- Rainfall is an effective removal mechanism of atmospheric pollutants as when it falls, it brings pollutants down with it. Rainfall further reduces the erosion potential by increasing the moisture content of erodible materials.
- MFC receives most of its rainfall during summer as indicated by the modelled WRF data. The lowest rainfall levels are experienced during the winter months (June - August) (Figure 9). Total rainfall received for 2018, 2019 and 2020 was 585 mm, 374 mm and 586 mm, respectively. Relative humidity is generally moderate, with values ranging from 54 to 66% during summer and 35 to 52% during winter.
- MFC falls within the HPA and experiences distinct weather patterns in summer and winter that affect the dispersal of pollutants in the atmosphere. In summer, unstable atmospheric conditions result in mixing of the atmosphere and rapid dispersion of pollutants. Summer rainfall also aids in removing pollutants through wet deposition. In contrast, winter is characterised by atmospheric stability caused by a persistent high-pressure system over South Africa. This dominant high-pressure system results in subsidence, causing clear skies and a pronounced temperature inversion over the Highveld. This inversion layer traps the pollutants in the lower atmosphere, which results in reduced dispersion and a poorer ambient air quality.

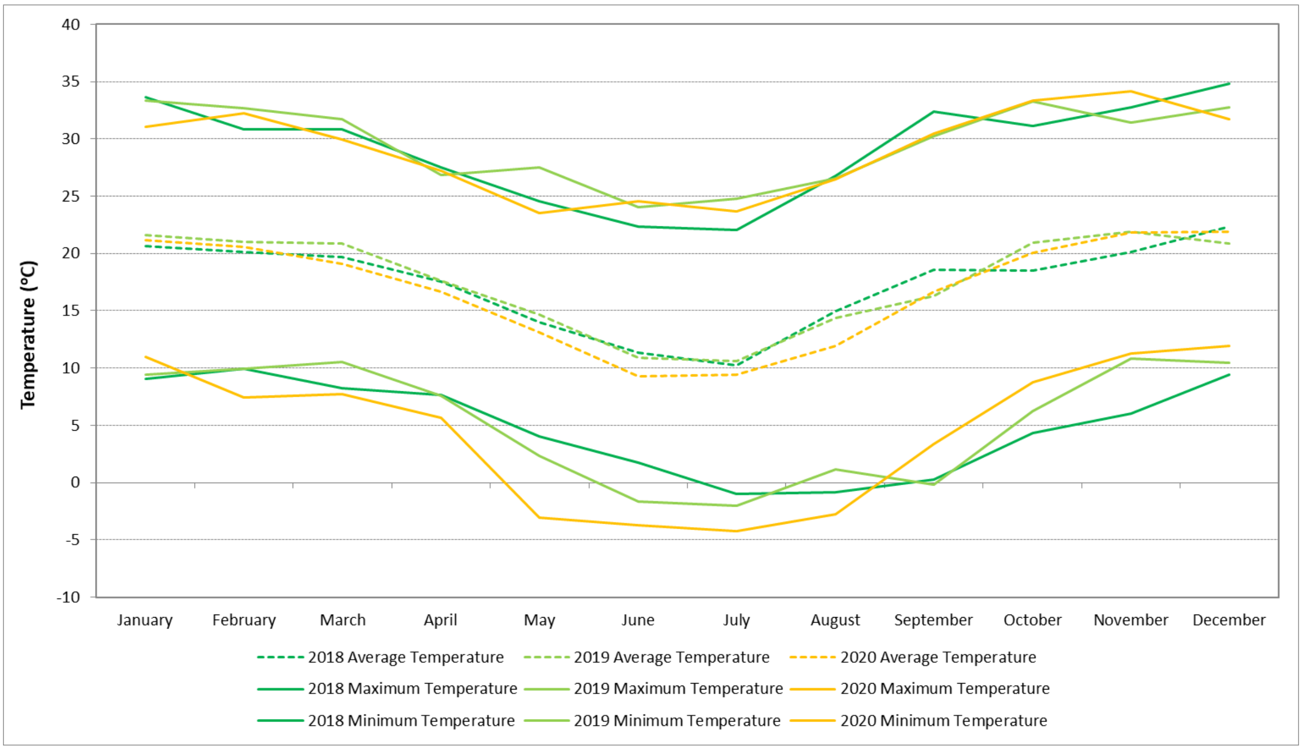


Figure 8: Average, maximum and minimum temperatures for 2018 to 2020 (WRF data)

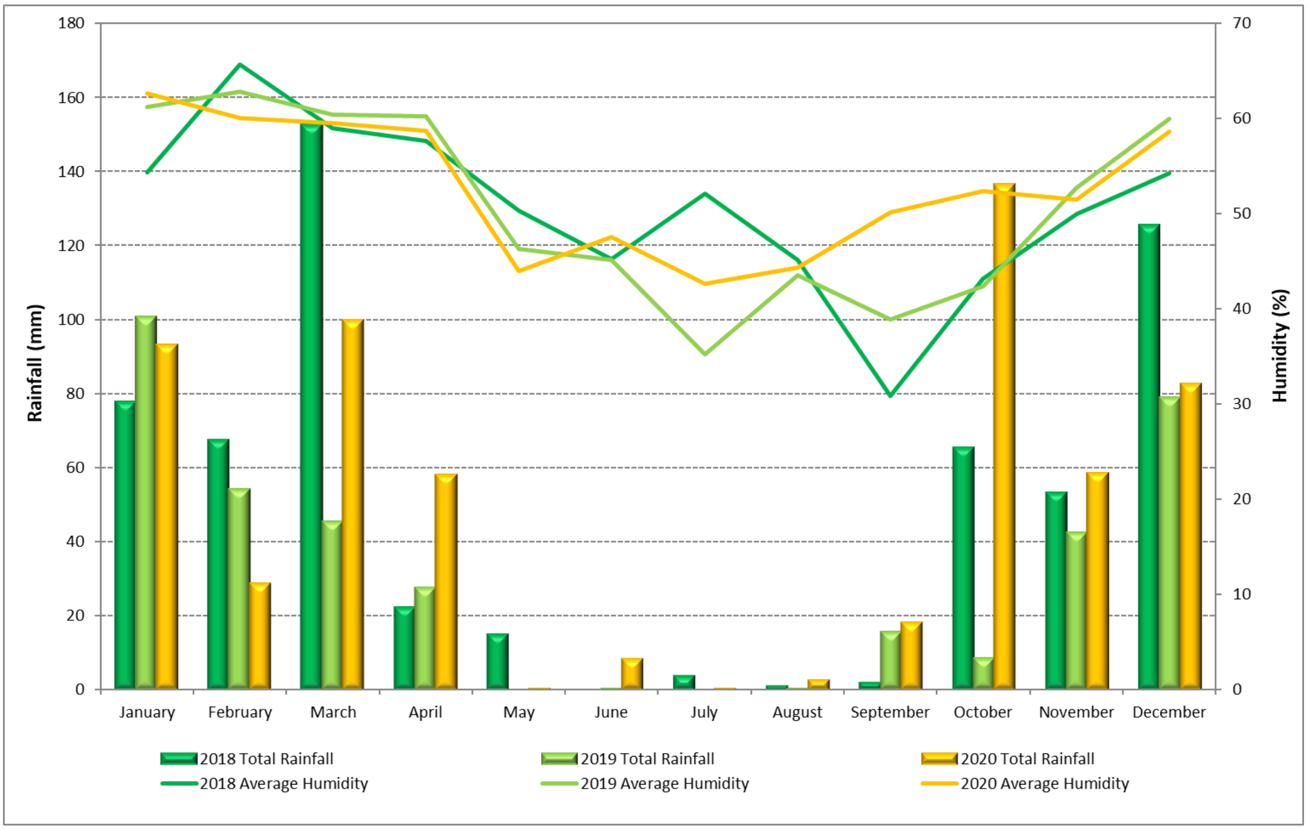


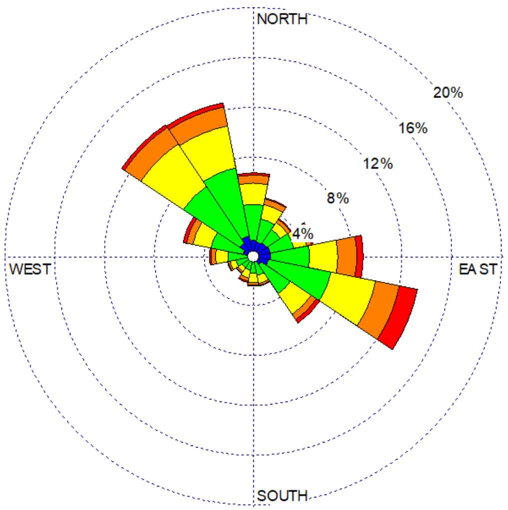
Figure 9: Monthly rainfall and average humidity for 2018 to 2020 (WRF data)

6.1.3.2.2 Wind field

Wind roses summarise the occurrence of winds at a specified location by representing their strength, direction and frequency. Calm conditions are defined as wind speeds of less than 1 m/s which are represented as a percentage of the total winds in the centre circle. Each directional branch on a wind rose represents wind originating from that specific cardinal direction (16 cardinal directions). Each cardinal branch is divided into segments of different colours which represent different wind speed classes. Period, seasonal and diurnal wind roses using modelled WRF and station data are presented below. The following can be observed from the wind roses:

- Light to strong winds from the east southeast prevailed in the region as indicated in the modelled WRF and station data, with calm conditions occurring frequently (5.3% and 7.3% of the time, from the WRF and station data, respectively) during the full periods for each dataset.
- During the day, winds are predominantly from the northwest while at night, winds shift completely and are predominantly from the east-southeast as observed from the modelled WRF and MFC station datasets. Winds speeds are generally moderate to strong with higher wind speeds noted during the day.
- During the summer to winter months, winds are dominant from the east-southeast from both the WRF and MFC datasets. In spring, a shift in winds is observed in the modelled WRF data, with winds originating predominantly from the north-northwest, whilst the dominant wind direction remains in the east-southeast and northwest direction in the MFC station data. Wind speeds are moderate to strong during all months in the modelled WRF data but show light to moderate winds in the MFC data. Higher wind speeds are noted during the months of spring and summer using both sets of data.
- It is noted that the datasets are similar and hence gives confidence that the WRF data is an accurate representation for the dispersion model.

WRF AERMET Data
January 2018 – December 2020

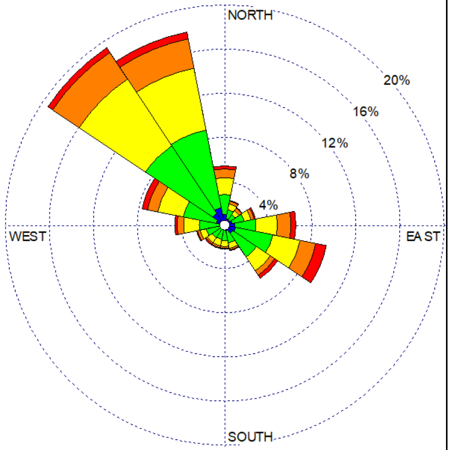


Calms = 5.34%

WIND SPEED
(m/s)

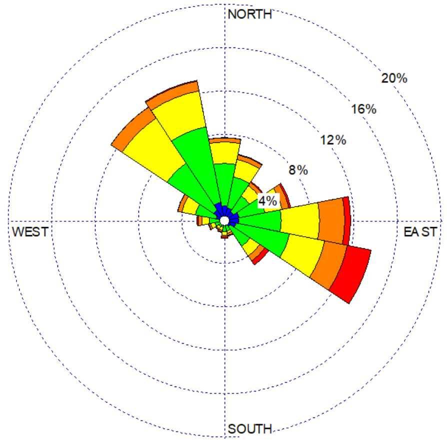
- >= 8.0
- 6.0 - 8.0
- 4.0 - 6.0
- 2.0 - 4.0
- 1.0 - 2.0

Day
06h00 – 18h00



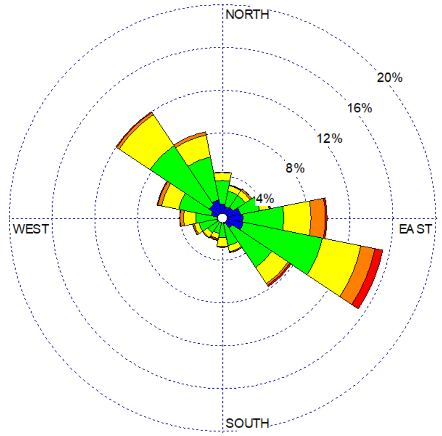
Calms = 4.37%

Summer
December, January & February



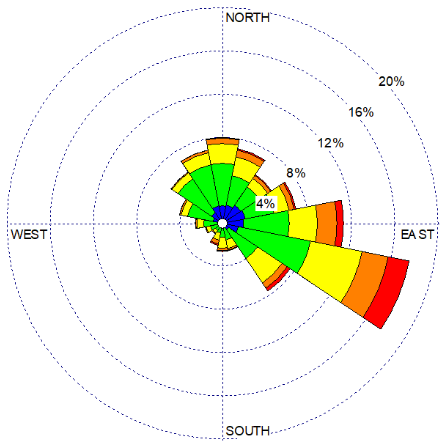
Calms = 4.89%

Autumn
March, April & May



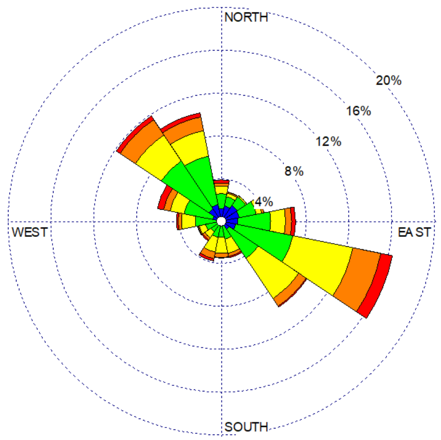
Calms = 7.41%

Night
18H00 – 06H00



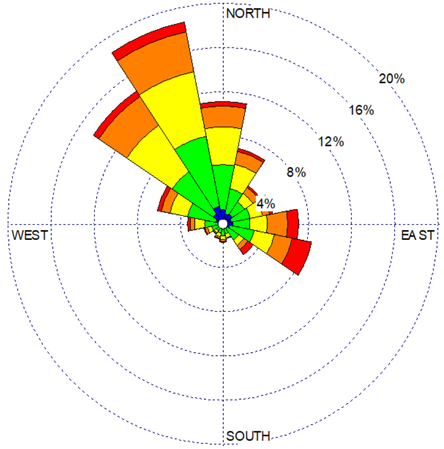
Calms = 6.30%

Winter
June, July & August



Calms = 5.25%

Spring
September, October & November

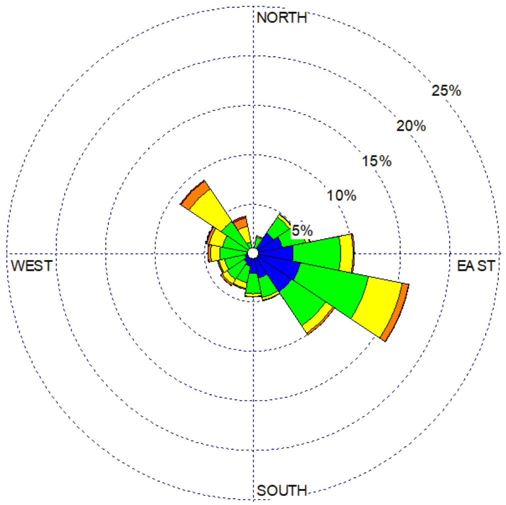


Calms = 3.77%

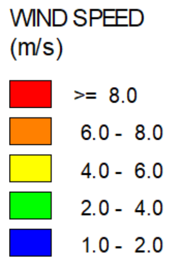
Figure 10:Wind conditions using WRF data for the period January 2018 to December 2020

MFC Station Data

August 2018 – August 2021

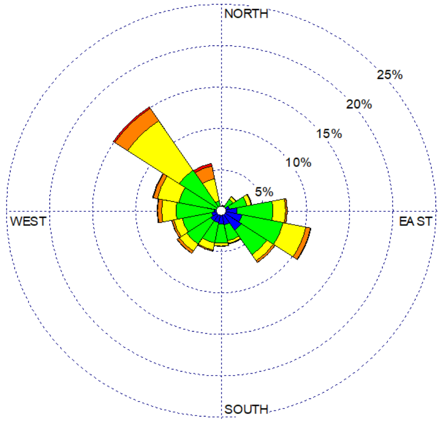


Calms = 7.31%



Day

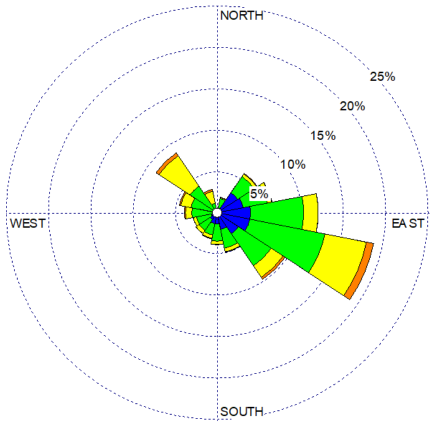
06h00 – 18h00



Calms = 4.85%

Summer

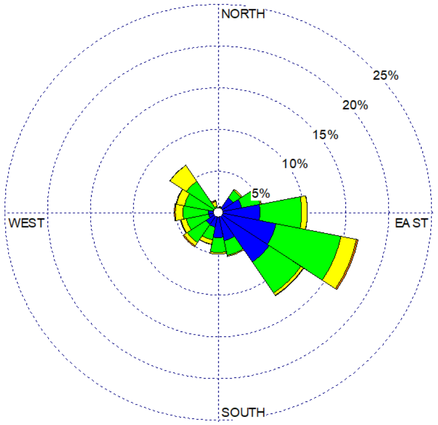
December, January & February



Calms = 6.44%

Autumn

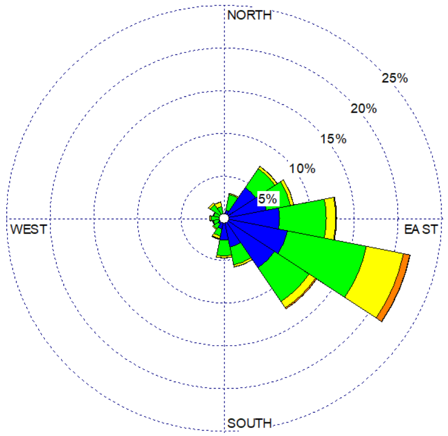
March, April & May



Calms = 8.50%

Night

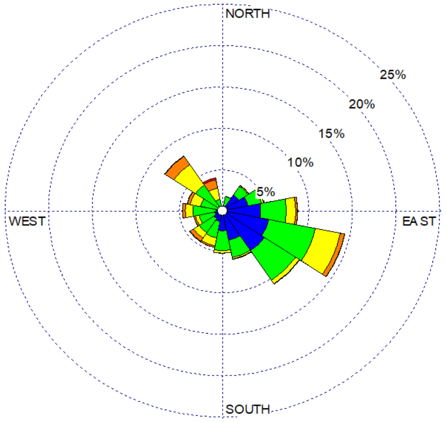
18H00 – 06H00



Calms = 9.99%

Winter

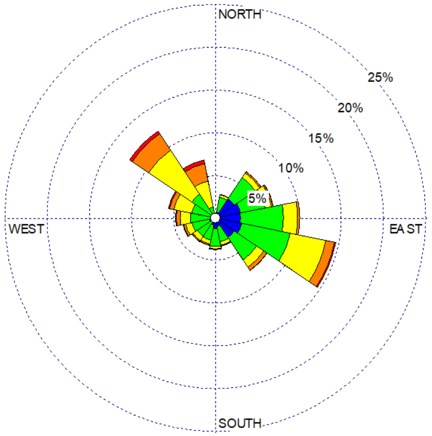
June, July & August



Calms = 10.68%

Spring

September, October & November



Calms = 3.51%

Figure 11:Wind conditions using MFC station data for the period August 2018 to August 2021

6.1.3.3 Regional ambient air quality overview

MFC is located in the Steve Tshwete Local Municipality within the Nkangala District Municipality and as such, falls within the HPA. This infers that the authorities may impose measures on MFC and other industries in the area in order to improve the air quality in the region.

Driving forces of poor air quality include both anthropogenic and natural processes. Anthropogenic driving forces for example include economic activity, urbanisation, industrial development, population growth, and the current political climate. Natural process driving forces for example include climate change, natural disasters and many others. These driving forces lead to pressures on the natural environment such as increased demand for resources, habitat change and increased development (Mpumalanga State of Environment report, 2003), which can lead to impacts being exerted on the natural, social, political and economic environments.

The Highveld experiences a wide range of both natural and anthropogenic sources of air pollution ranging from veld fires to industrial processes, agriculture, mining activities, power generation, paper and pulp processing, vehicle use and domestic use of fossil fuels. Different pollutants are associated with each of the above activities, ranging from volatile organic compounds and heavy metals to dusts and odours.

While certain areas of the HPA experience relatively good air quality, ambient air quality is largely of poor quality. Exceedances of fine particulate matter with an aerodynamic diameter ten microns (PM_{10}), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and ozone (O_3) have often been recorded in the pollution hotspots of the eMalahleni, Kriel, Steve Tshwete, Ermelo, Secunda, Ekurhuleni, Lekwa, Balfour and Delmas areas (DEA, 2015). Despite the implementation of the HPA AQMP there continue to be exceedances in:

- PM_{10} and $PM_{2.5}$ in particular, areas proximate to significant industrial operations as well as residential areas where domestic coal burning is occurring.
- SO_2 in eMalahleni, Middelburg, Secunda, Ermelo, Standertonne, Balfour, and Komati due to a combination of emissions from the different industrial sectors, residential fuel burning, motor vehicle emissions, mining and cross-boundary transport of pollutants into the HPA adding to the base loading.
- NO_2 in the eMalahleni, Steve Tshwete and Ekurhuleni areas where anthropogenically induced and naturally occurring biomass fires occur throughout the HPA at all times of the year and contribute NO_2.
- O_3 in Kendal, Witbank, Hendrina, Middelburg, Elandsfontein, Camden, Ermelo, Verkykkop and Balfour thought to be due to biomass burning.

Based on the available information and the data analysed, it is clear that the regional air quality in the project area is relatively poor.

6.1.3.4 Local ambient air quality overview

Existing sources of air pollution within the area have been identified to include:

- Agricultural activities
- Biomass burning
- Domestic fuel burning
- Mining activities
- Vehicle emissions
- Power generation

Agricultural activities

Emissions from agricultural activities are difficult to control due to the seasonality of emissions and the large surface area producing emissions (USEPA, 1995). Most of the agricultural activities in the region appear to be the commercial farming dedicated to crops and to a smaller extent grazing, which is common in the region.

Despite the large-scale presence of agricultural activities within the area, agricultural emissions are not expected to significantly influence the air quality in the area. As per the HPA AQMP ,industrial sources are by far the largest contributor of emissions, accounting for 89% of PM_{10}, 90% of NO_x and 99% of SO_2. Particulate emissions may increase during the frequent periods where the Highveld grasslands are subjected to wildfires.

Biomass burning

Biomass burning may be described as the incomplete combustion process of natural plant matter with CO, Methane (CH_4), NO_2 and PM_{10} being emitted during the process. During the combustion process, approximately 40% of the nitrogen in biomass is emitted as nitrogen, 10% remains in the ashes and it is assumed that 20% of the nitrogen is emitted as higher molecular weight nitrogen compounds. In comparison to the nitrogen emissions, only small amounts of SO_2 and sulphate aerosols are emitted. With all biomass burning, visible smoke plumes are typically generated. These plumes are created by the aerosol content of the emissions and are often visible for many kilometres from the actual source of origin.

The extent of emissions liberated from biomass burning is controlled by several factors, including:

- The type of biomass material.
- The quantity of material available for combustion.
- The quality of the material available for combustion.
- The fire temperature.
- Rate of fire progression through the biomass body.

Crop-residue burning and general wildfires represent significant sources of combustion-related emissions associated with agricultural areas. Given that the region has significant agricultural activities rather, controlled burning related to the agricultural activities contribute to air quality.

Domestic fuel burning

Domestic fuel burning of coal emits a large amount of gaseous and particulate pollutants including sulphur dioxide, heavy metals, total and respirable particulates, inorganic ash, CO, polycyclic aromatic hydrocarbons (PAH), and benzo(a) pyrene. Pollutants arising due to the combustion of wood include respirable particulates, NO_2, CO, PAH, particulate benzo(a) pyrene and formaldehyde. The main pollutants emitted from the combustion of paraffin are NO_2, particulates, CO and PAH. The density of housing in the region is relatively low with most residential areas being confined to small local towns such as Phola, Wilge and Ogies. In addition to these small residential areas, individual farms/homesteads are scattered throughout the region and comprise of formal and informal residential structures. It is thus highly likely that certain households within the communities are likely to use coal, wood and paraffin for space heating and/or cooking purposes.

