Rapid Health Impact Assessment

Mortimer Smelter - Additional Slag Cleaning and SO_2 Abatement

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PREAMBLE

This Health Impact Assessment (HIA) study was conducted as part of the requirements for the Rustenburg Platinum Mines (RPM) - Anglo American Platinum Ltd (AAP) proposal to develop an additional slag cleaning (ASC) operation at the Mortimer Smelter in the North West Province. It forms part of the environmental authorisation in the form of a Basic Assessment (BA) process.

Prime Africa was appointed by WSP Group Africa (Pty) Ltd (WSP) to conduct this HIA which assesses the health impacts of SO_2, PM_{10}, $PM_{2.5}$ and NO_2 on the surrounding communities of the proposed operations. The HIA uses the results of the Atmospheric Impact Report (AIR) conducted by WSP.

The methodology used in the HIA is based on the guidelines as set out by the International Finance Corporation (IFC) (IFC, 2009), the epidemiological studies from the World Health Organisation (2016 and 2021) and internationally recognised methodologies for risk evaluation based on frameworks outlined by the U.S. EPA (1989), Health Canada (2017), WHO (WHO, 2000) and the United Nations Environment Programme (UNEP, 2018).

EXECUTIVE SUMMARY

This Rapid Health Impact Assessment (HIA) was commissioned by WSP Group Africa on behalf of Rustenburg Platinum Mines (RPM) - Anglo American Platinum Ltd (AAP) to evaluate potential health risks associated with the proposed Additional Slag Cleaning (ASC) operations and SO_2 abatement plant at the Mortimer Smelter in North West Province, South Africa. The Mortimer Smelter, currently under care and maintenance, is set to incorporate ASC capabilities to alleviate processing pressures from RPM's Waterval Smelter. This transition will necessitate updates to the facility's Atmospheric Emissions Licence (AEL) and will include new emission control technologies.

The HIA forms part of the Basic Assessment (BA) process under national environmental legislation. The HIA was commissioned by WSP Group Africa (Pty) Ltd and executed by Prime Africa Consult, following the International Finance Corporation (IFC, 2009) framework and WHO guidance on air pollution health risk assessment (WHO 2016 and 2021) and supporting risk assessment frameworks as referenced elsewhere in this document.

The HIA utilised dispersion modelling (AERMOD) outputs from WSP's Atmospheric Impact Report (AIR) to estimate pollutant concentrations and population exposure under two scenarios:

- Scenario 1: Assessing Primary Smelting operations for SO_2 for short-term (1-hour and 24-hour) and long-term (annual). Using data representing the years 2022 to 2024.
- Scenario 2: Additional Slag Cleaning operations for SO_2, NO_X, TSP (reported as dust fallout), PM_{10} and $PM_{2.5}$ for short-term (1-hour, 24-hour, and 30-day) and long-term (annual). Using data representing the years 2022 to 2024.

Modelled pollutant concentrations covered a 15×15 km domain, centred on the smelter, and incorporated 15 identified sensitive receptors (residential areas, schools, hospitals). Modelling accounted for terrain and meteorological conditions using multi-tier grid resolution and site-specific stack parameters derived via SCREEN View.

Population exposure was quantified at the ward level using extrapolated 2024 estimates based on Census 2011 and United Nations (UN) growth projections. The total estimated exposed population within the domain is 25,980 individuals.

The health risk assessment approaches that were followed during this HIA included:

- *Exposure-Response Functions (ERFs)* were applied to estimate incremental changes in all-cause mortality risk, using WHO-recommended relative risk (RR) coefficients for SO_2, PM_{10}, $PM_{2.5}$ and NO_2
- *Hazard Quotients (HQ)* were