Emissions from these communities and/or the individual residences/homesteads are not anticipated to have a significant impact on the regional air quality due to their low density and dispersed nature.

Mining activities

Numerous significant mining operations are present in the region. Mining, along with contributions from power stations, are likely to be the largest sources of particulates (PM_{10}, $PM_{2.5}$, TSP) within the region, with smaller contributions from industry and biomass burning.

Dust and fine particulate emissions associated with mining operations include wind erosion from stockpiles, open mining pits, blasting, drilling, crushing and screening, material handling, ore processing and refining, sintering operations, unpaved mine access roads and other exposed areas. Factors which influence the rate of wind erosion include surface compaction, moisture content, vegetation, shape of storage pile, particle size distribution, wind speed and rain.

Emissions from the mining activities are anticipated to be one of the dominant emissions influencing and impacting on the regional air quality.

Vehicle emissions

Air pollution generated from vehicle emissions may be grouped into primary and secondary pollutants. Primary pollutants are those emitted directly to the atmosphere as tail-pile emissions, whereas secondary pollutants are formed in the atmosphere as a result of atmospheric chemical reactions, such as hydrolysis, oxidation, or photochemical reactions. The primary pollutants emitted typically include carbon dioxide (CO_2), CO, hydrocarbons (including benzene, 1.2-butadiene, aldehydes and PAH), SO_2, oxides of nitrogen (NO_x) and particulates. Secondary pollutants formed in the atmosphere typically include nitrogen dioxide (NO_2), photochemical oxidants such as ozone, hydrocarbons, sulphur acid, sulphates, nitric acid, sulphates, nitric acid and nitrate aerosols.

The quantity of pollutants emitted by a vehicle depends on specific vehicle related factors such as vehicle weight, speed and age; fuel-related factors such as fuel type (petroleum or diesel), fuel formulation (oxygen, sulphur, benzene and lead replacement agents); and environmental factors such as altitude, humidity and temperature (Samaras and Sorensen, 1999).

Given the population density in the region, and the distribution of the mining activities, it is anticipated that vehicle exhaust emissions and their contribution to ambient air pollutant will be relatively insignificant.

Power generation

South Africa mainly relies on its extensive coal reserves as its primary source of energy. Several coal-fired power stations are in close proximity to the proposed Project. A large amount of CO_2, CO, SO_2, sulphur trioxide (SO_3), NO_2 and nitric oxide (NO), some traces of heavy metals and particulates such as PM_{10} are released whenever coal is burned at these stations (Munawer, 2017).

These power stations are one of the key emission sources and contribute significantly to the level of air pollution within the region.

6.1.3.5 Local ambient air quality monitoring

6.1.3.5.1 Dust fallout monitoring

Dust fallout monitoring at MFC is currently conducted at four on-site monitoring locations, all equipped with single dust fallout units and in line with the National Dust Control Regulations and the ASTM D1739-70 methodology (Figure 12). Importantly, the eastern boundary is monitored by adjacent industries situated between MFC and residential areas to the east of the property and no concerns have been noted. The dust fallout monitoring results for the twelve-month period June 2020 to May 2021 are presented in Table 31.

Results indicate that all dust fallout monitoring locations are compliant with the National Dust Control Regulations. To date a non-residential network average of 447 mg/m^2/day was recorded, below the non-residential dust fallout guideline of 1,200 mg/m^2/day.

Figure 12:Location of dust fallout monitoring points

Table 31: Dust fallout results for a rolling twelve-month period

Sample Location	Guidelines	Dust Fallout ($mg/m^2/day$)												Compliant
		Jun-20	Jul-20	Aug-20	Sept-20	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	
MFC-3	1200	262	266	402	295	449	221	222	432	186	171	313	155	Yes
MFC-4	1200	343	679	585	440	526	326	417	150	364	523	708	180	Yes
MFC-5	1200	487	564	631	640	293	464	562	590	375	640	529	351	Yes
MFC-7	1200	432	455	842	488	606	344	403	463	694	509	834	642	Yes

6.1.3.5.2 MFC station monitoring

MFC continuously monitors background concentrations of PM_{10}, SO_2 and NO_2 via their onsite station. As such, background concentrations of these pollutants have been assessed below for the period August 2018 to August 2021. The SANAS (SANAS, 2012) TR 07-03 standards stipulate a minimum data recovery of 90% for the dataset to be deemed representative of conditions during a particular reporting period. Data recovery at MFC's continuous monitoring station for each pollutant is given in Table 32. Given the extremely low data recovery of PM_{10} concentrations in 2018 and 2019, this data should be viewed with caution.

Table 32: Data recovery for each pollutant measured at MFC for the period August 2018 to August 2021

Pollutant	2018	2019	2020	2021
PM_{10}	No data	26%	82%	97%
SO_2	60%	80%	96%	97%
NO_2	82%	98%	77%	95%

6.1.3.5.2.1 Particulate concentrations

Table 33 presents the PM_{10} concentrations recorded at MFC for the period August 2018 to August 2021. Measured PM_{10} concentrations were compliant with the annual average NAAQS for PM_{10} (40 µg/m^3) for the entire monitoring period. Ambient PM_{10} concentrations exceeded the 24-hour NAAQS (75 µg/m^3) twenty times and five times during 2019 and 2020 respectively. Since only four exceedances of the 24-hour NAAQS are permitted per annum, PM_{10} concentrations at MFC were non-compliant for 2019 and 2020. PM_{10} concentrations were above the 24-hour NAAQS in 2021 but remained compliant, with less than four exceedances of the 24-hour NAAQS recorded per annum (Figure 13). It is noted that such exceedances are likely to be influenced by road works to the east of the property as well as adjacent industries and as such, is likely not fully attributable to MFC. Given the low data recovery of PM_{10} in 2018 and 2019, these datasets were excluded to obtain an average across all years from the station.

Table 33: Particulate matter concentrations and exceedances recorded at MFC for the period August 2018 to August 2021

Pollutant	Ambient Particulate Concentrations					
	Averaging Period	2018	2019	2020	2021	Average
PM_{10}	Annual average (µg/m^3)	No data	18	18	19	19
	24-hour exceedances	No data	20	5	3	-
	P99 24-hour concentration (µg/m^3)	No data	82	81	81	81

Red values represent exceedances of the relevant standards

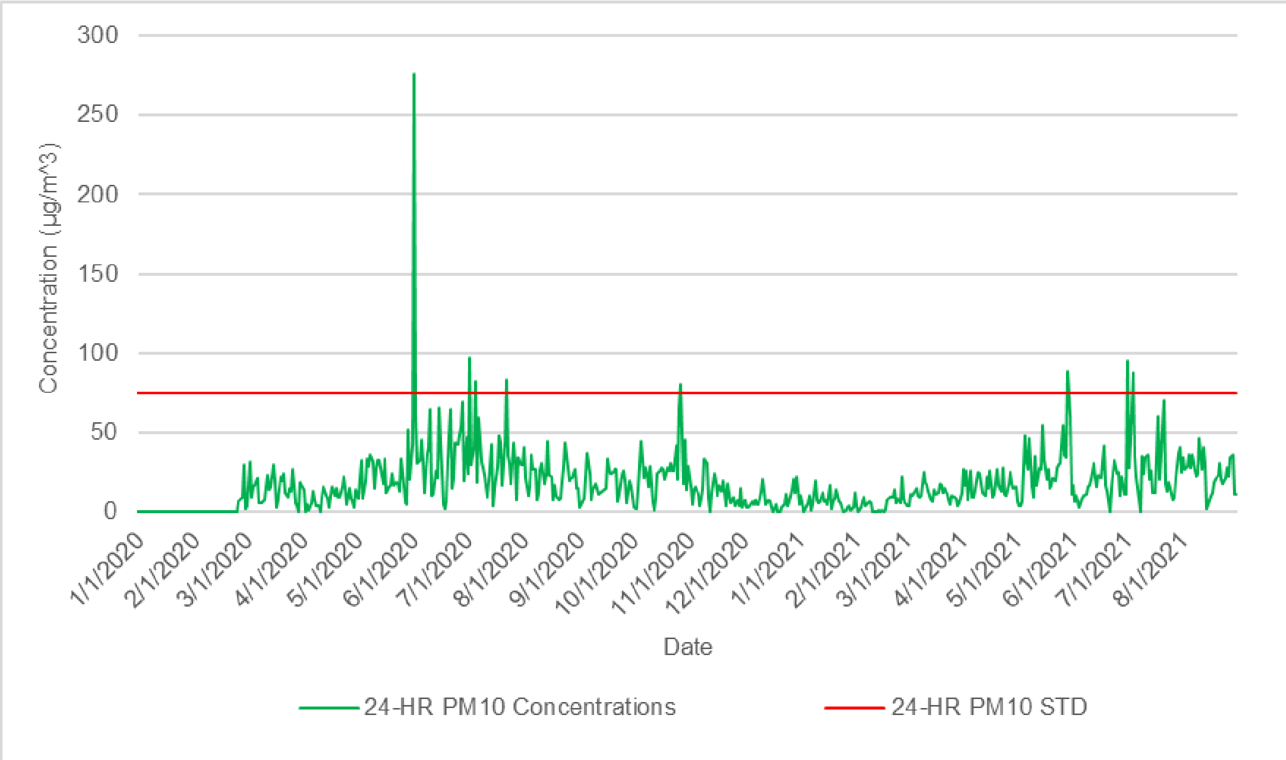


Figure 13:24-hour PM_{10} concentrations at MFC for the period January 2020 to August 2021

6.1.3.5.2.2 SO_2 concentrations

Table 34 presents the SO_2 concentrations recorded at MFC for the period August 2018 to August 2021. Measured SO_2 concentrations were compliant with the annual, 24-hour and 1-hour averaging periods for SO_2 (350 µg/m³, 125 µg/m³ and 50 µg/m³ respectively) for the entire period. (Figure 14 and Figure 15). Importantly, the data recovery in 2018 and 2019 for SO_2 was a little below the recommended data recovery of 90% but has been used in this assessment as it still represents a suitable dataset.

Table 34: Sulphur dioxide concentrations and exceedances recorded at MFC for the period August 2018 to August 2021

Pollutant	Ambient SO_2 Concentrations					
	Averaging Period	2018	2019	2020	2021	Average
SO_2	Annual average (µg/m³)	2	4	6	6	5
	No. of 1-hour exceedances	0	2	2	0	-
	No. of 24-hour exceedances	0	0	0	0	-
	P99 1-hour concentration (µg/m³)	19	34	40	33	32
	P99 24-hour concentration (µg/m³)	6	21	24	16	17

Red values represent exceedances of the relevant standards

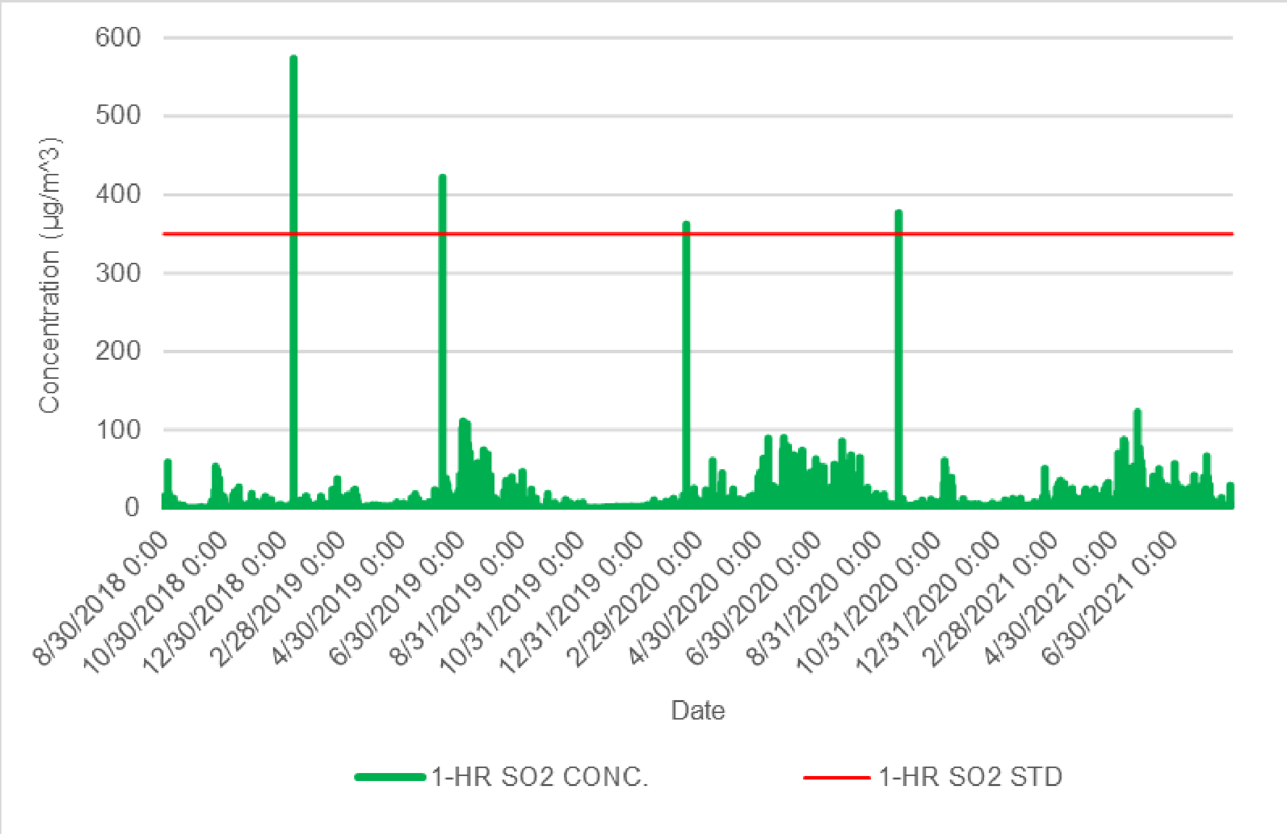


Figure 14:1-hour SO_2 concentrations at MFC for the period August 2018 to August 2021

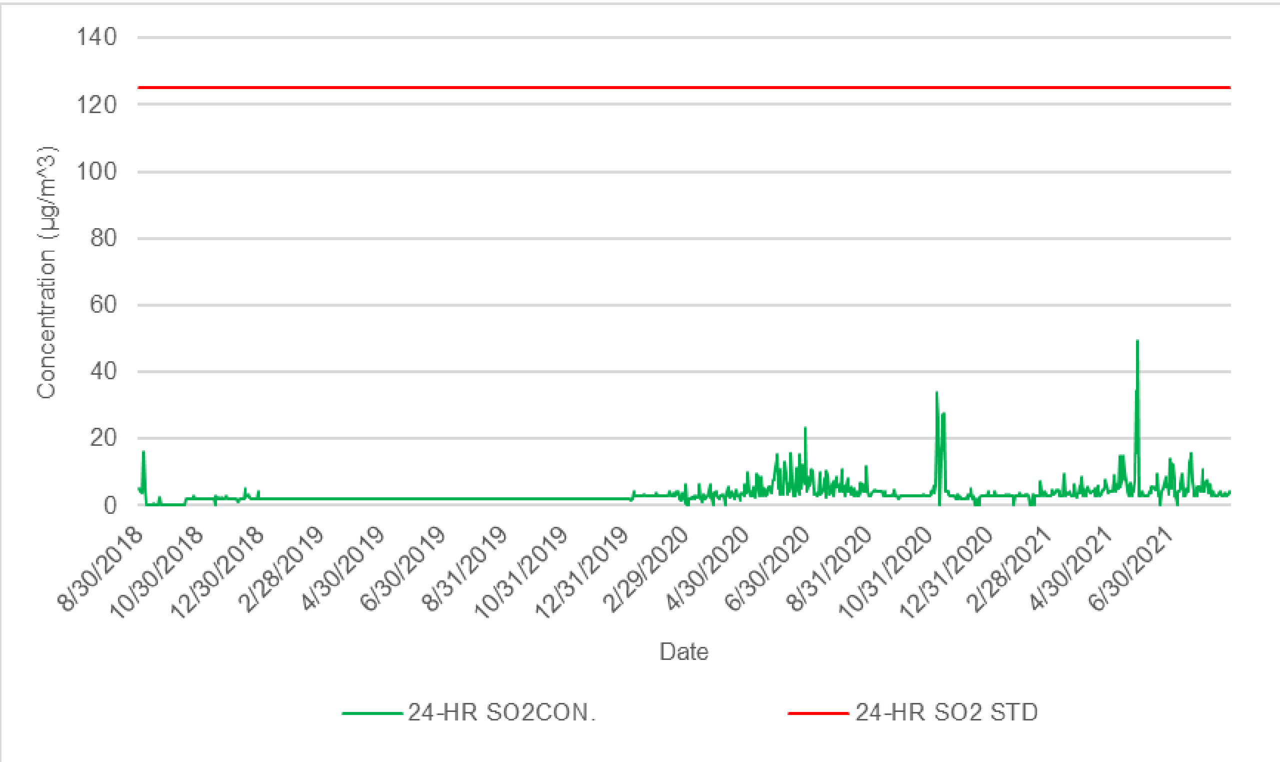


Figure 15:24-hour SO_2 concentrations at MFC for the period August 2018 to August 2021

6.1.3.5.2.3 NO_2 concentrations

Table 35 presents the NO_2 concentrations recorded at MFC for the period August 2018 to August 2021. Measured NO_2 concentrations were compliant with the annual averaging period for NO_2 (40 µg/m^3) for 2018, 2020 and 2021, however in 2019 concentrations were above the annual NAAQS (61 µg/m^3). Ambient NO_2 concentrations exceeded the 1-hour NAAQS (200 µg/m^3) 441 times and 106 times during 2019 and 2020 respectively. Since only 88 exceedances of the 1-hour NAAQS are permitted per annum, NO_2 concentrations at MFC were non-compliant for 2019 and 2020 (Figure 16). The P99 1-hour concentration in 2019 was noted to be significantly high and this should be viewed with caution. Such a concentration could likely be a result of inaccurate data recordings from the equipment. Additionally, it is noted that the NO_2 concentrations from MFC stacks are below the National standards, and thus exceedances could likely be from an alternative source in the region. Measurements however have significantly improved in 2021 which suggests better mitigation measures have been put in place. Importantly, the data recovery in 2018 and 2020 for NO_2 was a slightly below the recommended data recovery of 90% but has been used in this assessment as it still represents a valuable dataset.

Table 35: Nitrogen dioxide concentrations and exceedances recorded at MFC for the period August 2018 to August 2021

Pollutant	Ambient NO_2 Concentrations					
	Averaging Period	2018	2019	2020	2021	Average
NO_2	Annual average (µg/m^3)	10	61	14	9	24
	No. of 1-hour exceedances	1	441	106	0	-
	P99 1-hour concentration (µg/m^3)	25	1,000	242	36	101

Red values represent exceedances of the relevant standards

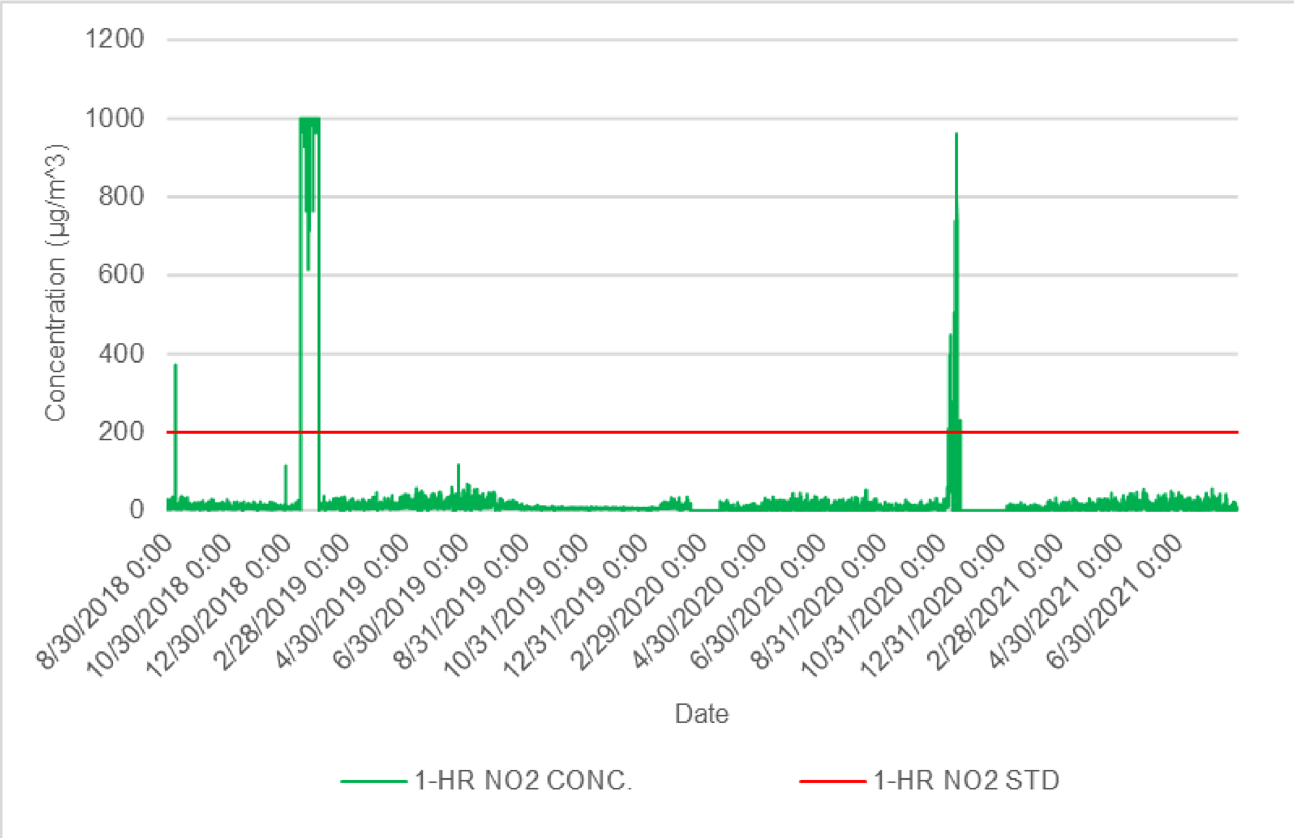


Figure 16:1-hour NO_2 concentrations at MFC for the period August 2018 to August 2021

6.2 Dispersion modelling

6.2.1 Model type

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.

As per the Regulations Regarding Air Dispersion Modelling (2014) the level of assessment is dependent on technical factors such as geophysical and meteorological context and the complexity of the emissions inventory. The temporal and spatial resolution and accuracy required from a model must also be taken into account. As such, this assessment is considered to be a Level 2 assessment.

Level 2 assessments should be used for air quality impact assessment in standard/generic licence or amendment processes where:

- The distribution of pollutant concentrations and depositions are required in time and space;
- Pollutant dispersion can be reasonable treated by a straight-line, steady-state, Gaussian plume model with first order chemical transformation. Although more complicated processes may be occurring, a more complicated model that explicitly treats these processes may not be necessary depending on the purposes of the modelling and the zone of interest; and
- Emissions are from sources where the greatest impacts are in the order of a few kilometres (less than 50 km), downwind.

For this assessment, the AERMOD dispersion modelling software was utilised. 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 latest National and International ambient air quality standards for compliance testing. AERMOD is the recommended level 2 model prescribed in the Regulations Regarding Air Dispersion Modelling (2014).

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 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; and
- A terrain pre-processor (AERMAP) to provide the 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.

6.2.2 Model input

Data input into the model includes modelled WRF meteorological data with wind speed, wind direction, temperature, pressure, precipitation, cloud cover and ceiling height for January 2018 to December 2020. Terrain data at a resolution of 90 m (Shuttle Radar Topography Mission (SRTM3)) was also input into the model. A modelling domain of 40 km × 40 km was used (Table 36), with multi-tier Cartesian grid receptor spacing's of 50 m (general area of maximum impact, property boundary and over steep terrain), 100 m (5 km from the facility of interest), 250 m (10 km from the facility of interest) and 1,000 m(beyond 10 km from source). A receptor spacing of 50 m was also located along the boundary of the MFC operations.

Table 36: Modelling domain coordinates

Domain Point	Latitude (°E)	Longitude (°S)
North-Eastern Point	-25.4378	29.8813
South-Western Point	-26.1746	29.1003

6.2.3 Model settings

A summary of the model settings into AERMOD used in this assessment is provided in Table 37.

Table 37: Summary of model settings

Parameter	Setting
Assessment Level	Level 2
Default Regulatory Settings Utilised	Yes
Dispersion Model	Aermod 9.9.0
Supporting Models	Aermet and Aermap
Pollutants modelled	Dust fallout, PM_{10}, $PM_{2.5}$, SO_2, NO_2 and Cr
Scenarios	Existing and Proposed Scenarios (Three Scenarios in total, see Section 0 for the detailed descriptions)
Flagpole Height	1.5 m

Parameter	Setting
Building Downwash	N/A
Chemical Transformation	N/A
Exponential Decay	N/A
Terrain Settings (simple, flat, elevated)	Elevated
Terrain Data	SRTM3
Terrain Data Resolution (m)	90
Elevation Data	The WebGIS Shuttle Radar Topography Mission (STRM) Terrain data was used with a resolution of 90 m
Land Use Characterisation	Cultivated Land (characterised based on aerial imagery and land use data)
Number of Sectors	1
Modelling Domain Centre	Latitude: 25.80621°S; Longitude: 29.49335°E
Modelling Domain (km)	40 x 40
Property Line Resolution (m)	50
Fine Grid Resolution (m)	50
Medium Grid Resolution (m)	100 and 250
Course Grid Resolution (m)	1000

6.2.4 Modelling scenarios

Three modelling scenarios have been considered for this assessment:

1) Scenario 1 (Existing operations): All operations at MFC under the current existing conditions.
2) Scenario 2 (Cumulative operations - existing operations including the proposed production increase and new installations/PSP abatement): All operations at MFC for the existing operations and proposed changes in production of the M3 and M4 furnaces and PSP. Additionally, the new installations of the PSP abatement and M3 and M4 preheaters have been included.
3) Scenario 3: (Cumulative operations - Scenario 2 plus the M3 abatement upgrade change).

Various statistical outputs that have been generated, are described below:

- Short-term averages: Refers to the predicted 99th percentile (P99) 1-hour and 24-hour average outputs. The P99 is required as per the ambient air quality guidelines and makes allowance for exceedances, eliminating outliers.
- Annual average (long-term) outputs, which is calculated by averaging all hourly concentrations. The calculation is conducted for each grid point within the modelling domain.

It must be noted that, as defined in the Regulations Regarding Air Dispersion Modelling, ambient air quality objectives 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.

6.2.5 Results and discussion

This section presents the results of the atmospheric dispersion modelling conducted for the operations. Concentration results at specified sensitive receptors are presented in tabular format, while concentration isopleths are presented graphically to indicate the dispersion of pollutants.

Furthermore, 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 taking into account all local and regional contributions to background concentrations. For the different facility locations and averaging times, the comparisons with NAAQS must be based on recommendations in Table 38.

Table 38: Summary of recommended procedures for assessing compliance with NAAQS

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

*For an isolated facility influenced by regional background pollution C_B (background concentration) must be considered

** C_P is the predicted concentration

In order to assess the cumulative impacts, the existing and proposed operations were modelled together and are presented as Scenario 2 and Scenario 3. As such, the background concentrations were not added to the proposed operations, which is an alternative method to obtain the cumulative impacts. If this were to be added to Scenario 2 and Scenario 3, this would result in double accounting/over estimation of the emissions for Scenario 2 and Scenario 3.

6.2.5.1 Dust fallout

Predicted dust fallout rates associated with the existing and cumulative (existing and proposed) operating scenarios for the highest rate and at each discrete receptor are presented in Table 40. Figure 18 shows the plume isopleths for the predicted dust fallout rates for all scenarios at the operations.

- Offsite Concentrations:
  - The highest predicted offsite rates for all scenarios are below the residential and non-residential Dust Control Regulations standards.
- Receptor Concentrations:
  - Predicted dust fallout rates for all scenarios are below the residential and non-residential dust control regulation standards at all surrounding sensitive receptors.

Table 39: Dust fallout at specified sensitive receptors

No.	Sensitive Receptor	Residential Dust Fallout Standard (mg/m^2/day)	Non-residential Dust Fallout Standard (mg/m^2/day)	Scenario 1	Scenario 2	Scenario 3
				Existing Dust Fallout Rate (mg/m^2/day)	Cumulative Dust Fallout Rate (mg/m^2/day)	Cumulative Dust Fallout Rate (mg/m^2/day)
1	4D Scan Hospital	**600**	**1,200**	5.70	6.02	6.02
2	Aerorand			6.83	7.79	7.79
3	Dennesig			5.23	5.37	5.37
4	Hoerskool Middelburg			10.66	11.29	11.29
5	Industria			34.19	39.68	39.68
6	Laerskool Dennesig			5.99	6.19	6.19
7	Malope Village			6.12	6.92	6.92
8	Mhluzi			6.53	6.75	6.75
9	Middelburg - MP			10.29	11.48	11.48
10	Middelburg Hospital			18.42	18.83	18.83
11	Middelburg Town Masjid			10.24	10.77	10.77
12	Middelburg-Midmed PVT Hospital			7.06	7.45	7.45
13	Mineralia			26.10	27.73	27.73
14	Mphanama Secondary School			8.37	8.71	8.71
15	Nazareth			26.78	30.31	30.31
16	Rockdale			12.61	14.16	14.16
17	Sozama Secondary School			6.86	7.21	7.21
Highest Offsite Rate				71.03	72.90	72.90

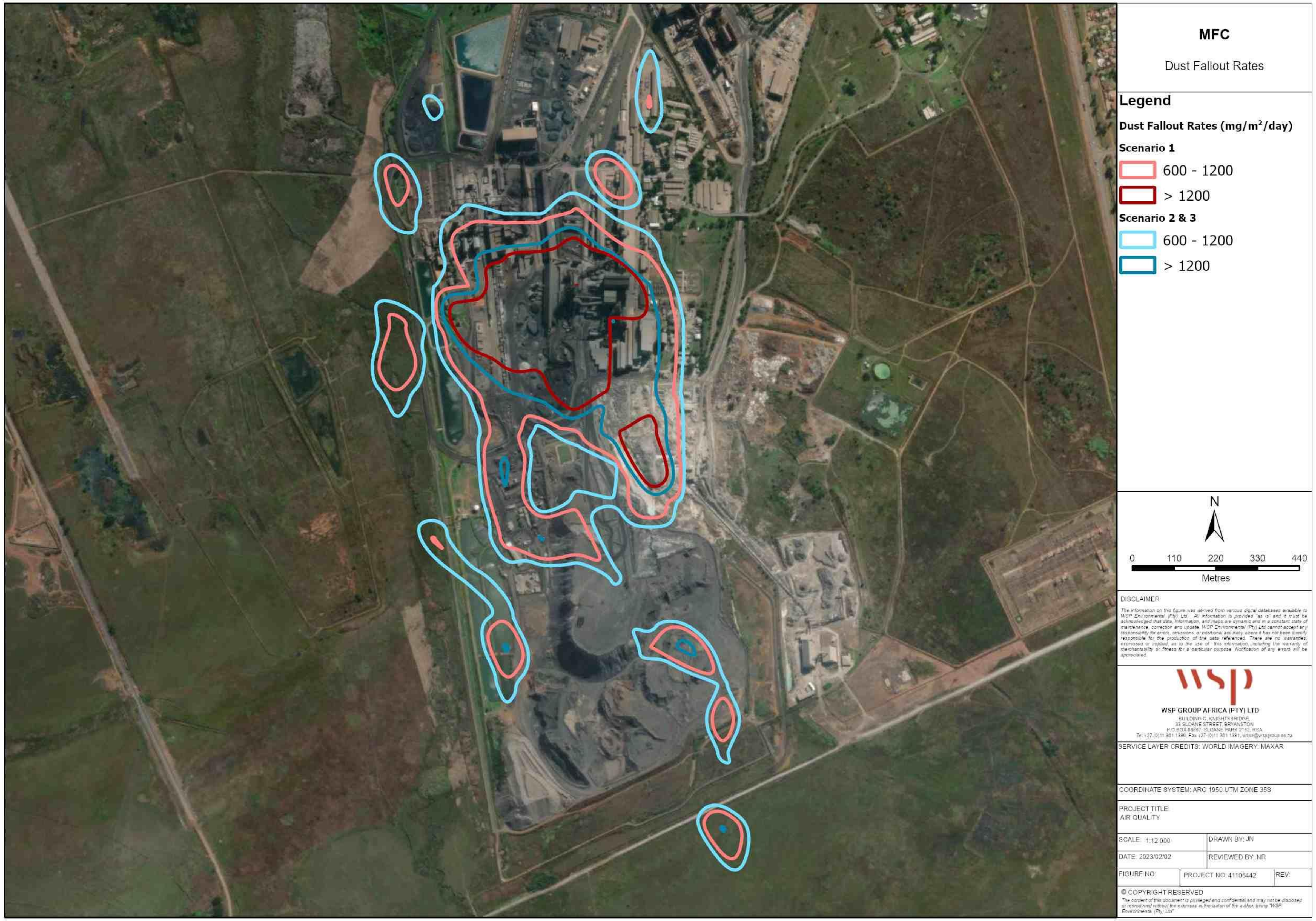


Figure 17:Predicted dust fallout rates at MFC (mg/m²/day)

6.2.5.2 PM_{10} concentrations

Predicted PM_{10} concentrations associated with the existing and cumulative (existing and proposed) operating scenarios for the highest offsite concentration and at each discrete receptor are presented in Table 40. Figure 18 and Figure 19 show the plume isopleths for the predicted P99 24-hour and annual average PM_{10} concentrations for all three scenarios at the operations.

- Offsite Concentrations:
  - The highest predicted offsite P99 24-hour average PM_{10} concentration from Scenario 1 is below the 24-hour average PM_{10} NAAQS of 75 µg/m^3.
  - The highest predicted offsite P99 24-hour average PM_{10} concentration from Scenario 2 and Scenario 3 are above the 24-hour average PM_{10} NAAQS. These exceedances occur approximately 65 m west and 58 m west, respectively of the facility. However, no receptors are located here.
  - The highest predicted offsite annual average PM_{10} concentrations from all scenarios are below the annual average PM_{10} NAAQS of 40 µg/m^3.
- Receptor Concentrations:
  - Predicted P99 24-hour and annual average PM_{10} concentrations for all scenarios are below their respective 24-hour and annual average PM_{10} NAAQS at all surrounding sensitive receptors.

Table 40: PM_{10} concentrations at specified sensitive receptors

No.	Sensitive Receptor	24-hour NAAQS (µg/m³)	Scenario 1 Existing P99 24-hour Average Concentration (µg/m³)	Scenario 2 Cumulative P99 24-hour Average Concentration (µg/m³)	Scenario 3 Cumulative P99 24-hour Average Concentration (µg/m³)	Annual NAAQS (µg/m³)	Scenario 1 Existing Annual Average Concentration (µg/m³)	Scenario 2 Cumulative Annual Average Concentration (µg/m³)	Scenario 3 Cumulative Annual Average Concentration (µg/m³)
1	4D Scan Hospital	75	1.94	2.35	2.34	40	0.18	0.23	0.22
2	Aerorand		1.72	2.13	2.12		0.36	0.42	0.41
3	Dennesig		1.60	2.06	2.05		0.09	0.11	0.10
4	Hoerskool Middelburg		2.95	3.65	3.59		0.36	0.45	0.44
5	Industria		8.48	10.91	10.91		0.80	0.98	0.97
6	Laerskool Dennesig		1.66	2.15	2.14		0.09	0.11	0.11
7	Malope Village		1.42	1.49	1.42		0.28	0.30	0.29
8	Mhluzi		1.80	2.32	2.32		0.25	0.31	0.31
9	Middelburg - MP		3.28	3.92	3.92		0.37	0.45	0.45
10	Middelburg Hospital		3.29	4.07	4.03		0.57	0.70	0.69
11	Middelburg Town Masjid		2.74	3.39	3.38		0.29	0.36	0.35
12	Middelburg-Midmed PVT Hospital		2.40	3.01	2.99		0.25	0.31	0.31
13	Mineralia		8.10	10.53	10.53		1.97	2.41	2.38
14	Mphanama Secondary School		1.90	2.42	2.42		0.22	0.27	0.26
15	Nazareth		5.07	6.46	6.38		0.70	0.84	0.82
16	Rockdale		2.14	2.41	2.00		0.35	0.41	0.35
17	Sozama Secondary School		2.10	2.61	2.60		0.25	0.30	0.30
Highest Offsite Concentration			65.78	85.73	85.70		25.43	33.25	33.16

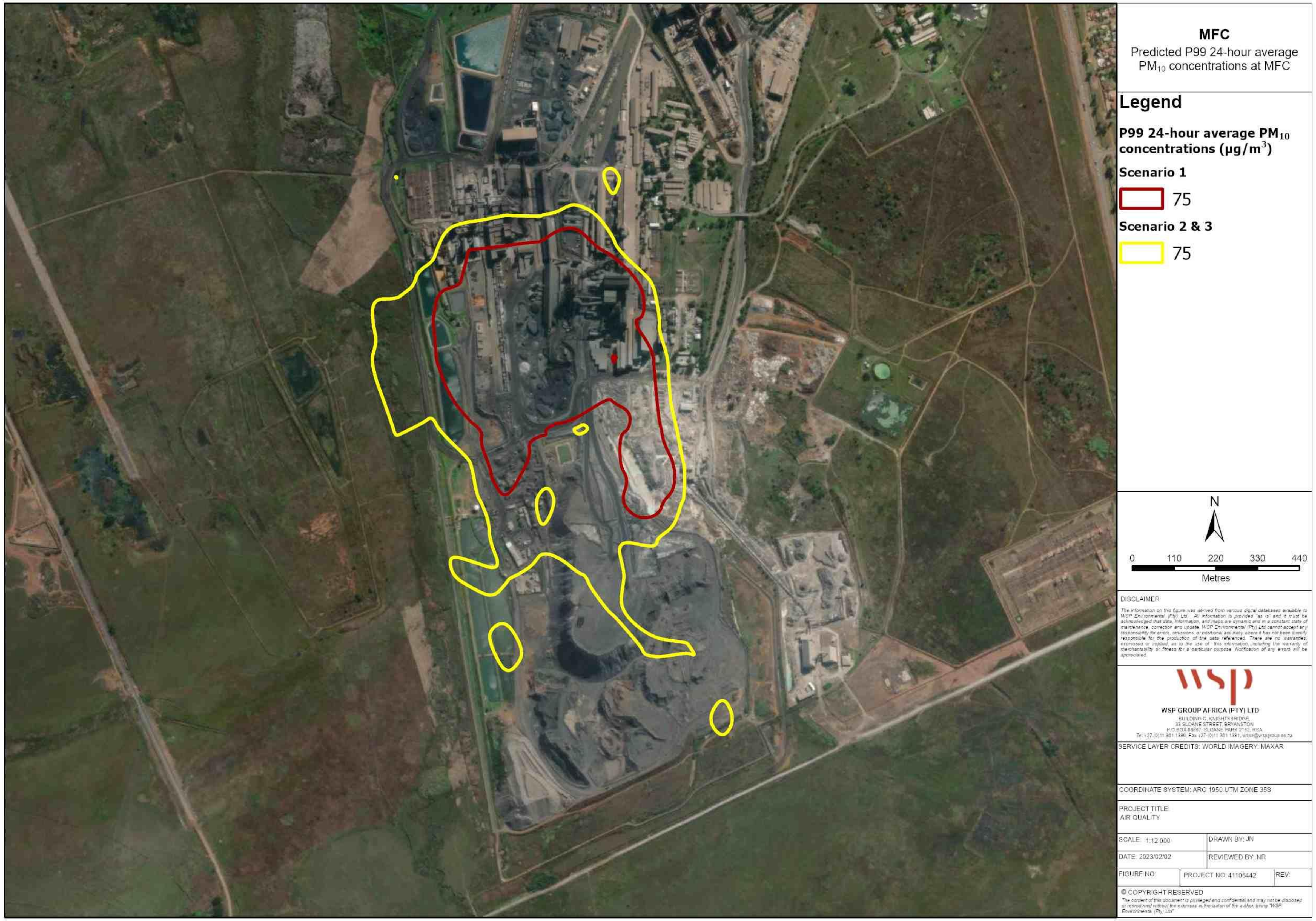


Figure 18:Predicted P99 24-hour average PM_{10} concentrations at MFC ($\mu g/m^3$)

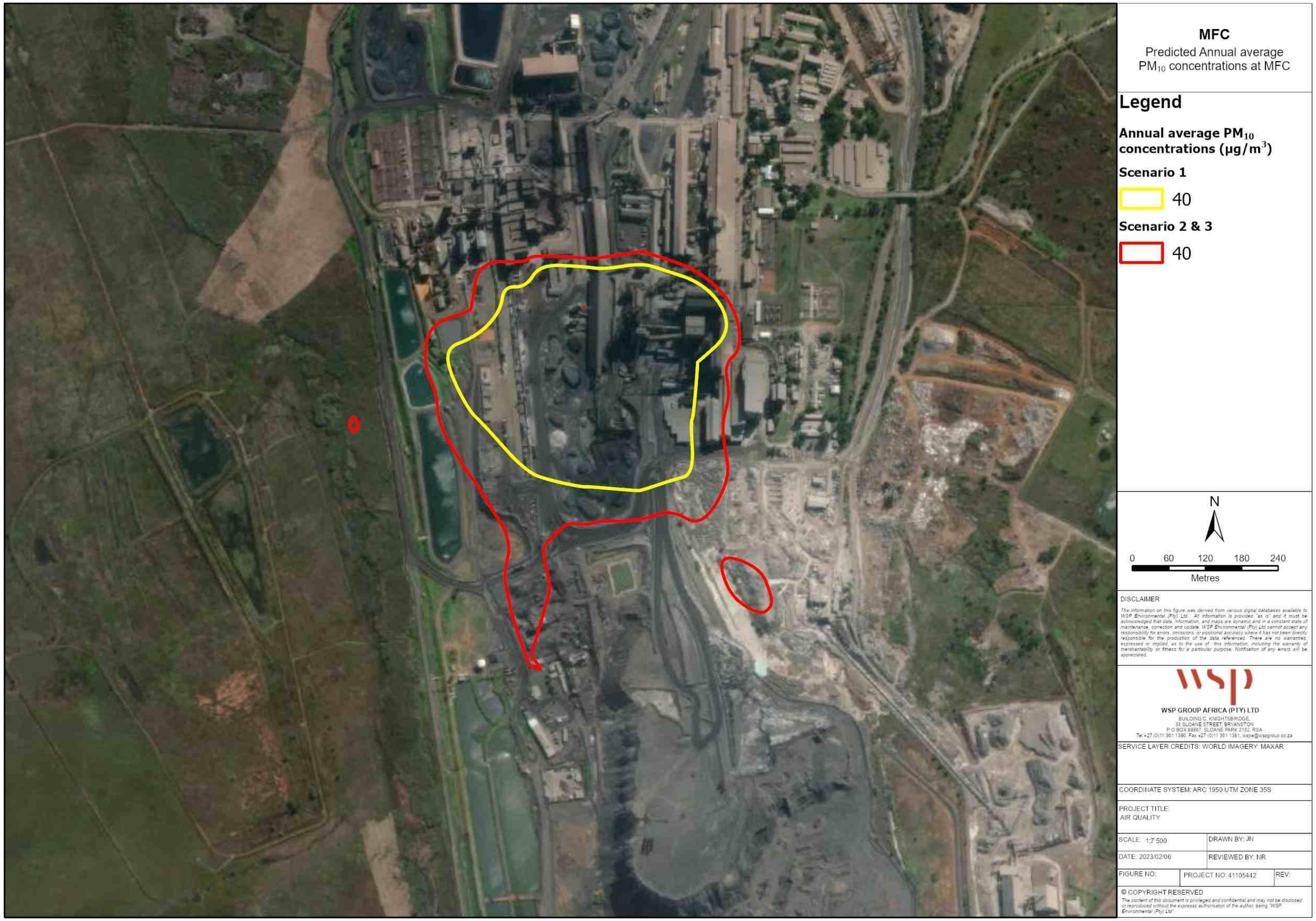


Figure 19:Predicted annual average PM_{10} concentrations at MFC ($\mu g/m^3$)

6.2.5.3 $PM_{2.5}$ concentrations

Predicted $PM_{2.5}$ concentrations associated with the existing and cumulative (existing and proposed) operating scenarios for the highest offsite concentration and at each discrete receptor are presented in Table 41. Figure 20 and Figure 21 shows the plume isopleths for the predicted P99 24-hour and annual average $PM_{2.5}$ concentrations for all three scenarios at the operations.

- Offsite Concentrations:
  - The highest predicted offsite P99 24-hour and annual average $PM_{2.5}$ concentrations from all scenarios are below the 24-hour and annual average $PM_{2.5}$ NAAQS of 40 µg/m^3 and 20 µg/m^3, respectively.
- Receptor Concentrations:
  - Predicted P99 24-hour and annual average $PM_{2.5}$ concentrations for all scenarios are below their respective 24-hour and annual average $PM_{2.5}$ NAAQS at all surrounding sensitive receptors.

Table 41: $PM_{2.5}$ concentrations at specified sensitive receptors

No.	Sensitive Receptor	24-hour NAAQS (µg/m³)	Scenario 1 Existing P99 24-hour Average Concentration (µg/m³)	Scenario 2 Cumulative P99 24-hour Average Concentration (µg/m³)	Scenario 3 Cumulative P99 24-hour Average Concentration (µg/m³)	Annual NAAQS (µg/m³)	Scenario 1 Existing Annual Average Concentration (µg/m³)	Scenario 2 Cumulative Annual Average Concentration (µg/m³)	Scenario 3 Cumulative Annual Average Concentration (µg/m³)
1	4D Scan Hospital	40	0.46	0.48	0.46	20	0.05	0.06	0.05
2	Aerorand		0.71	0.71	0.64		0.15	0.16	0.14
3	Dennesig		0.34	0.38	0.36		0.03	0.03	0.03
4	Hoerskool Middelburg		0.69	0.79	0.78		0.09	0.10	0.10
5	Industria		1.59	1.87	1.84		0.19	0.20	0.19
6	Laerskool Dennesig		0.34	0.40	0.39		0.03	0.03	0.03
7	Malope Village		0.81	0.60	0.54		0.13	0.11	0.10
8	Mhluzi		0.51	0.59	0.57		0.07	0.08	0.08
9	Middelburg - MP		0.70	0.85	0.82		0.09	0.10	0.10
10	Middelburg Hospital		0.88	0.93	0.85		0.15	0.16	0.16
11	Middelburg Town Masjid		0.64	0.76	0.74		0.07	0.08	0.08
12	Middelburg-Midmed PVT Hospital		0.53	0.65	0.62		0.07	0.08	0.07
13	Mineralia		2.18	2.38	2.15		0.55	0.61	0.57
14	Mphanama Secondary School		0.46	0.52	0.49		0.06	0.07	0.07
15	Nazareth		1.40	1.71	1.66		0.24	0.24	0.23
16	Rockdale		1.55	1.44	0.94		0.21	0.23	0.17
17	Sozama Secondary School		0.50	0.57	0.57		0.07	0.08	0.07
Highest Offsite Concentration			14.16	18.10	18.10		4.66	6.74	6.65

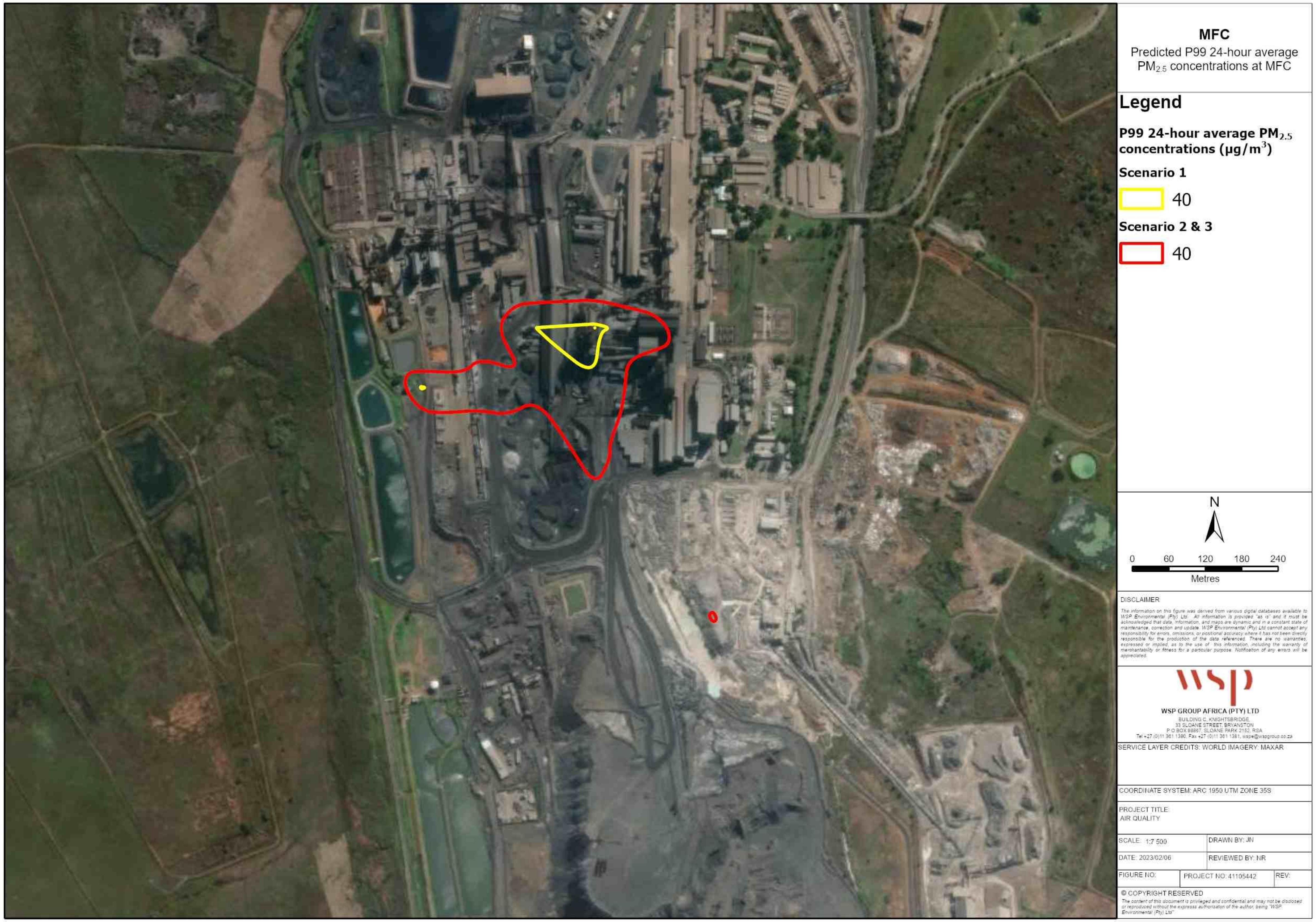


Figure 20:Predicted P99 24-hour average $PM_{2.5}$ concentrations at MFC (µg/m³)

Figure 21:Predicted annual average $PM_{2.5}$ concentrations at MFC (µg/m^3)

6.2.5.4 NO_2 concentrations

Predicted NO_2 concentrations associated with the existing and cumulative (existing and proposed) operating scenarios for the highest offsite concentration and at each discrete receptor are presented in Table 42. Figure 22 and Figure 23 shows the plume isopleths for the predicted P99 1-hour and annual average NO_2 concentrations for all scenarios at the operations.

- Offsite Concentrations:
  - The highest predicted offsite P99 1-hour average NO_2 concentration from all scenarios are below the 1-hour average NO_2 NAAQS of 200 µg/m^3.
  - The highest predicted offsite annual average NO_2 concentrations from all scenarios are below the annual average NO_2 NAAQS of 40 µg/m^3.
- Receptor Concentrations:
  - Predicted P99 1-hour and annual average NO_2 concentrations for all scenarios are below their respective 1-hour and annual average NO_2 NAAQS at all surrounding sensitive receptors.

Table 42: NO_2 concentrations at specified sensitive receptors

No.	Sensitive Receptor	1-hour NAAQS (µg/m³)	Scenario 1	Scenario 2	Scenario 3	Annual NAAQS (µg/m³)	Scenario 1	Scenario 2	Scenario 3
			Existing P99 1-hour Average Concentration (µg/m³)	Cumulative P99 1-hour Average Concentration (µg/m³)	Cumulative P99 1-hour Average Concentration (µg/m³)		Existing Annual Average Concentration (µg/m³)	Cumulative Annual Average Concentration (µg/m³)	Cumulative Annual Average Concentration (µg/m³)
1	4D Scan Hospital	200	3.60	9.39	7.68	40	0.12	0.37	0.31
2	Aerorand		11.81	42.35	34.79		0.51	1.65	1.35
3	Dennesig		2.32	6.20	5.47		0.08	0.28	0.24
4	Hoerskool Middelburg		5.30	15.03	12.10		0.19	0.59	0.48
5	Industria		8.34	25.88	21.85		0.35	1.12	0.94
6	Laerskool Dennesig		2.45	6.13	5.66		0.08	0.28	0.24
7	Malope Village		11.94	31.75	23.70		0.48	1.22	0.93
8	Mhluzi		5.09	15.12	11.91		0.18	0.54	0.44
9	Middelburg - MP		5.20	13.91	11.19		0.19	0.58	0.48
10	Middelburg Hospital		8.07	26.25	20.40		0.32	0.92	0.75
11	Middelburg Town Masjid		4.74	11.80	9.44		0.16	0.50	0.41
12	Middelburg-Midmed PVT Hospital		4.36	11.04	8.50		0.15	0.46	0.38
13	Mineralia		22.75	83.43	67.86		1.33	3.82	3.06
14	Mphanama Secondary School		4.36	11.90	9.25		0.15	0.45	0.37
15	Nazareth		10.98	43.48	36.34		0.63	2.29	1.95
16	Rockdale		32.47	76.26	50.30		1.41	4.00	2.73
17	Sozama Secondary School		4.73	13.48	10.70		0.16	0.49	0.40
Highest Offsite Concentration			32.81	168.16	134.92		3.03	9.66	7.80

Figure 22:Predicted P99 1-hour average NO_2 concentrations at MFC (µg/m^3)

Figure 23:Predicted annual average NO_2 concentrations at MFC (µg/m^3)

6.2.5.5 SO_2 concentrations

Predicted SO_2 concentrations associated with the existing and cumulative (existing and proposed) operating scenarios for the highest offsite concentration and at each discrete receptor are presented in Table 43. Figure 24 to Figure 26 shows the plume isopleths for the predicted P99 1-hour, P99 24-hour and annual average SO_2 concentrations for all scenarios at the operations.

- Offsite Concentrations:
  - The highest predicted offsite P99 1-hour, P99 24-hour and annual average SO_2 concentrations for all scenarios are below the 1-hour, 24-hour and annual average SO_2 NAAQS of 350 µg/m3, 125 µg/m^3 and 50 µg/m^3, respectively.
- Receptor Concentrations:
  - Predicted P99 1-hour, P99 24-hour and annual average SO_2 concentrations for all scenarios are below their respective 1-hour, 24-hour and annual average SO_2 NAAQS at all surrounding sensitive receptors.

Table 43: SO_2 concentrations at specified sensitive receptors

No.	Sensitive Receptor	1-hour NAAQS (µg/m^3)	Scenario 1 Existing 1-hour Average Concentration (µg/m^3)	Scenario 2 Cumulative 1-hour Average Concentration (µg/m^3)	Scenario 3 Cumulative 1-hour Average Concentration (µg/m^3)	24-hour NAAQS (µg/m^3)	Scenario 1 Existing 24-hour Average Concentration (µg/m^3)	Scenario 2 Cumulative 24-hour Average Concentration (µg/m^3)	Scenario 3 Cumulative 24-hour Average Concentration (µg/m^3)	Annual NAAQS (µg/m^3)	Scenario 1 Existing Annual Average Concentration (µg/m^3)	Scenario 2 Cumulative Annual Average Concentration (µg/m^3)	Scenario 3 Cumulative Annual Average Concentration (µg/m^3)
1	4D Scan Hospital	**350**	0.59	1.94	1.89	**125**	0.33	0.82	0.81	**50**	0.03	0.07	0.07
2	Aerorand		3.15	8.72	8.49		0.86	2.43	2.38		0.11	0.32	0.32
3	Dennesig		0.41	1.34	1.32		0.26	0.66	0.64		0.02	0.06	0.06
4	Hoerskool Middelburg		1.06	3.05	2.99		0.53	1.29	1.26		0.04	0.11	0.11
5	Industria		2.39	5.50	5.38		0.88	2.04	2.02		0.10	0.23	0.22
6	Laerskool Dennesig		0.43	1.31	1.28		0.25	0.64	0.63		0.02	0.06	0.06
7	Malope Village		3.18	6.08	5.84		0.93	2.12	2.09		0.12	0.23	0.22
8	Mhluzi		1.00	3.03	2.94		0.47	1.24	1.23		0.04	0.10	0.10
9	Middelburg - MP		0.91	2.82	2.72		0.44	1.13	1.11		0.04	0.11	0.11
10	Middelburg Hospital		2.02	5.16	4.98		0.82	1.94	1.90		0.07	0.17	0.17
11	Middelburg Town Masjid		0.82	2.38	2.31		0.41	1.04	1.02		0.03	0.10	0.09
12	Middelburg-Midmed PVT Hospital		0.69	2.15	2.11		0.34	0.92	0.91		0.03	0.09	0.09
13	Mineralia		7.35	17.07	16.73		2.66	6.44	6.29		0.29	0.72	0.70
14	Mphanama Secondary School		0.78	2.33	2.28		0.36	0.97	0.95		0.03	0.08	0.08
15	Nazareth		3.06	9.18	9.01		0.99	3.11	3.06		0.19	0.48	0.47
16	Rockdale		5.16	12.96	12.49		2.06	4.30	3.90		0.25	0.71	0.68
17	Sozama Secondary School		0.92	2.69	2.61		0.41	1.04	1.03		0.03	0.09	0.09
Highest Offsite Concentration			11.76	33.73	32.91		5.12	12.73	12.46		0.59	1.77	1.72

Figure 24:Predicted P99 1-hour average SO_2 concentrations at MFC (µg/m³)

Figure 25:Predicted P99 24-hour average SO_2 concentrations at MFC (μg/m³)

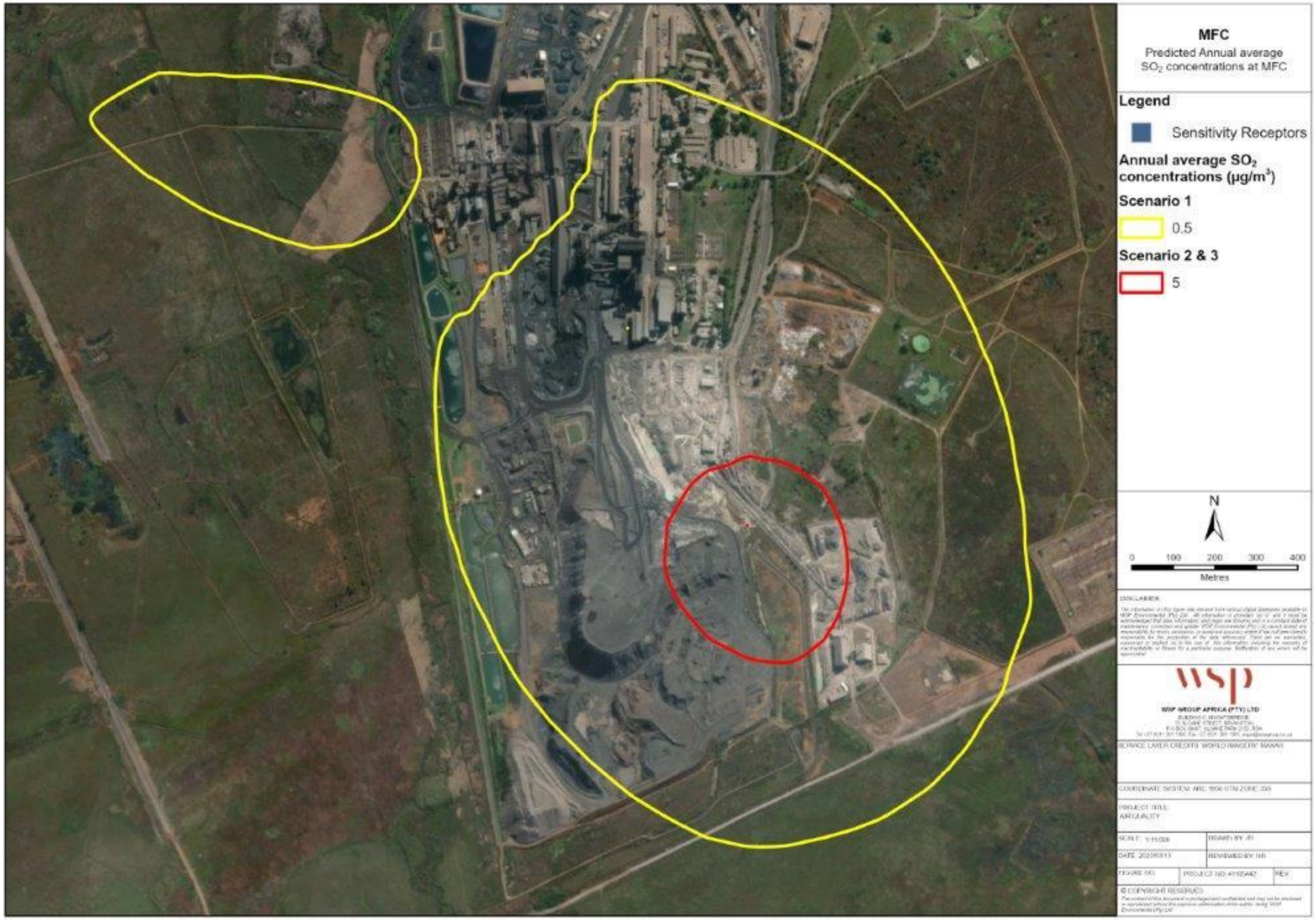


Figure 26:Predicted annual average SO_2 concentrations at MFC ($\mu g/m^3$)

6.2.5.6 Cr concentrations

Predicted Cr concentrations associated with the existing and cumulative (existing and proposed) operating scenarios for the highest offsite concentration and at each discrete receptor are presented in Table 44. Figure 27 shows the plume isopleths for the predicted annual average Cr concentrations for all scenarios at the operations.

- Offsite Concentrations:
  - The highest predicted offsite annual average Cr concentrations for all scenarios are minimal, below the relevant averaging period guidelines.
- Receptor Concentrations:
  - Predicted annual average Cr concentrations for all scenarios are minimal at all surrounding sensitive receptors, below the relevant averaging period guidelines.

Table 44: Cr concentrations at specified sensitive receptors

No.	Sensitive Receptor	Scenario 1	Scenario 2	Scenario 3
		Existing Annual Average Concentration (µg/m^3)	Cumulative Annual Average Concentration (µg/m^3)	Cumulative Annual Average Concentration (µg/m^3)
1	4D Scan Hospital	2.00E-05	3.00E-05	3.00E-05
2	Aerorand	1.10E-04	1.30E-04	1.30E-04
3	Dennesig	2.00E-05	2.00E-05	2.00E-05
4	Hoerskool Middelburg	3.00E-05	4.00E-05	4.00E-05
5	Industria	6.00E-05	8.00E-05	8.00E-05
6	Laerskool Dennesig	2.00E-05	2.00E-05	2.00E-05
7	Malope Village	1.10E-04	1.30E-04	1.30E-04
8	Mhluzi	3.00E-05	4.00E-05	4.00E-05
9	Middelburg - MP	3.00E-05	4.00E-05	4.00E-05
10	Middelburg Hospital	5.00E-05	6.00E-05	6.00E-05
11	Middelburg Town Masjid	3.00E-05	3.00E-05	3.00E-05
12	Middelburg-Midmed PVT Hospital	3.00E-05	3.00E-05	3.00E-05
13	Mineralia	2.50E-04	3.00E-04	3.00E-04
14	Mphanama Secondary School	3.00E-05	3.00E-05	3.00E-05
15	Nazareth	1.10E-04	1.30E-04	1.30E-04
16	Rockdale	3.10E-04	3.80E-04	3.80E-04
17	Sozama Secondary School	3.00E-05	3.00E-05	3.00E-05
Highest Offsite Concentration		5.50E-04	4.40E-04	4.40E-04

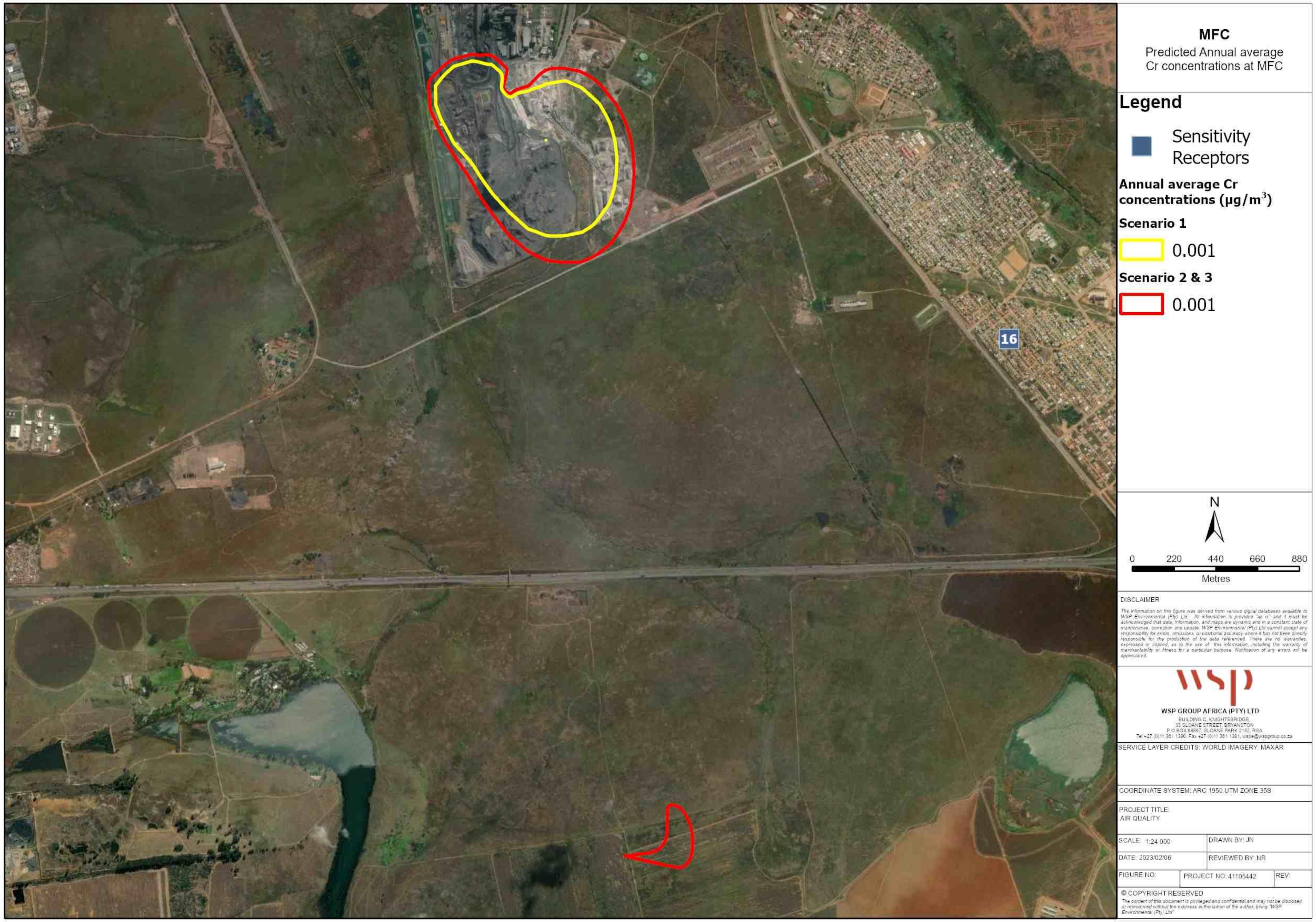


Figure 27:Predicted annual average Cr concentrations at MFC (µg/m³)

6.3 Assumptions and Limitations

The following assumptions were made for the assessment:

- Data input into the model is based on the information provided by the Client. It is assumed that the information provided by the Client is accurate and complete at the time of modelling.
- It must be noted that the WRF meteorological data, although slightly outdated, still falls within the Modelling Regulation limits.
- Default emission factors from USEPA AP42 Chapter 13.2.4 Aggregate Handling and Storage Piles (USEPA, 1995) were used to calculate particulate emissions from material handling of raw material, sinter plant and smelting activities. A 50% control efficiency was applied to the materials handling activities (COACOA, 2012). Importantly, material handling from crushing activities (transfer of material) are excluded (to prevent double accounting of emissions) as the crushing emission factors include emissions from the screens, the crusher, feeder, and conveyor belt transfer points that are integral to the crusher (COACOA, 2012).
- The default particulate emission factors for wind erosion over open areas from Emission Estimation Technique Manual for Mining (COACOA, 2012) were used. $PM_{2.5}$ emissions were assumed to equal 15% of TSP (USEPA, 2006) in the absence of a $PM_{2.5}$ emission factor. A 50% control efficiency for the use of wet suppression was applied as an environmentally conservative approach (COACOA, 2012) for those stockpiles that will be mitigated.
- To estimate the particulate emissions from crushing, emission factors for crushing operations from the from Emission Estimation Technique Manual for Mining (COACOA, 2012) were utilised. Emissions were based on primary crushing of high moisture content ore (> 4%). Primary crushing activities include emissions from screens, the crusher, the surge bin, the apron feeder, and conveyor belt transfer points that are integral to the crusher. $PM_{2.5}$ emission rates were calculated by applying a factor of 30% (US EPA, 1995) to the TSP emission rates. A 50% mitigation efficiency (COACOA, 2012) was applied in the calculations for water sprays.
- Emission factors from USEPA AP42 Chapter 13.2.2 Unpaved Roads (USEPA, 2006) were used to calculate particulate emissions for unpaved roads. The number of hauls trucks on unpaved roads were provided by the Client. The road surface silt content of 4.8% for industrial unpaved roads (USEPA, 2011) was used and a mean vehicle weight of 37.5 tonnenes was provided by the Client. A control efficiency factor of 75% (wet suppression) (COACOA, 2012) was applied to the unpaved haul roads for wet suppression.
- Emission factors from USEPA AP42 Chapter 13.2.1 Paved Roads (USEPA, 2011) were used to calculate particulate emissions for paved roads. The number of hauls trucks on paved roads were provided by the Client. The road surface silt loading of 9.7 g/m^2 for iron and steel production (USEPA, 2011) was used (in the absence of a specific ferrochrome production silt content) and a mean vehicle weight of 44 tonnenes was provided by the Client. A control efficiency factor of 50% (wet sweeping) (COACOA, 2012) was applied to the paved haul roads.

7.0 MITIGATION MEASURES

The following mitigation measures during the operational phase would serve to further reduce dust and particulate matter (specifically PM_{10} since the highest offsite concentrations during the P99 24-hour averaging period were above the 24-hour PM_{10} NAAQS) emissions on the receiving environment and at sensitive receptors.

Wind Erosion and Exposed Areas

Wind-blown dust can be minimised with the use of wet suppression and road sweepers, which have an estimated control efficiency of 50%. While wind-blown dust may not be a significant contributor to overall dust emissions, wind erosion can substantially increase dust entrainment at any site. It is understood that MFC, however, use both these mitigation measures on site and as such, ensure adequate mitigation from wind-blown dust.

Stockpiles

Dust emissions from stockpiles can occur during the loading of the piles, when wind disturbs the stockpile surface, and during reclamation (USEPA, 2006a). The following mitigation techniques are suggested to reduce wind erosion from stockpiles:

- The height of existing berms at stockpiles be increased, reducing the impact of winds on the stockpile.
- Store raw materials with high fines content in semi-enclosed bunkers where possible. MFC should however look at investigating options for dust extraction at enclosed bunkers.
- Shape stockpiles, taking into consideration width to height ratio, nature of stockpiled material, location, access and available area for the stockpile. Limit stockpile heights based on their stability, manageability, dust and amenity impacts.
- More gentle slopes for unstable soils are recommended. Avoid building steep sided stockpiles that have sharp changes in shape.

Truck Loading and Unloading

Truck loading and unloading activities are also likely to contribute significantly to the amount of dust generated from materials handling activities. Loading and offloading activities are fairly difficult to mitigate, although the following techniques can be employed to assist with dust suppression (Kate Stone, 2011):

- Avoid double handling of material where possible.
- Minimising the drop height of the material from truck loads.
- Using road sweepers when loading and unloading activities occur.

Crushing

Mitigation methods in these areas that can be implemented to reduce dust emissions include:

- Tasking a team to be responsible for the removal of all deposited dust from machinery and enclosures within the crushing plant and tip areas, resulting in less deposited dust available for wind entrainment.
- Deploy a dust sweeper to the plant, capable of collecting all deposited fines, reducing the amount of dust available for wind entrainment.

Unpaved Roads

To adequately mitigate emissions of dust associated with unpaved roads, the following key recommendations are suggested:

- Application of water (potential of reducing emissions by 75% (COA, 2012)) as a dust suppressant to all haul roads and other roads experiencing high traffic volumes. If the costs associated with water application are high, and water is scarce, etc (i.e. many disadvantages of water are posed) then consider a dust-a-side or similar chemical suppressant, which has the potential of reducing dust emissions by approximately 99%.

- Implement vehicle speed and access restrictions within the site (approximately 30 km/h).
- Prevention of material deposition onto haul roads through avoiding the overloading of truck loads resulting in spillages on the roads; preventing wind erosion from adjacent open areas; and ensure adequate storm water drainage to prevent water erosion of the roads.
- Prioritising source reduction measures through the use of the most direct travel routes on site and using larger capacity trucks to minimise the number of trips.
- Water bowser routes should align with the daily/weekly site plan schedule and a maintenance programme should be in place to ensure continuous availability of the water bowsers.

Paved Roads

To adequately mitigate emissions of dust associated with paved roads at the facility, the following key recommendations are suggested:

- Ensure road sweeping is implemented.
- Implement vehicle speed and access restrictions within the site (approximately 30 km/h).
- Prevention of material deposition onto haul roads through avoiding the overloading of truck loads resulting in spillages on the roads; preventing wind erosion from adjacent open areas; and ensure adequate storm water drainage to prevent water erosion of the roads.
- Prioritising source reduction measures through the use of the most direct travel routes on site and using larger capacity trucks to minimise the number of trips.

Stacks

The following measures would assist in reducing impacts from NO_2 (Since concentrations from SO_2 and Cr are considered to be minimal, no additional measures are suggested):

- Maintain and service all furnaces, preheaters and PSP stacks regularly to ensure that emissions are kept to a minimum.
- Investigate use of alternative fuels (cleaner fuels) supplied to the preheaters to assist in reducing NO_2 emissions.
- Ensure ongoing stack testing as per AEL conditions to monitor NO_x emissions.

Given that the impacts of Cr, $PM_{2.5}$ and SO_2 are negligible, no further mitigation methods (other than the ones already implemented) are deemed necessary to reduce emissions from these pollutants.

7.1 Analysis of emissions' impact on the environment

The following sections analyse the potential impacts associated with air pollution on the surrounding environment.

7.1.1 Effects on vegetation

Air pollution in South Africa was first identified as a potential threat to vegetation in 1988 (Tyson et al., 1988). The commercial forests of the eastern escarpment were highlighted as a threatened resource due to their proximity to the heavily industrialised Highveld. Marshal et al. (1998) also identified concerns around the potential impacts on crop yields on the Highveld. Air pollutants that could impact on vegetation include PM, SO_2, O_3, NO_x and hydrogen fluoride (HF). The effects of pollution on plants include mottled foliage, 'burning' at leaf tips or margins, twig dieback, stunted growth, premature leaf drop, delayed maturity, abortion or early drop of blossoms, and reduced yield or quality. In general, the visible injury to plants is of three types: (1) collapse of leaf tissue with the development of necrotic patterns, (2) yellowing or other colour changes, and (3) alterations in growth or premature loss of foliage (Sikora and Chappelka, 2004). Factors that govern the extent of damage and the region where air pollution is a problem are (1) type and concentration of pollutants, (2) distance from the source, (3) length of exposure, and (4) meteorological conditions. Other important factors are city size and location, land topography, soil moisture and nutrient supply, maturity of plant tissues, time of year, and species and variety of plants. A soil moisture deficit or extremes of temperature, humidity, and light often alter a plant's response to an air pollutant (Sikora and Chappelka, 2004).

7.1.2 Effects on animals

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

7.1.3 Effects on physical structures

Air pollution commonly effects structures in the following manners:

- Soiling of structures.
- Increases corrosion of metals and/or concrete structures.
- Increased maintenance costs.

8.0 COMPLAINTS

One air quality complaint was received on 1 August 2019 from the Nkangala District Municipality for "black dust" which was found at a residents' house in extension 18, which was reported for the month of July and August.

9.0 CURRENT OR PLANNED AIR QUALITY MANAGEMENT INTERVENTIONS

It is noted that the M4 abatement equipment may be upgraded in the future should there be a likelihood of exceedances. It is thus recommended to continue to evaluate, model and monitor this to maintain compliance. No other current or planned air quality management interventions are proposed for the facility.

10.0 COMPLIANCE AND ENFORCEMENT ACTIONS

There are no compliance or enforcement actions undertaken against MFC in the last five years.

11.0 ADDITIONAL INFORMATION

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

12.0 REFERENCES

DEA, 2011. The Highveld Priority Area Air Quality Management Plan (Draft). Pretoria, Department of Environmental Affairs and Tourism (Directorate: Air Quality Management).

Fenger, J., 2002: Urban air quality, In J. Austin, P. Brimblecombe and W. Sturges (eds), Air pollution science for the 21st century, Elsevier, Oxford.

Harrison, R.M. and R.E. van Grieken, 1998: Atmospheric Aerosols. John Wiley: Great Britain.

Held, G., Gore, B.J., Surridge, A.D., Tosen, G.R., and Wamsley, R.D, 1996: Air Pollution and its impacts on the South African Highveld, Environmental Scientific Association, Cleveland, 144p.

HEW, 2001: Health, Environment and Work: Learning about air quality. Available at http://www.agius.com.

Jury, M.R., 2013: Climate trends in southern Africa. *South African Journal of Science*, *109*(1-2), pp.1-11.

Manahan, S.E., 1991: Environmental Chemistry, Lewis Publishers Inc, United States of America.

Commonwealth of Australia (CoA) (2012): National Pollutant Inventory, Emission Estimation Technique Manual for Mining, Version 3.1. Available online at: https://www.dcceew.gov.au/environment/protection/CoA/reporting/industry-reporting-materials/emission-estimation-technique-manuals.

Prestonne-Whyte, R.A., and Tyson, P.D., 1997: The Atmosphere and Weather of Southern Africa. Oxford University Press, Cape Town.

Prestonne-Whyte, R.A., and Tyson, P.D., 1998: The Weather and Climate of Southern Africa, 2nd Edition.

Republic of South Africa, Government Notice 1210 (2009), Government Gazette 32816: National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), National Ambient Air Quality Standards.

Republic of South Africa, Government Notice 827 (2013), Government Gazette 36974: National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), National Dust Control Regulations.

Republic of South Africa, Government Notice 893 (2013), Government Gazette 36974: National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), List of Activities which result in atmospheric emissions.

Republic of South Africa, Government Notice 533 (2014), Government Gazette 37804: National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004), Regulations Regarding Air Dispersion Modelling.

Rubel, F., & Kottek, M., 2010: Observed and projected climate shifts 1901–2100 depicted by world maps of the Köppen-Geiger climate classification. *Meteorologische Zeitschrift*, *19*(2), 135-141.

Samaras, Z., and Sorensen, S.C., 1999: Mobile sources, In J. Fenger, O. Hertel and F. Palmgren (eds), urban air pollution – European aspects, Kluwer Academic Publishers, Denmark.

USEPA (1995) Air Pollutant Emission Factors (AP-42).

WSP Group Africa (Pty) Ltd

Novania Reddy
Principal Consultant

Reddy

Kirsten Collett
Principal Consultant

KCollett

NR/KC

APPENDIX A

Formal Declarations

Declaration of Independence of Practitioner

DECLARATION OF INDEPENDENCE - PRACTITIONER

Name of Practitioner: Novania Reddy

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

Professional Registration No:

Declaration of independence and accuracy of information provided:

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

I, Novania Reddy, 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 Waterfall on this 14 day of March 2023.

Reddy

SIGNATURE

Air Quality Specialist

CAPACITY OF SIGNATORY

APPENDIX C

Public Participation Documentation

Our Ref: 41105442

22 March 2023

NOTICE OF A BASIC ASSESSMENT PROCESS AND AMENDMENT OF THE ATMOSPHERIC EMISSION LICENCE FOR THE PROPOSED UPGRADING OF THE M3 AND M4 FURNACES, PSP AND ASSOCIATED ABATEMENT INFRASTRUCTURE AND INSTALLATION OF PRE-HEATERS AT SAMANCOR MIDDELBURG FERROCHROME, MIDDELBURG, MPUMALANGA PROVINCE.

- Draft Basic Assessment Report available for public review.

Dear Stakeholder,

Samancor Chrome produces charge chrome at its Middelburg Ferrochrome (MFC) site in two complete Submerged-Arc furnaces (SAFs) and two complete Direct-Current furnaces (DCFs) with associated atmospheric emissions abatement and other related equipment. The products are produced from the smelting of a combination of chrome ore, reductants and fluxes.

The production facilities at the MFC site also comprises a pelletising and sintering plant (PSP), in which chrome ore fines and furnace dust are agglomerated and sintered to produce pellets which join lumpy chrome ore as feed to the SAFs. Slag tapped from the furnaces contains entrained ferrochrome. It is allowed to cool, then crushed and fed to a metal recovery plant. The barren slag is disposed on a site located on the southern side of the MFC site.

MFC is proposing to upgrade the existing M3 and M4 furnaces and PSP to increase the current production rate. In addition, pre-heaters will be installed for the M3 and M4 furnaces and the gas abatement equipment for the M3 furnace and PSP will be upgraded.

WSP Group Africa (Pty) Ltd (WSP), an independent environmental assessment practitioner (EA), is appointed by MFC to conduct the required environmental authorisations for the proposed project.

DESCRIPTION OF THE ACTIVITIES TO BE UNDERTAKEN

In order to achieve the increase production rate and to upgrade the abatement equipment, MFC is proposing to install and upgrade to the following infrastructure within the existing footprint of the plant area (Figure 1):

Building 1, Maxwell Office Park
Magwa Crescent West, Waterfall City
Midrand, 1685
South Africa
Tel: +27 11 254 4800
wsp.com

INCREASED IN THROUGHPUT OF THE M3 AND M4 FURNACES

The proposed preheating of raw materials is expected to increase the throughput of the M3 and M4 furnaces. This will result in in more raw materials being required proportional to the improvement in efficiency. Consequently, more alloy product would be produced in the process. The anticipated increase in production will require an increase in the licensed consumption, production and off-gas volumes.

Additional infrastructure will be incorporated in the process feed stream of the furnace. This will improve the furnace electrical efficiency and will result in the furnace producing more ferrochrome, consuming more raw materials and other utilities. It will increase the gas stack volumetric flow.

PELLETISING AND SINTERING PLANT

The Pelletising and Sintering Plant (PSP) makes use of a steel belted sintering furnace. Historically the steel belt was replaced on a six-to-nine-month cycle. An improved technology steel belt has been installed, and this increases the availability of the PSP. An opportunity presents itself to increase the annual throughput of the PSP. This will require an increase in the licensed annual consumption and production volumes of the unit.

The proposed change to PSP involves an improved operating philosophy resulting in an increased production throughput. This will result in a higher consumption of raw materials and other plant utilities and an increase in the gas stack volumetric flow.

PREHEATERS

Carbon Monoxide gas (CO-gas) is produced by the carbonaceous reduction of chromite ore into ferrochrome in the M3 and M4 furnaces. Historically, this flammable CO-gas was flared into the atmosphere after being cleaned in a gas scrubbing plant, converting it to carbon dioxide gas and heat before being release to atmosphere.

Currently, the sole source of energy supplied to the M3 and M4 furnaces is electrical energy supplied by a DC arc inside the furnace reaction zone. An opportunity was identified to utilise the CO-gas produced by the furnace as an energy source to preheat the raw material feed to the furnace. This will reduce the energy requirement per unit of ferrochrome produced. The electrical energy input to the furnace will remain unchanged thus increasing the throughput of the furnaces.

Each of the preheaters will receive combustion gas from the CO-gas reticulation system and burn this gas to generate thermal energy, which will in turn be used to heat up the raw material feed to the furnace. Sasol gas, from an existing source at the MFC site, will be used as a backup energy source if CO-gas is not available from the DC furnaces.

The selected preheating technology will have indirect heat transfer from the combustion products to the raw material. Therefore, the off gas from the preheater will have similar particulate matter content than that of the off gas. Since the gas is already fully combusted in a highly oxidizing atmosphere, it is not expected that this gas will contain any CO.

The preheaters will be installed at both the M3 and M4 furnaces.

M3 AND PSP ABATEMENT EQUIPMENT

In a continuous drive for improvement and to ensure future legal compliance, the current gas scrubbing plants on the M3 furnace and PSP will be upgraded which is expected to improve the particulate matter remissions.

The proposed changes to the M3 furnace and PSP will include the upgrade of the current furnace off gas abatement equipment to ensure future environmental compliance to the latest air emissions requirements[1].

ENVIRONMENTAL AUTHORISATION PROCESSES

In terms of the *Environmental Impact Assessment (EIA) Regulations (2014, as amended) GN R.983 Listing Notice 1 Activity 34* pertaining to the *expansion of existing facilities or infrastructure for any process or activity where such expansion will result in the need for a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the release of emissions*, MFC must submit an application for Environmental Authorisation (EA) to the Mpumalanga Department of Agriculture, Rural Development, Land & Environmental Affairs (MDARDLEA), supported by a Basic Assessment process, which entails the compilation of a Basic Assessment Report (BAR) and an Environmental Management Programme (EMPr), which describes how the potential environmental impacts of the proposed upgrading activities will be managed and mitigated.

MFC is also required to submit written notification and an Atmospheric Emission License (AEL) amendment application to the AEL licensing authority regarding the proposed upgrading of the above-mentioned infrastructure.

Invitation to register as an I&AP and to comment

Stakeholders are invited to register as interested and affected parties (I&APs) and to participate in the environmental authorisation process by commenting on the proposed Basic Assessment Process as follows:

- Completing the enclosed Registration and Comment Sheet and return it to the WSP Public Participation (PP) Office by post or email.

- Providing comments on the proposed project, draft BAR and EMPr by contacting the WSP PP Office telephonically, by email or post.

I&APs are invited to register as stakeholders and comment on the draft BAR and EMPr which is available for public review and comment from **Wednesday, 22 March 2023 to Monday, 24 April 2023**.

Printed copies of the draft BAR and EMPr are available at the public places listed below. This background information letter and the draft reports can be downloaded from the following websites: WSP website - https://www.wsp.com/en-za/services/public-documents or data free website - https://wsp-engage.com/.

PUBLIC PLACE	TOWN
Gerard Sekoto Library, Cnr Sisulu and Wanderers Street, Middelburg	Middelburg
Nazareth Library, 16 Fort Napier Street, Nazareth	Middelburg
Samancor Middelburg Ferrochrome Security Entrance, Hendrina Road, Middelburg	Middelburg

[1] Section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEM:AQA) (Government Notice 893 in Government Gazette 37054 of 2013)

We would like to encourage you to actively participate in the environmental authorisation process. Should you wish to obtain more information to comment, please contact the WSP PP Office at (011) 254 4800, fax: 086 582 1561 or email: gld.pp@wsp.com.

WAY FORWARD

After the public review period on the draft BAR and EMPr has closed, the report will be updated with comments received and submitted to the MDARDLEA for decision making.

Yours sincerely

WSP Group Africa (Pty) LTD

MS/AS

Attachments: Figure 1: Locality Map
Figure 2: Site Layout Map
Registration and Comment Sheet

WSP will be processing certain personal information about you as an I&AP for purposes of enabling your registration as an I&AP and for purposes of storing your details on our database, if you consent for us to do so. WSP uses these details to contact you about other projects in the future. WSP will always process your personal information in accordance with the Protection of Personal Information Act 4 of 2013. You are entitled to exercise your rights as a data subject and let us know if you wish to be deregistered as an I&AP or if you no longer want your contact details to be included on our database

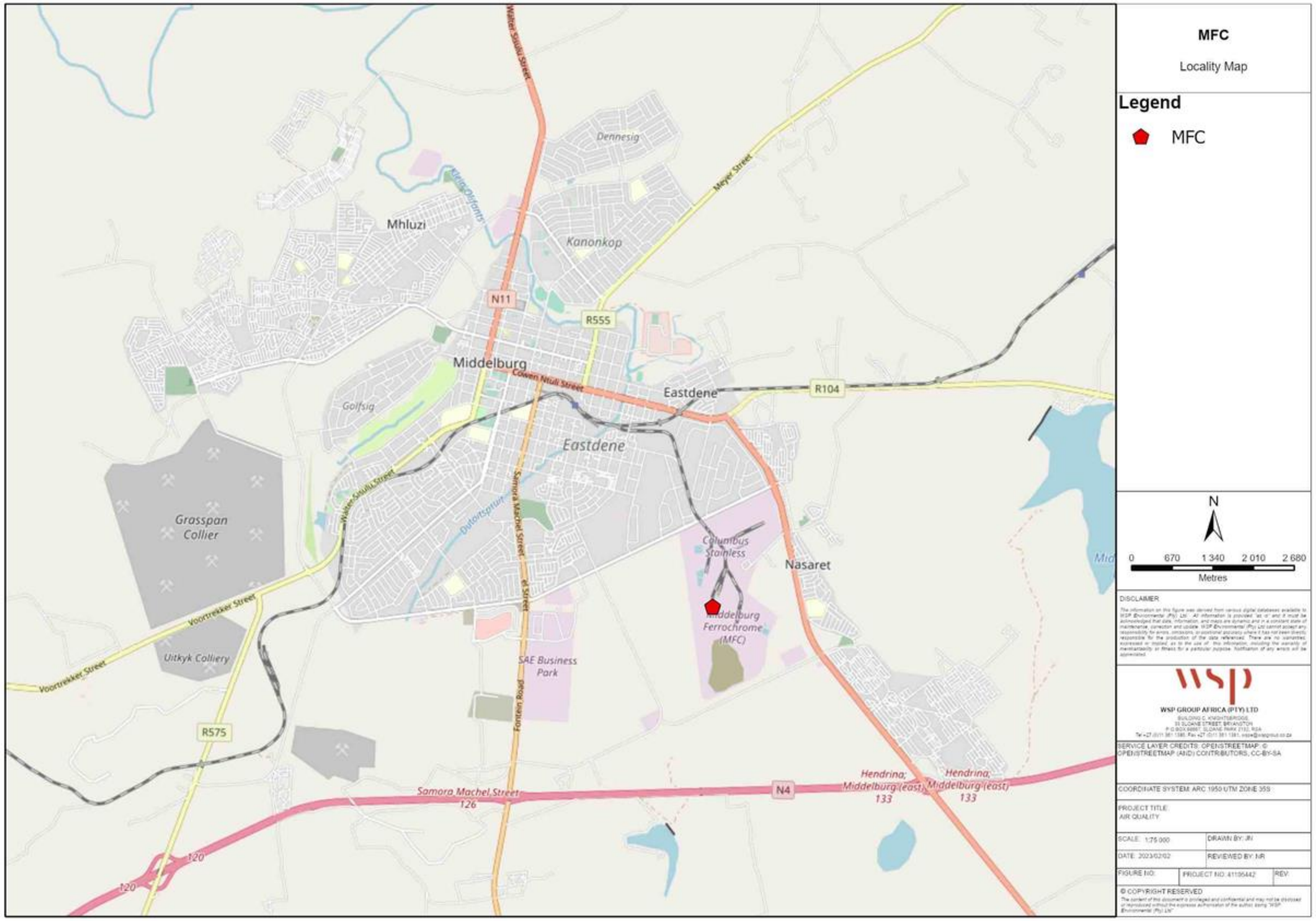


Figure 1: Locality of the MFC site.

Building 1, Maxwell Office Park
Magwa Crescent West, Waterfall City
Midrand, 1685
South Africa
Tel: +27 11 254 4800
wsp.com

Figure 2: Location of the project components

BASIC ASSESSMENT PROCESS AND ATMOSPHERIC EMISSION LICENCE AMENDMENT FOR THE PROPOSED UPGRADING OF THE M3 AND M4 FURNACES, PSP AND ASSOCIATED ABATEMENT INFRASTRUCTURE AND INSTALLATION OF PRE-HEATERS AT SAMANCOR MIDDELBURG FERROCHROME, MIDDELBURG, MPUMALANGA PROVINCE.

Registration and Comment Sheet

Draft Basic Assessment Report Review Period: Wednesday, 22 March 2023 to Monday, 24 April 2023

Your comments make an important contribution to these permitting processes. We would like to encourage you to register as an Interested and Affected Party (I&AP) so that we can keep you updated and can respond to any questions or concerns that you may have.

PERSONAL DETAILS			
Name	**Surname**	**Title**	**Organisation / Department / Farm/ Community** ***(If applicable)***

Contact Details	
Mobile Number	
Office Number	
Home Number	
Fax Number	
Email Address	

Postal Address	**Postal code**			

WSP, will not share personal information with a third party

LANDOWNERS	
If your property is adjacent to the MFC site, please tell us your, street address, farm name and/or erf/portion number	

WOULD YOU LIKE TO REGISTER AS AN INTERESTED AND AFFECTED PARTY? (Mark with an X)	**YES**	**NO**

Preferred Method of Communication (Mark with an X)	**Post**	**Email**	**Fax**
In terms of the EIA Regulations, 2014 (as amended), I disclose below any direct business, financial, personal or other interest that I may have in the approval or refusal of the application:	**Date**		
	Signature		

COMMENT(S)

You are welcome to use additional pages should you so wish to do so.

I have the following comments to make regarding the proposed project:

Please ask the following of my colleagues / friends to register as Interested and Affected Parties:

NAME	CONTACT DETAILS

PLEASE RETURN THE REGISTRATION AND COMMENT SHEET TO:

Public Participation Office
WSP Group Africa (Pty) Ltd
P O Box 6001, HALFWAY HOUSE, 1685
Tel: (011) 254 4800, Fax: 086 582 1561
Email: gld.pp@wsp.com
Reference: 41105442

THANK YOU

WSP will be processing certain personal information about you as an interested and affected party (I & AP) for purposes of enabling your registration as an I & AP and for purposes of storing your details on our database, if you consent for us to do so. WSP uses these details to contact you about other projects in the future. WSP will always process your personal information in accordance with the Protection of Personal Information Act 4 of 2013. You are entitled to exercise your rights as a data subject and let us know if you wish to be deregistered as an I & AP or if you no longer want your contact details to be included on our database.

NOTICE OF A BASIC ASSESSMENT PROCESS AND AMENDMENT OF THE ATMOSPHERIC EMISSION LICENCE FOR THE PROPOSED UPGRADING OF THE M3 AND M4 FURNACES, PSP AND ASSOCIATED ABATEMENT INFRASTRUCTURE AND INSTALLATION OF PRE-HEATERS AT SAMANCOR MIDDELBURG FERROCHROME, MIDDELBURG, MPUMALANGA PROVINCE.

Notice issued in terms of the National Environmental Management Act 107 of 1998 (NEMA), the Environmental Impact Assessment Regulations, 2014 (as amended), and the National Environmental Management: Air Quality Act 39 of 2004 (NEM:AQA)

Samancor Chrome produces charge chrome at its Middelburg Ferrochrome (MFC) site on Hendrina Road in Middelburg, Mpumalanga. MFC is proposing to upgrade the existing M3 and M4 furnaces and PSP to increase the current production rate. In addition, pre-heaters will be installed for the M3 and M4 furnaces and the gas abatement equipment for the M3 furnace and PSP will be upgraded.

This notice serves to notify landowners and/or Interested and Affected Parties (I&APs) that, in terms of the *Environmental Impact Assessment (EIA) Regulations (2014, as amended) GN R.983 Listing Notice 1 Activity 34* pertaining to *the expansion of existing facilities or infrastructure for any process or activity where such expansion will result in the need for a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the release of emissions*, MFC must submit an application for Environmental Authorisation (EA) to the Mpumalanga Department of Agriculture, Rural Development, Land & Environmental Affairs (MDARDLEA), supported by a Basic Assessment process. A draft Basic Assessment Report (BAR) is now available for public review and comment.

In addition, MFC is also required to submit an Atmospheric Emission License (AEL) amendment application to the AEL licensing authority for the above-mentioned changes. MFC was issued with an AEL on 18 October 2017 for a number of listed activities, as per GNR. 893 of 22 November 2013. Activities for the existing MFC operations are classified, as a listed activity in terms of *Category 4: Metallurgical Industry, Subcategory 4.1 Drying and Calcining (i.e. for facilities with capacity of more than 100 tons/month product), Subcategory 4.5 Sinter Plant (i.e. for all installations) and Subcategory 4.9 Ferro-alloy Production (i.e for all installations)*. With the proposed changes, *Category 5: Mineral Processing, Storage and Handling, Subcategory 5.1 Storage and Handling of Ore and Coal (i.e for facilities designed to hold more than 100000 tons*) will also be triggered.

WSP Group Africa (Pty) Ltd (WSP), an independent environmental assessment practitioner (EAP), is appointed by MFC to conduct the required EAs for the proposed project.

I&APs are invited to register as stakeholders and comment on the draft BAR, Air Quality Impact Report and AEL Amendment, which is available for review and comment from **Wednesday, 22 March 2023 to Monday, 24 April 2023**. The draft reports and Background Information Document can be downloaded from: WSP website - https://www.wsp.com/en-za/services/public-documents or data free website - https://wsp-engage.com/. Printed copies of the documents are available at the following public places:

- Gerard Sekoto Library, Cnr Sisulu and Wanderers Street, Middelburg
- Nazareth Library, 16 Fort Napier Street, Nazareth, Middelburg
- Samancor Middelburg Ferrochrome Security Entrance, Hendrina Road, Middelburg

FOR MORE INFORMATION, PLEASE CONTACT: Public Participation Office, WSP Group Africa (Pty) Ltd
Tel: (011) 254 4800, Fax: 086 582 1561, Email: gld.pp@wsp.com, Reference: 41105442

NOTICE

NOTICE OF A BASIC ASSESSMENT PROCESS AND AMENDMENT OF THE ATMOSPHERIC EMISSION LICENCE FOR THE PROPOSED UPGRADING OF THE M3 AND M4 FURNACES, PSP AND ASSOCIATED ABATEMENT INFRASTRUCTURE, AND INSTALLATION OF PRE-HEATERS AT SAMANCOR MIDDELBURG FERROCHROME, MIDDELBURG, MPUMALANGA PROVINCE.

Notice issued in terms of the National Environmental Management Act 107 of 1998 (NEMA), the Environmental Impact Assessment (EIA) Regulations, 2014 (as amended), and the National Environmental Management: Air Quality Act 39 of 2004 (NEM:AQA)

Samancor Chrome produces charge chrome at its Middelburg Ferrochrome (MFC) site in two complete Submerged-Arc furnaces (SAFs) and two complete Direct-Current furnaces (DCFs) with associated atmospheric emissions abatement and other related equipment. The products are produced from the smelting of a combination of chrome ore, reductants and fluxes.

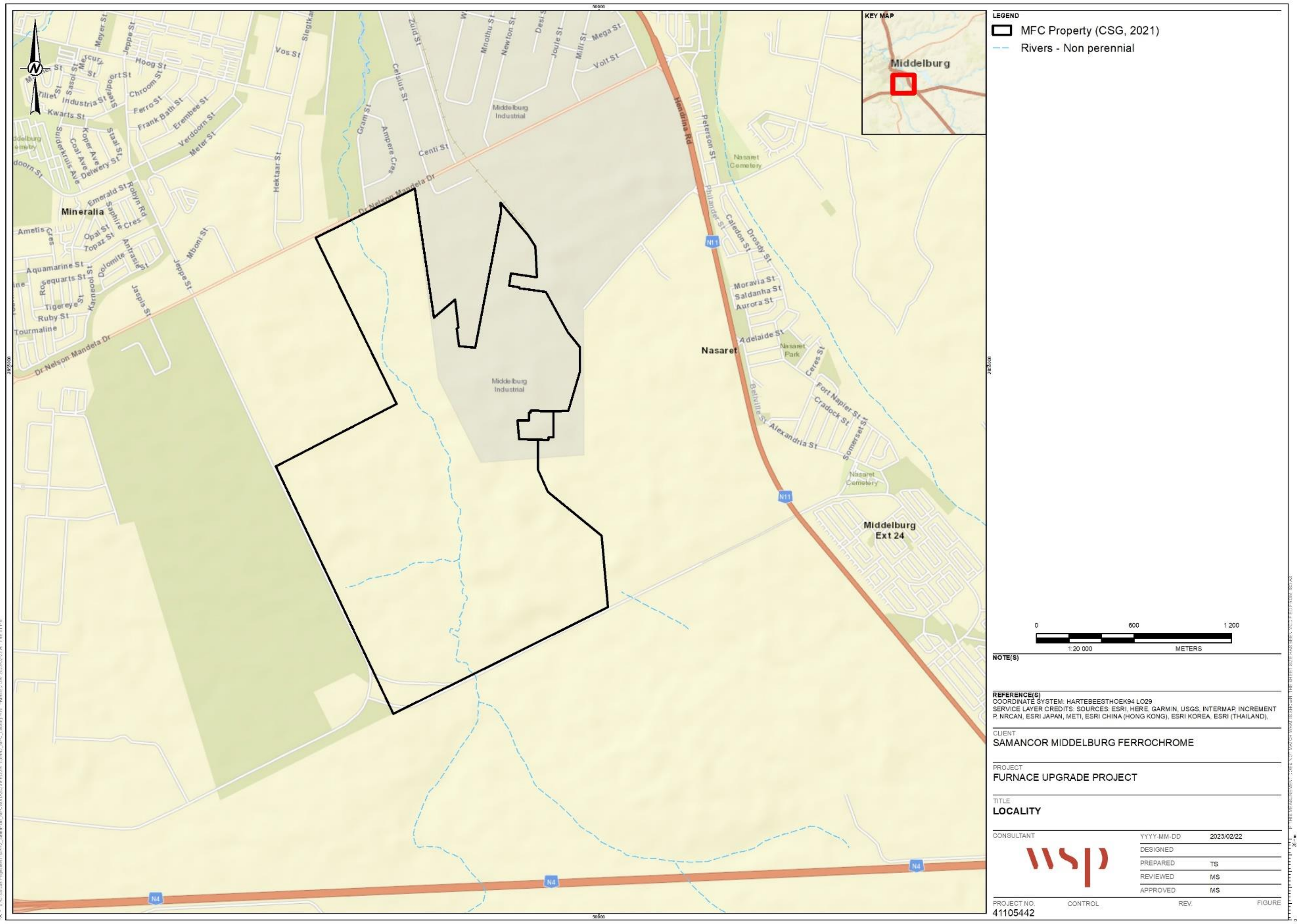
The production facilities at the MFC site also comprises a pelletising and sintering plant (PSP), in which chrome ore fines and furnace dust are agglomerated and sintered to produce pellets which join lumpy chrome ore as feed to the SAFs. Slag tapped from the furnaces contains entrained ferrochrome. It is allowed to cool, then crushed and fed to a metal recovery plant. The barren slag is disposed on a site located on the southern side of the MFC site.

MFC is proposing to upgrade the existing M3 and M4 furnaces, and PSP to increase the current production rate. In addition, pre-heaters will be installed for the M3 and M4 furnaces and the gas abatement equipment for the M3 furnace and PSP will be upgraded.

This notice serves to notify landowners and/or Interested and Affected Parties (I&APs) that, in terms of the *Environmental Impact Assessment (EIA) Regulations (2014, as amended) GN R.983 Listing Notice 1 Activity 34* pertaining to *the expansion of existing facilities or infrastructure for any process or activity where such expansion will result in the need for a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the release of emissions*, MFC must submit an application for Environmental Authorisation (EA) to the Mpumalanga Department of Agriculture, Rural Development, Land & Environmental Affairs (MDARDLEA), supported by a Basic Assessment process, which entails the compilation of a Basic Assessment Report (BAR) and an Environmental Management Programme (EMPr), which describes how the potential environmental impacts of the proposed upgrading activities will be managed and mitigated. A draft Basic Assessment Report is now available for public review and comment.

In addition to the Basic Assessment Process, MFC is also required to submit written notification and an Atmospheric Emission License (AEL) amendment application to the AEL licensing authority regarding the proposed upgrading of the above-mentioned infrastructure.

WSP Group Africa (Pty) Ltd (WSP), an independent environmental assessment practitioner (EA), is appointed by MFC to conduct the required environmental authorisations for the proposed project.



INVITATION TO REGISTER AS AN I&AP AND TO COMMENT

I&APs are invited to register as stakeholders and comment on the draft Basic Assessment Report which is available for public review and comment from **Wednesday, 22 March 2023 to Monday, 24 April 2023.**

Printed copies of the draft Basic Assessment Report are available at the public places listed below.

Printed copies of the draft Basic Assessment Report are available at the public places listed below. The Background Information Document and draft report can be downloaded from the following websites: WSP website - **https://www.wsp.com/en-za/services/public-documents or data free website - https://wsp-engage.com/.**

FOR MORE INFORMATION, PLEASE CONTACT:

Public Participation Office
WSP Group Africa (Pty) Ltd
P O Box 6001, HALFWAY HOUSE, 1685
Tel: (011) 254 4800
Fax: 086 582 1561
Email: gld.pp@wsp.com
Reference: 41105442

Date of notice: 23 March 2023

PUBLIC PLACE	TOWN
Gerard Sekoto Library, Cnr Sisulu and Wanderers Street, Middelburg	Middelburg
Nazareth Library, 16 Fort Napier Street, Nazareth	Middelburg
Samancor Middelburg Ferrochrome Security Entrance, Hendrina Road, Middelburg	Middelburg

WSP will be processing certain personal information about you as an I&AP for purposes of enabling your registration as an I&AP and for purposes of storing your details on our database, if you consent for us to do so. WSP uses these details to contact you about other projects in the future. WSP will always process your personal information in accordance with the Protection of Personal Information Act 4 of 2013. You are entitled to exercise your rights as a data subject and let us know if you wish to be deregistered as an I&AP or if you no longer want your contact details to be included on our database

APPENDIX D

National Environmental Screening Tool

SCREENING REPORT FOR AN ENVIRONMENTAL AUTHORIZATION AS REQUIRED BY THE 2014 EIA REGULATIONS – PROPOSED SITE ENVIRONMENTAL SENSITIVITY

EIA Reference number: TBC

Project name: Samancor MFC Furnace Upgrade Project

Project title: Environmental Regulatory Process for the upgrading of the M3 and M4 Furnaces and associated infrastructure.

Date screening report generated: 30/01/2023 08:25:30

Applicant: Samancor Middelburg Ferrochrome

Compiler: WSP Group Africa (Pty) Ltd

Compiler signature:

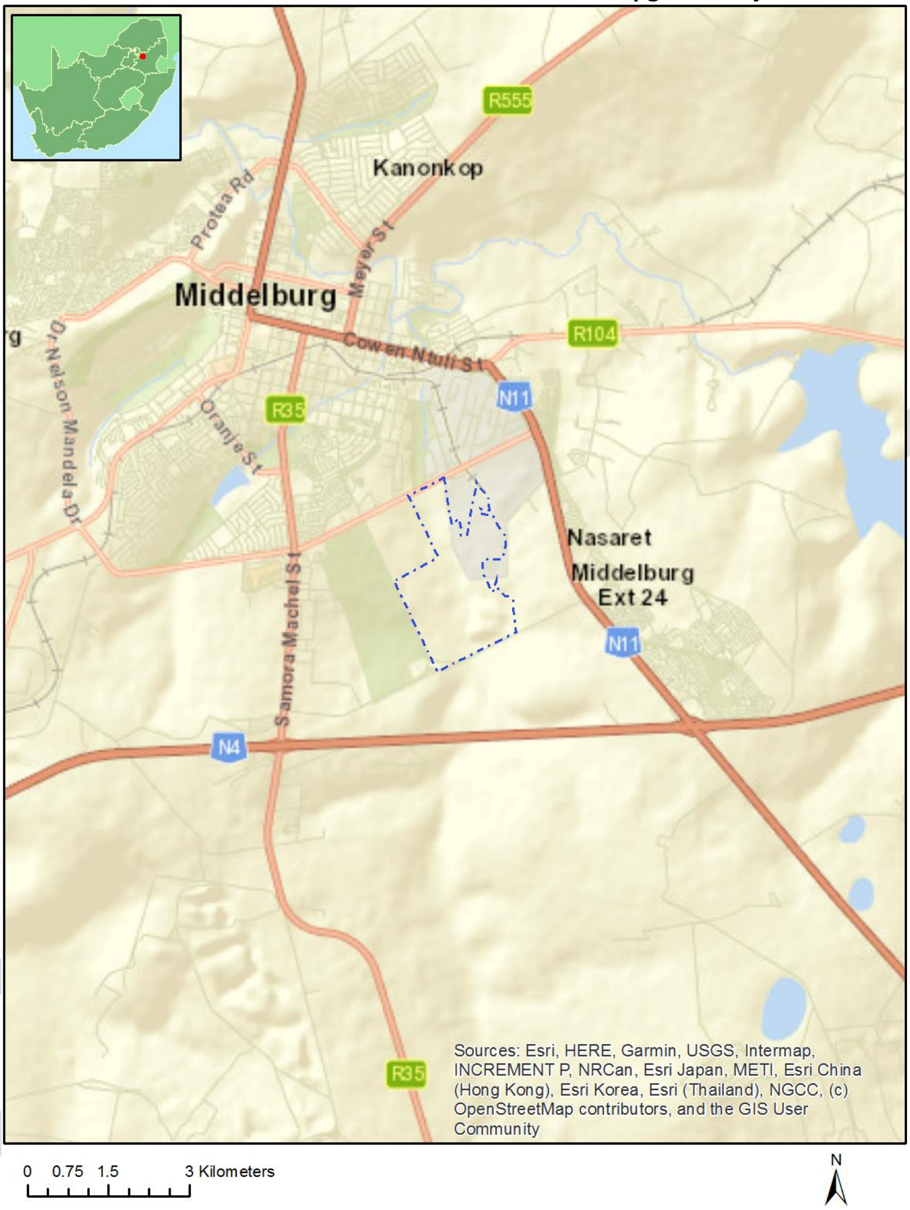
Application Category: Activity requiring permit or licence in terms of National or Provincial legislation governing the release or generation of emissions|Emissions

Table of Contents

Proposed Project Location

Orientation map 1: General location

General Orientation: Samancor MFC Furnace Upgrade Project



30/01/2023

Map of proposed site and relevant area(s)

Cadastral details of the proposed site

Property details:

No	Farm Name	Farm/ Erf No	Portion	Latitude	Longitude	Property Type
1	MIDDELBURG TOWN AND TOWNLANDS	287	0	25°46'29.31S	29°27'20.04E	Farm
2	MIDDELBURG TOWN AND TOWNLANDS	287	377	25°48'15.85S	29°29'21.84E	Farm Portion
3	MIDDELBURG TOWN AND TOWNLANDS	287	380	25°48'32.14S	29°29'15.2E	Farm Portion
4	MIDDELBURG TOWN AND TOWNLANDS	287	381	25°47'58.8S	29°30'3.71E	Farm Portion
5	MIDDELBURG TOWN AND TOWNLANDS	287	27	25°48'9.4S	29°27'47.44E	Farm Portion
6	MIDDELBURG TOWN AND TOWNLANDS	287	381	25°47'58.8S	29°30'3.71E	Farm Portion

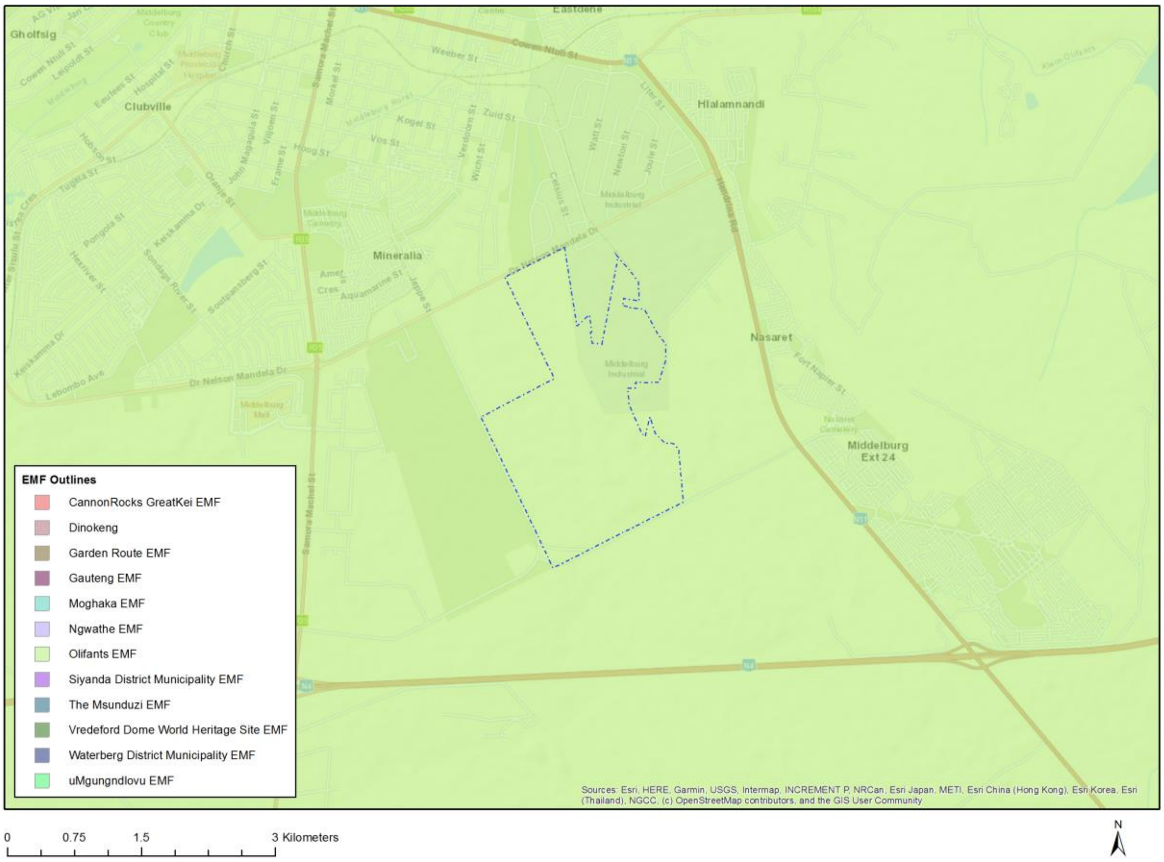
Development footprint[1] vertices:
No development footprint(s) specified.

[1] "development footprint", means the area within the site on which the development will take place and incudes all ancillary developments for example roads, power lines, boundary walls, paving etc. which require vegetation clearance or which will be disturbed and for which the application has been submitted.

Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area

No	EIA Reference No	Classification	Status of application	Distance from proposed area (km)
1	14/12/16/3/3/2/759	Solar PV	Approved	19.7

Environmental Management Frameworks relevant to the application



Environmental Management Framework	LINK
Olifants EMF	https://screening.environment.gov.za/ScreeningDownloads/EMF/Zone_46,_67,_78,_80,_92,_103,_122,_129.pdf

Environmental screening results and assessment outcomes

The following sections contain a summary of any development incentives, restrictions, exclusions or prohibitions that apply to the proposed development site as well as the most environmental

sensitive features on the site based on the site sensitivity screening results for the application classification that was selected. The application classification selected for this report is:
Activity requiring permit or licence in terms of National or Provincial legislation governing the release or generation of emissions|Emissions.

Relevant development incentives, restrictions, exclusions or prohibitions

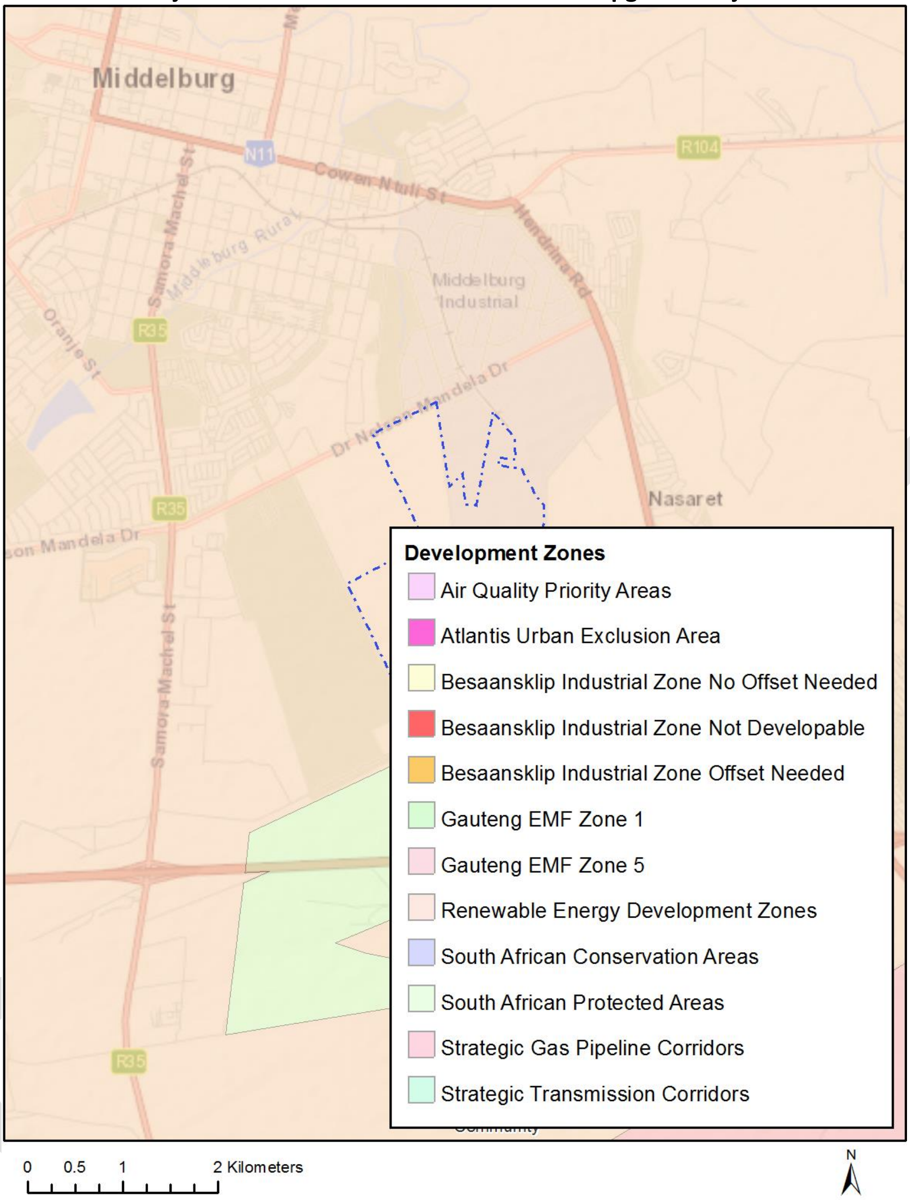
The following development incentives, restrictions, exclusions or prohibitions and their implications that apply to this site are indicated below.

Incentive, restriction or prohibition	Implication
Strategic Transmission Corridor-International corridor	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/Combined_EGI.pdf
Air Quality-Highveld Priority Area	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/HIGHVELD_PRIORITY_AREA_AQMP.pdf
Renewable energy development zones 9-Emalahleni	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/Combined_REDZ.pdf

Disclaimer applies
30/01/2023

Map indicating proposed development footprint within applicable development incentive, restriction, exclusion or prohibition zones

Project Location: Samancor MFC Furnace Upgrade Project



Proposed Development Area Environmental Sensitivity

The following summary of the development site environmental sensitivities is identified. Only the highest environmental sensitivity is indicated. The footprint environmental sensitivities for the proposed development footprint as identified, are indicative only and must be verified on site by a suitably qualified person before the specialist assessments identified below can be confirmed.

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme		X		
Animal Species Theme		X		

Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme				X
Civil Aviation Theme		X		
Defence Theme				X
Paleontology Theme			X	
Plant Species Theme		X		
Terrestrial Biodiversity Theme	X			

Specialist assessments identified

Based on the selected classification, and the environmental sensitivities of the proposed development footprint, the following list of specialist assessments have been identified for inclusion in the assessment report. It is the responsibility of the EAP to confirm this list and to motivate in the assessment report, the reason for not including any of the identified specialist study including the provision of photographic evidence of the site situation.

No	Specialist assessment	Assessment Protocol
1	Agricultural Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Agriculture_Assessment_Protocols.pdf
2	Landscape/Visual Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
3	Archaeological and Cultural Heritage Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
4	Palaeontology Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
5	Terrestrial Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Terrestrial_Biodiversity_Assessment_Protocols.pdf
6	Aquatic Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Aquatic_Biodiversity_Assessment_Protocols.pdf
7	Hydrology	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols

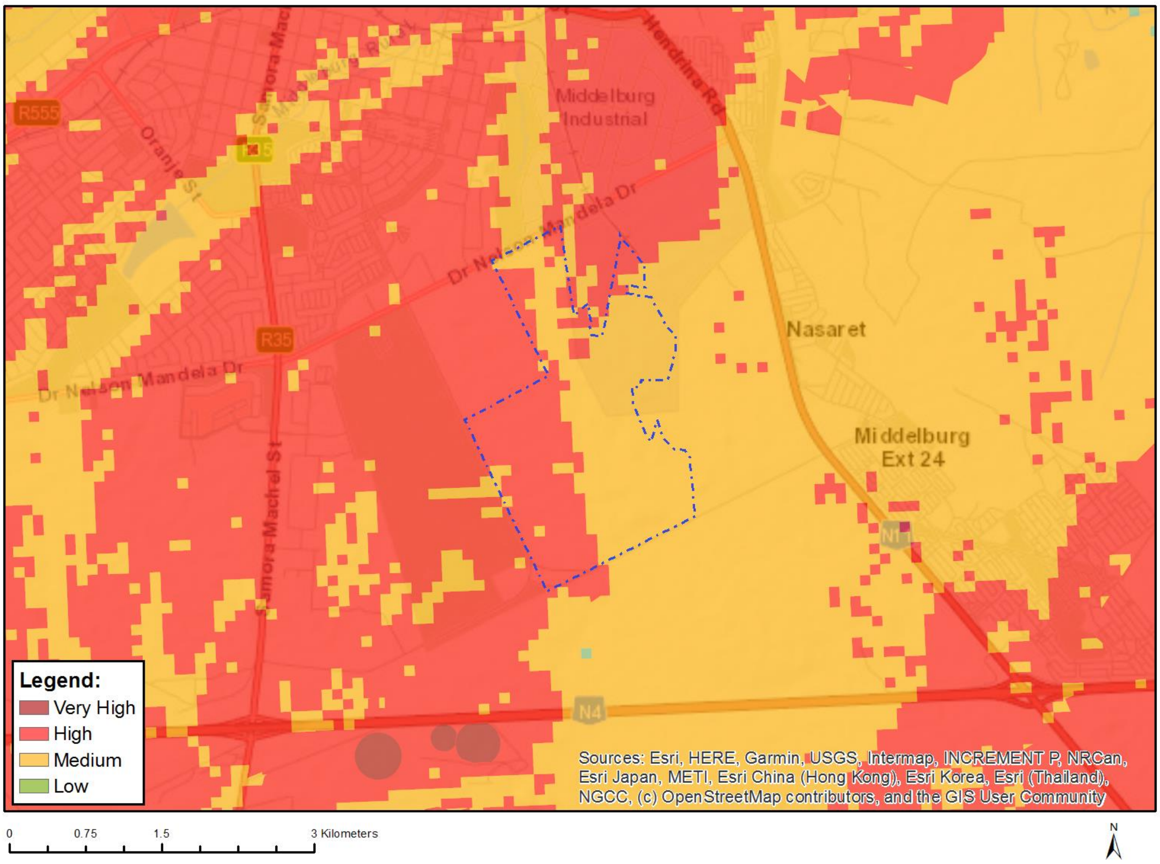
	Assessment	/Gazetted_General_Requirement_Assessment_Protocols.pdf
8	Noise Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Noise_Impacts_Assessment_Protocol.pdf
9	Traffic Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
10	Health Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
11	Socio-Economic Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
12	Ambient Air Quality Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
13	Air Quality Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
14	Plant Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Plant_Species_Assessment_Protocols.pdf
15	Animal Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Animal_Species_Assessment_Protocols.pdf

30/01/2023

Results of the environmental sensitivity of the proposed area.

The following section represents the results of the screening for environmental sensitivity of the proposed site for relevant environmental themes associated with the project classification. It is the duty of the EAP to ensure that the environmental themes provided by the screening tool are comprehensive and complete for the project. Refer to the disclaimer.

MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY

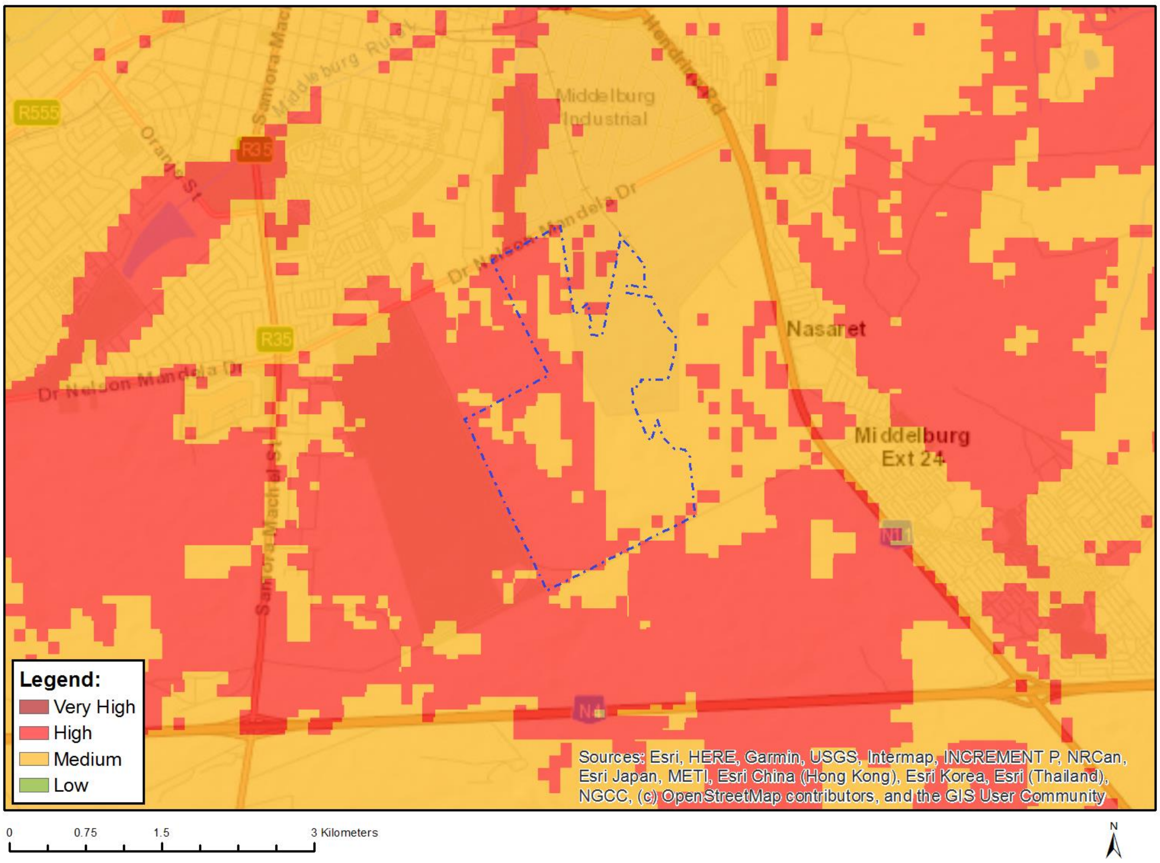


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Land capability;09. Moderate-High/10. Moderate-High
Medium	Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



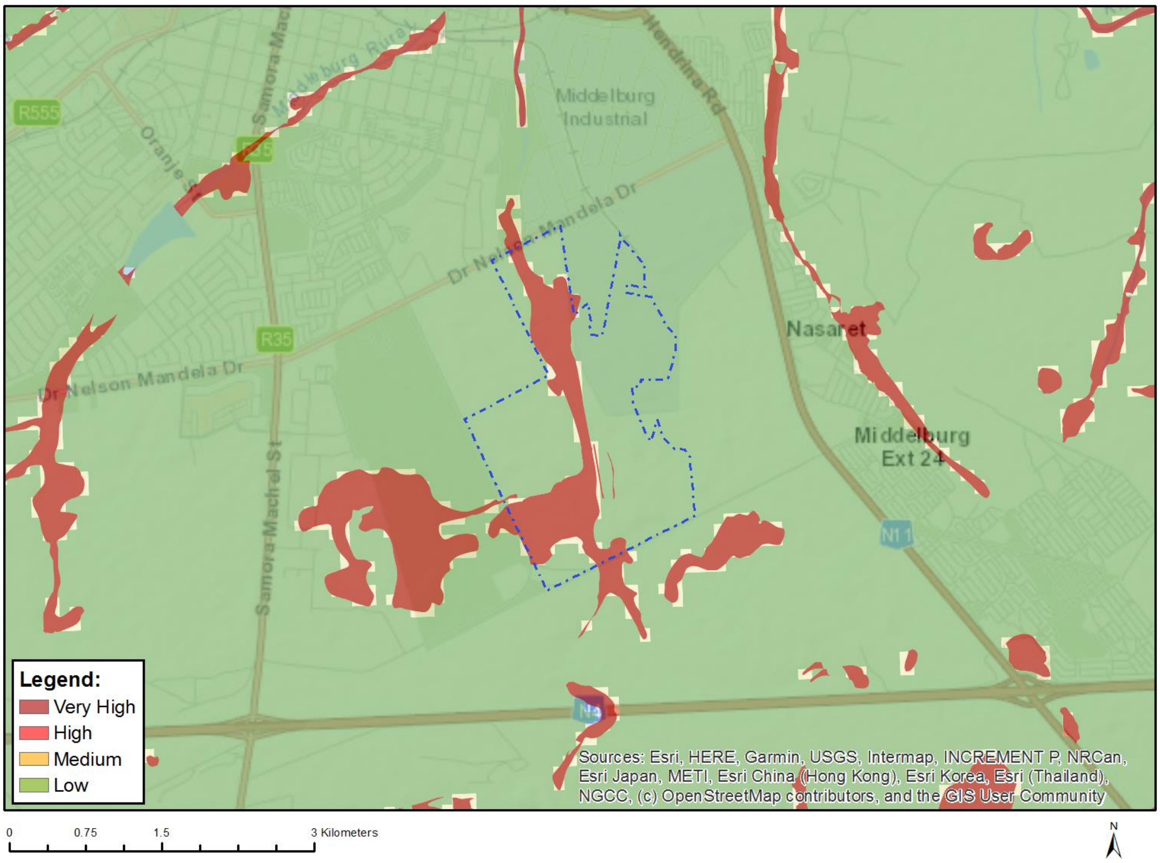
Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Aves-Tyto capensis
High	Aves-Circus ranivorus
High	Aves-Hydroprogne caspia
High	Aves-Eupodotis senegalensis
Medium	Aves-Podica senegalensis
Medium	Mammalia-Crocidura maquassiensis
Medium	Mammalia-Dasymys robertsii
Medium	Mammalia-Hydrictis maculicollis
Medium	Mammalia-Ourebia ourebi ourebi
Medium	Reptilia-Kinixys lobatsiana

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY

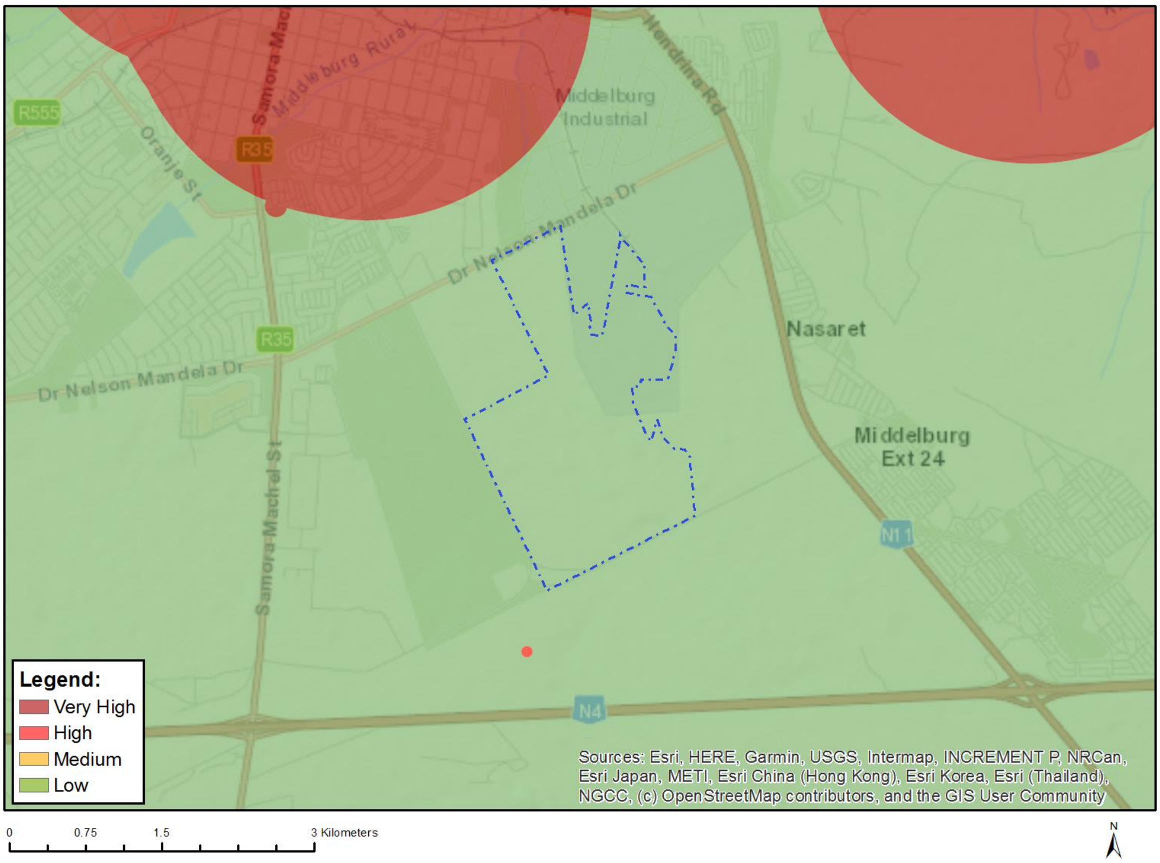


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	Wetlands and Estuaries

MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY

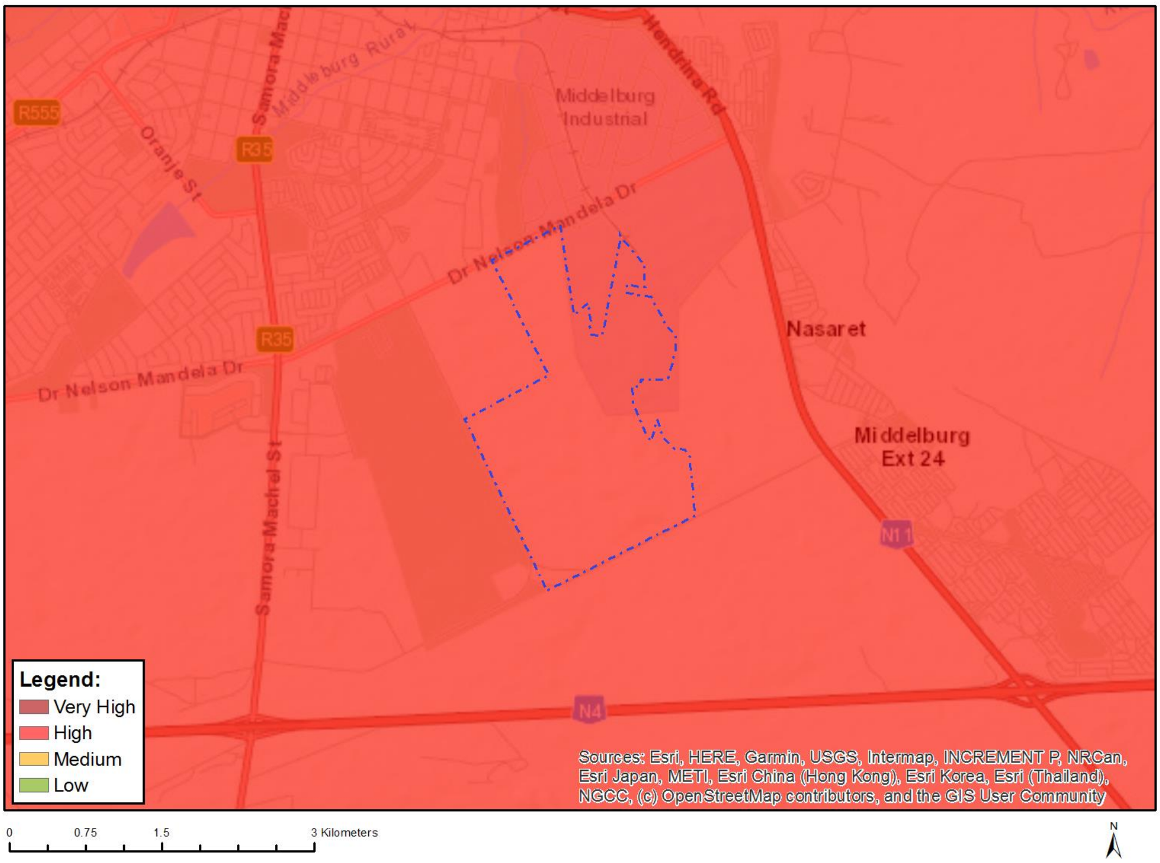


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity

MAP OF RELATIVE CIVIL AVIATION THEME SENSITIVITY

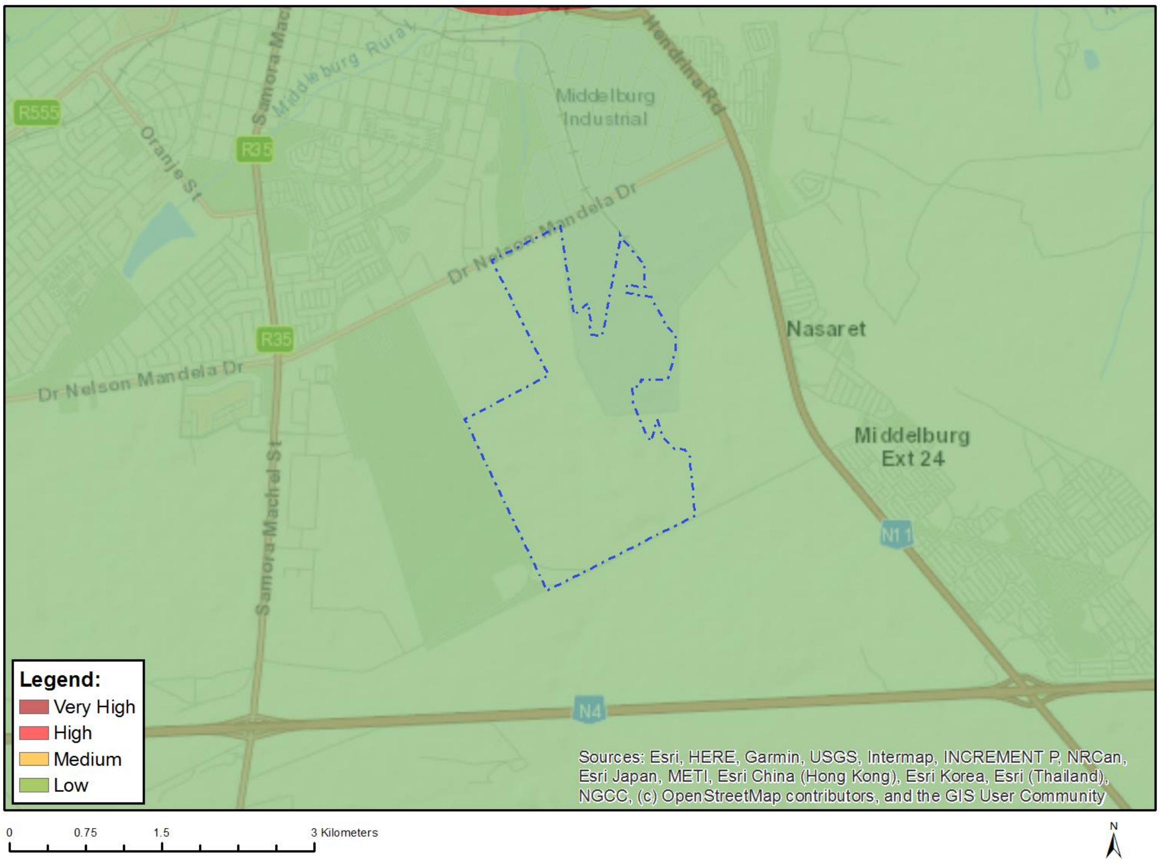


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Within 8 km of other civil aviation aerodrome

MAP OF RELATIVE DEFENCE THEME SENSITIVITY

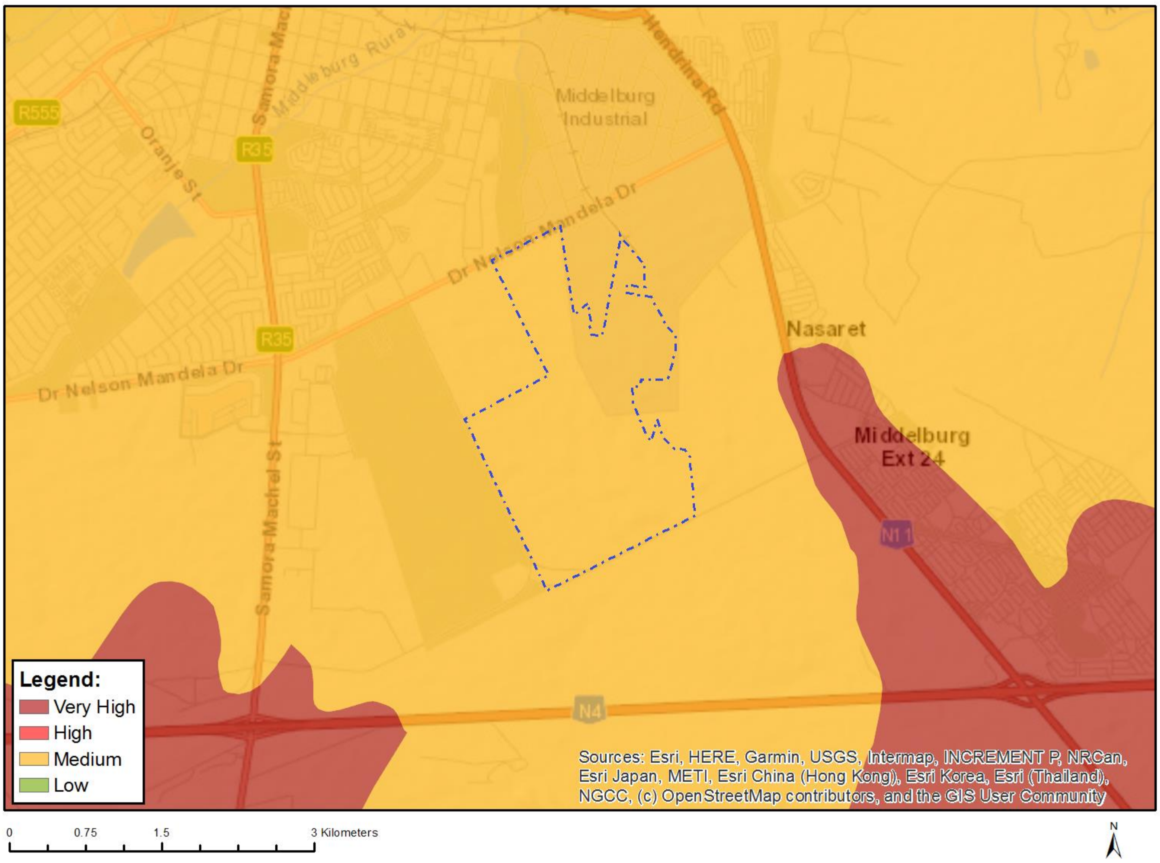


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY

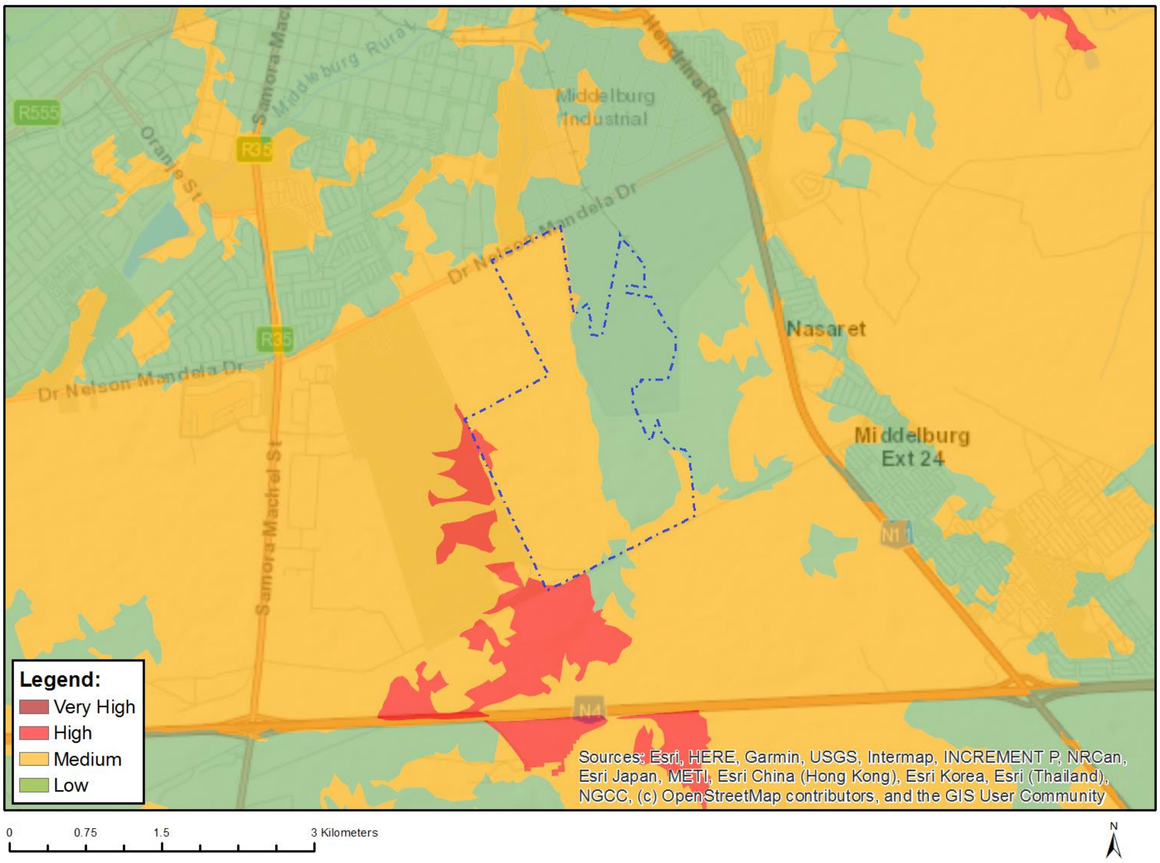


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Features with a Low paleontological sensitivity
Medium	Features with a Medium paleontological sensitivity

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



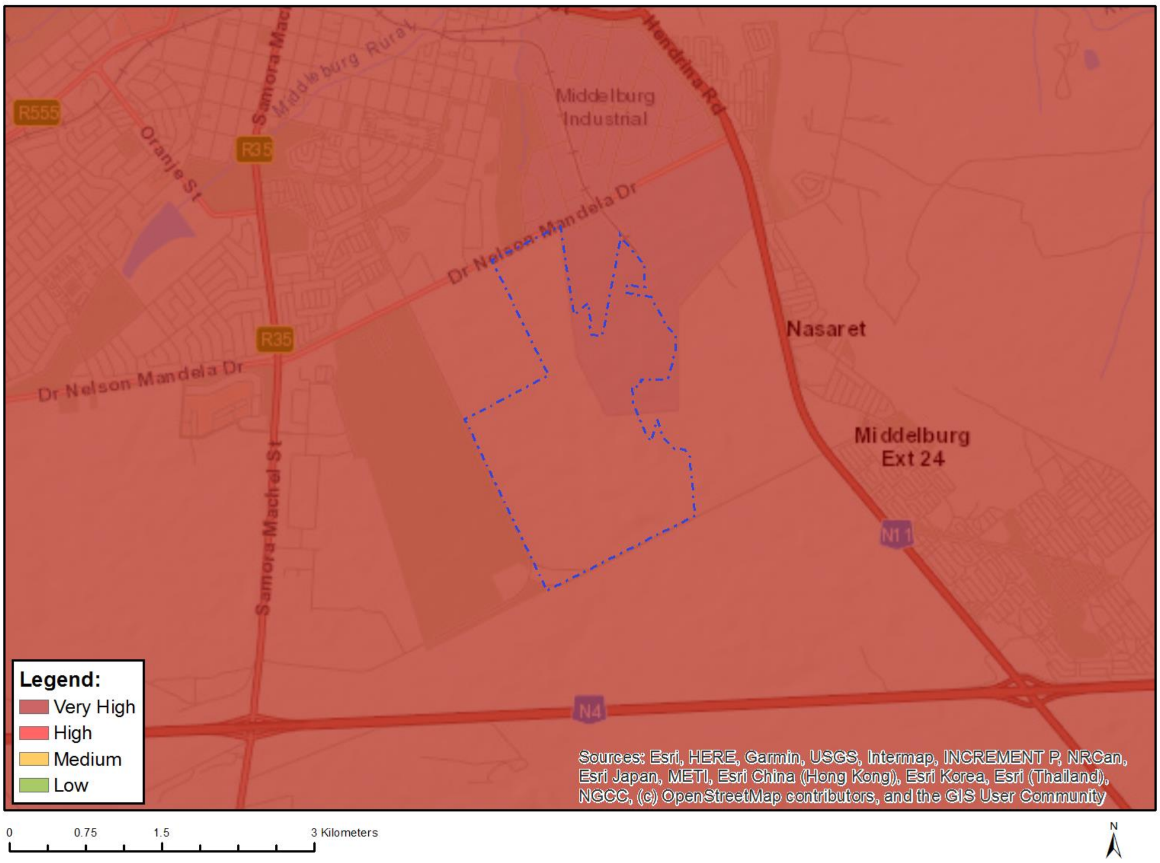
Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Sensitive species 933
High	Brachycorythis conica subsp. transvaalensis
Low	Low Sensitivity
Medium	Sensitive species 1252
Medium	Pavetta zeyheri subsp. middelburgensis
Medium	Sensitive species 933
Medium	Sensitive species 691
Medium	Pachycarpus suaveolens
Medium	Brachycorythis conica subsp. transvaalensis

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	Critical biodiveristy area 1
Very High	Protected Areas Expansion Strategy
Very High	Vulnerable ecosystem

APPENDIX E

Impact Assessment and Mitigation Table

EMPr Ref. Nr	ACTIVITY *whether listed or not listed.*	POTENTIAL IMPACT	ASPECTS AFFECTED	PHASE In which impact is anticipated	Size and Scale of Disturb ance	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type	Time period for implementa tion	Standards to be Achieved	Compliance with Standards	Responsible person
Air Quality																							
1.1	Upgrade of existing furnaces and associated infrastructure, that includes the use of vehicles, equipment and machinery.	Impact on surrounding sensitive receptors due to increased dust and particulate matter as a result of upgrade activities.	Ambient air quality	Construction	3.1 ha	6	2	2	3	**30**	**Moderate**	4	2	1	2	**14**	**Low**	Apply wet suppression and road surface sweepers, where applicable.	Minimise and control through impact management and monitoring.	Duration of construction phase	Compliance with NAAQA at the mine boundary.	By implementing dust control measures at significant emission sources, the cumulative ambient particulate load will be reduced.	MFC Logistics Superintende nt

1.2	Operation of the upgraded furnaces and associated equipment.	Cumulative impact on air quality as a result of the existing MFC operations, including the proposed production increase and new installations, plus the M3 abatement upgrade change.	Ambient air quality	Operation	3.1 ha	6	3	3	3	**36**	**Moderate**	2	3	2	2	**14**	**Low**	**Wind Erosion and Exposed Areas** Wind-blown dust can be minimised with the use of wet suppression and road sweepers, which have an estimated control efficiency of 50%. While wind-blown dust may not be a significant contributor to overall dust emissions, wind erosion can substantially increase dust entrainment at any site. It is understood that MFC, however, use both these measures on site and as such, ensure adequate mitigation from wind-blown dust. **Stockpiles** Dust emissions from stockpiles can occur during the loading of the piles, when wind disturbs the stockpile surface, and during reclamation (USEPA, 2006a). The following mitigation techniques are suggested to reduce wind erosion from stockpiles: Shape stockpiles, taking into consideration width to height ratio, nature of stockpiled material, location, access and available area for the stockpile. Limit stockpile heights based on their stability, manageability, dust and amenity impacts. Store raw materials with high fines content in semi-enclosed bunkers, where possible. Investigate options for dust extraction at enclosed bunkers. More gentle slopes for unstable soils are recommended. Avoid building steep sided stockpiles that have sharp changes in shape. **Truck Loading and Unloading** Truck loading and unloading activities are also likely to contribute significantly to the amount of dust generated from materials handling activities. Loading and offloading activities are fairly difficult to mitigate, although the following techniques can be employed to assist with dust suppression (Katestonnee, 2011): - Avoid double handling of material where possible. - Minimising the drop height of the material from truck loads. - Using road sweepers loading and unloading activities occur. **Crushing**	Minimise and control through impact management and monitoring.	Duration of operational phase	Compliance with NAAQA at the mine boundary.	By implementing dust control measures at significant emission sources, the cumulative ambient particulate load will be reduced.	MFC Logistics Superintendent

																		Mitigation methods in these areas that can be implemented to reduce dust emissions include: - Tasking a team to be responsible for the removal of all deposited dust from machinery and enclosures within the crushing plant and tip areas, resulting in less deposited dust available for wind entrainment. - Deploy a dust sweeper to the plant, capable of collecting all deposited fines, reducing the amount of dust available for wind entrainment. **Unpaved Roads** To adequately mitigate emissions of dust associated with unpaved roads, the following key recommendations are suggested: Application of water (potential of reducing emissions by 75% (COACOA, 2012)) as a dust suppressant to all haul roads and other roads experiencing high traffic volumes. If the costs associated with water application are high, and water is scarce, etc (i.e. many disadvantages of water are posed) then consider a dust-a-side or similar chemical suppressant, which has the potential of reducing dust emissions by approximately 99%. Implement vehicle speed and access restrictions within the site (approximately 30 km/h). Prevention of material deposition onto haul roads through avoiding the overloading of truck loads resulting in spillages on the roads; preventing wind erosion from adjacent open areas; and ensure adequate storm water drainage to prevent water erosion of the roads. Prioritising source reduction measures through the use of the most direct travel routes on site and using larger capacity trucks to minimise the number of trips. Water bowser routes should align with the daily/weekly site plan schedule and a maintenance programme should be in place to ensure continuous availability of the water bowsers. **Paved Roads**					

																		To adequately mitigate emissions of dust associated with paved roads at the facility, the following key recommendations are suggested: - Ensure road sweeping is implemented. Implement vehicle speed and access restrictions within the site (approximately 30 km/h). - Prevention of material deposition onto haul roads through avoiding the overloading of truck loads resulting in spillages on the roads; preventing wind erosion from adjacent open areas; and ensure adequate storm water drainage to prevent water erosion of the roads. - Prioritising source reduction measures through the use of the most direct travel routes on site and using larger capacity trucks to minimise the number of trips. **Stacks** The following measures would assist in reducing impacts from NO_2 (Since concentrations from SO_2 and Cr are considered to be minimal, no additional measures are suggested): - Maintain and service all furnaces, preheaters and PSP stacks regularly to ensure that emissions are kept to a minimum. - Investigate use of alternative fuels (cleaner fuels) supplied to the preheaters to assist in reducing NO_2 emissions. - Ensure on-going stack testing as per AEL conditions to monitor NOx emissions. - Given that the impacts of $PM_{2.5}$ and SO_2 are negligible, no further mitigation methods (other than the ones already implemented) are deemed necessary to reduce emissions from these pollutants.					

1.3		Impact on surrounding sensitive receptors due to increased dust and particulate matter during demolition / removal of upgraded equipment.	Ambient air quality	Decommissioning and demolition	3.1 ha	6	2	2	3	**30**	Moderate	4	2	1	2	**14**	Low	Apply wet suppression and road sweeping, where applicable.	Minimise and control through impact management and monitoring.	Duration of decommissioning and demolition phase	Compliance with NAAQA at the mine boundary.	By implementing dust control measures at significant emission sources, the cumulative ambient particulate load will be reduced.	MFC Logistics Superintendent
Groundwater																							
2.1	Upgrade of existing furnaces and associated infrastructure, that includes the use of vehicles, equipment and machinery.	A change in groundwater quality.	Groundwater resources	Construction	3.1 ha	2	1	1	1	**4**	Low	2	1	1	1	**4**	Low	No noticeable impact change expected during all phases of the project, no mitigation required during construction phase. Groundwater monitoring (water levels and quality) should be used to confirm that the groundwater quality remains unchanged.	Minimise and control through impact management and monitoring.	During construction phase	Groundwater quality limits in MFC WUL	N/A	MFC SHEQ Specialist Environment
2.2		A change in the volume or recharge of groundwater / change in water level.	Groundwater resources	Construction	3.1 ha	2	1	1	1	**4**	Low	2	1	1	1	**4**	Low						
2.3		Possible change in groundwater flow regime.	Groundwater resources	Construction	3.1 ha	2	1	0	0	**3**	Low	2	1	0	0	**3**	Low						
2.4	Operation of the upgraded furnaces and associated equipment.	A change in groundwater quality.	Groundwater resources	Operation	3.1 ha	2	1	1	1	**4**	Low	2	1	1	1	**4**	Low		Minimise and control through impact management and monitoring.	During operational phase	Groundwater quality limits in MFC WUL	N/A	MFC SHEQ Specialist Environment
2.5		A change in the volume or recharge of groundwater / change in water level.	Groundwater resources	Operation	3.1 ha	2	1	1	1	**4**	Low	2	1	1	1	**4**	Low						
2.6		Possible change in groundwater flow regime.	Groundwater resources	Operation	3.1 ha	2	1	0	0	**3**	Low	2	1	0	0	**3**	Low						
2.7	Decommissioning and demolition of the upgraded equipment	Spillage of hazardous substances during the dismantling of upgraded equipment which were in contact with hazardous substances may contaminate soils and groundwater.	Groundwater resources	Decommissioning and demolition	3.1 ha	2	1	1	1	**4**	Low	2	1	1	1	**4**	Low		Minimise and control through impact management and monitoring.	During decommissioning and demolition phase	Groundwater quality limits in MFC WUL	N/A	MFC SHEQ Specialist Environment
Surface Water																							

3.1	Upgrade of existing furnaces and associated infrastructure, that includes the use of vehicles, equipment and machinery.	Contamination of soils and downstream water resources by chemical pollutants.	Surface water resources	Construction	3.1 ha	4	1	1	2	**12**	**Low**	2	1	1	1	**4**	**Low**	Contaminated water as a result of the construction, operation or decommissioning and demolition phases must be managed in accordance with the existing water management procedures and infrastructure at the MFC site to prevent any contaminated water from leaving the site. All pollution control mechanisms are to be in accordance with the conditions of the site's WUL. Continue the surface water monitoring programme.	Minimise and control through impact management and monitoring.	During construction phase	Surface water quality limits in MFC WUL	N/A	MFC SHEQ Specialist Environment
3.2	Operation of the upgraded furnaces and associated equipment.	Contamination of soils and downstream water resources by chemical pollutants.	Surface water resources	Operation	3.1 ha	4	1	1	2	**12**	**Low**	2	1	1	1	**4**	**Low**		Minimise and control through impact management and monitoring.	During operational phase	Surface water quality limits in MFC WUL	N/A	MFC SHEQ Specialist Environment
3.3	Decommissioning and demolition of the upgraded equipment	Spillage of hazardous substances during the dismantling of upgraded equipment which were in contact with hazardous substances may contaminate soils and surface water resources.	Surface water resources	Decommissioning and demolition	3.1 ha	4	1	1	2	**12**	**Low**	2	1	1	1	**4**	**Low**		Minimise and control through impact management and monitoring.	During decommissioning and demolition phase	Surface water quality limits in MFC WUL	N/A	MFC SHEQ Specialist Environment
Soils, Land use and Land Capability																							
4.1	Upgrade of existing furnaces and associated infrastructure, that includes the use of vehicles, equipment and machinery.	Impact on soils due to potential spillage of hazardous substances, incorrect waste handling and storage or storm water contamination.	Soils, Land Use and Land Capability	Construction	3.1 ha	4	1	1	2	**12**	**Low**	2	1	1	1	**4**	**Low**	All vehicles and machinery must be kept in good working order and inspected on a regular basis for possible leaks and shall be repaired as soon as possible if required. Repairs shall be carried out in a dedicated repair area only, unless in-situ repair is necessary as a result of a breakdown. Drip trays shall at all times be placed under vehicles that require in-situ repairs. Drip trays shall be emptied into designated containers only and should be send to an approved oil recycler.	Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided	Implementing the requirements of GNR. 331. Norms and Standards for Remediation of Contaminated Land & Soil Quality will reduce the impact on soils in the immediate area.	MFC SHEQ Specialist Environment
4.2	Operation of the upgraded furnaces and associated equipment.	Impact on soils due to potential spillage of hazardous substances, incorrect waste handling and storage or storm water contamination.	Soils, Land Use and Land Capability	Operation	3.1 ha	4	1	1	2	**12**	**Low**	2	1	1	1	**4**	**Low**		Minimise and control through impact management and monitoring.	Duration of operational phase	Impact avoided	Implementing the requirements of GNR. 331. Norms and Standards for Remediation of Contaminated Land & Soil Quality will reduce the impact on soils in the immediate area.	MFC SHEQ Specialist Environment

4.3	Decommissioning and demolition of the upgraded equipment	Impact on soils due to potential spillage of hazardous substances, incorrect waste handling and storage or storm water contamination.	Soils, Land Use and Land Capability	Decommissioning and demolition	3.1 ha	4	1	1	2	**12**	Low	2	1	1	1	**4**	Low	Ensure proper handling of hazardous chemicals and materials (e.g., fuel, oil, cement, concrete, reagents, etc.) as per their corresponding Safety Data Sheets (SDS) and the MFC spill response procedures. Accidental spills (concrete, chemicals, process water, hydrocarbons, waste) need to be reported immediately so that effective remediation and clean-up strategies and procedures can be implemented. Soil that is contaminated by fuel, chemical or oil spills, for example, from vehicles, or waste spillage will either be collected to be treated at a pre-determined and dedicated location, or will be cleaned up and treated in situ, using sand, soil or a suitable absorption medium. Ensure all general rubble, fugitive waste and hazardous waste is stored and removed in accordance with the site's Waste Management Plan. Ensure that spill kits are available at dedicated areas and that clean up procedures are followed at all times.	Minimise and control through impact management and monitoring.	Duration of decommissioning and demolition phase	Impact avoided	Implementing the requirements of GNR. 331. Norms and Standards for Remediation of Contaminated Land & Soil Quality will reduce the impact on soils in the immediate area.	MFC SHEQ Specialist Environment
Biodiversity																							
5.1	Upgrade of existing furnaces and associated infrastructure, that includes the use of vehicles, equipment and machinery.	Impact on fauna as a result of the construction activities.	Biodiversity	Construction	3.1 ha	2	1	1	1	**4**	Low	2	1	1	1	**4**	Low	No noticeable impact change expected during the construction phase, no mitigation required during construction phase. Fauna monitoring (mortalities) should be used to confirm no impact on biodiversity.	Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided	N/A	MFC SHEQ Specialist Environment
5.2	Operation of the upgraded furnaces and associated equipment.	Impact on fauna as a result of the operational activities.	Biodiversity	Operation	3.1 ha	2	1	1	1	**4**	Low	2	1	1	1	**4**	Low		Minimise and control through impact management and monitoring.	Duration of operational phase	Impact avoided	N/A	MFC SHEQ Specialist Environment

5.3	Decommissioning and demolition of the upgraded equipment	Impact on fauna as a result of the decommissioning activities.	Biodiversity	Decommissioning and demolition	3.1 ha	2	1	1	1	**4**	Low	2	1	1	1	**4**	Low		Minimise and control through impact management and monitoring.	Duration of decommissioning and demolition phase	Impact avoided	N/A	MFC SHEQ Specialist Environment
Noise																							
6.1	Upgrade of existing furnaces and associated infrastructure, that includes the use of vehicles, equipment and machinery.	Impact on surrounding sensitive receptors due to increased noise as a result of upgrade activities.	Noise	Construction	3.1 ha	4	2	1	1	**7**	Low	2	1	1	1	**4**	Low	Selecting equipment with the lowest possible sound power levels, suitable for operational safety requirements. Ensure equipment utilised is maintained and operated as per manufacturers' specifications.	Minimise and control through impact management and monitoring.	Duration of construction phase	SANS 10103:2008[1]	By implementing noise control measures at significant sources, the cumulative noise levels will be reduced.	MFC SHEQ Specialist Environment
6.2	Operation of the upgraded furnaces and associated equipment.	Cumulative impact on noise as a result of the existing MFC operations, including the proposed production increase and new installations, plus the M3 abatement upgrade change.	Noise	Operation	3.1 ha	4	3	1	1	**8**	Low	2	1	1	1	**4**	Low	Selecting equipment with the lowest possible sound power levels, suitable for operational safety requirements. Ensure equipment utilised is maintained and operated as per manufacturers' specifications.	Minimise and control through impact management and monitoring.	Duration of operational phase	SANS 10103:2008	By implementing noise control measures at significant sources, the cumulative noise levels will be reduced.	MFC SHEQ Specialist Environment

[1] SANS 10103:2008 – The measurement and rating of environmental noise with respect to annoyance and to speech communication.

6.3	Decommissioning and demolition of the upgraded equipment	Impact on surrounding sensitive receptors due to increased noise during demolition / removal of upgraded equipment.	Noise	Decommissioning and demolition	3.1 ha	4	2	1	1	**7**	Low	2	1	1	1	**4**	Low	Selecting equipment with the lowest possible sound power levels, suitable for operational safety requirements. Ensure equipment utilised is maintained and operated as per manufacturers' specifications.	Minimise and control through impact management and monitoring.	Duration of demolition phase	SANS 10103:2008	By implementing noise control measures at significant sources, the cumulative noise levels will be reduced.	MFC SHEQ Specialist Environment
Palaeontological and Heritage Resources																							
7.1	Possible site clearance during the upgrade of the infrastructure	No impacts expected, but chance finds with potentially moderate impacts could occur	Palaeontological and heritage resources	Construction phase	3.1 ha	8	5	1	1	**19**	Low	4	1	1	1	6	Low	■ Chance Find Procedure to be implemented immediately should any paleontological or heritage resources be unearthed: ▪ Cease all work in the immediate vicinity of the find. ▪ Demarcate the area with barrier tape or other highly visible means. ▪ Notify the South African Heritage Resources Authority (SAHRA) immediately. ▪ Commission an archaeologist accredited with the Association for Southern African Professional Archaeologists (ASAPA) to assess the find and determine appropriate mitigation measures. These may include obtaining the necessary authorisation from SAHRA to conduct the mitigation measures. ▪ Prevent access to the find by unqualified persons until the assessment and mitigation processes have been completed.	Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided	By monitoring construction activities and implementing the chance find procedure, damage to heritage resources can be avoided.	MFC SHEQ Specialist Environment, ECO, appointed contractor(s)
Socio-Economic																							
8.1	Upgrade of existing furnaces and associated infrastructure, that includes the use of vehicles, equipment and machinery.	Sustain current employment into the future	Socio-economic	Construction phase	N/A	2	2	2	4	**24**	Positive	2	2	2	4	**24**	Positive	None required	N/A	N/A	N/A	N/A	N/A
8.2		Increase economic revenue	Socio-economic	Construction phase	N/A	4	2	2	3	**24**	Positive	2	2	2	4	**24**	Positive	None required					

8.3	Operation of the upgraded furnaces and associated equipment.	Sustain current employment into the future	Socio-economic	Operational phase	N/A	2	2	2	4	**24**	Positive	2	2	2	4	**24**	Positive	None required	N/A	N/A	N/A	N/A	N/A
8.4		Increase economic revenue	Socio-economic	Operational phase	N/A	4	2	2	3	**24**	Positive	2	2	2	4	**24**	Positive	None required					
8.5	Decommissioning and demolition of the upgraded equipment	Nuisance impacts	Socio-economic	Construction phase	N/A	6	5	2	4	**52**	Moderate	4	5	2	4	**44**	Moderate	Timely and adequate consultation with employees who are dependent on the operation for employment. Assisting employees in seeking alternative employment at other mining operations. Training and education of employees to equip them with skills that could benefit them in other industries.	Minimise and control through impact management and monitoring.	Duration of construction phase	Impact avoided	Implement the proposed mitigation measures to reduce the health and safety risks.	

wsp.com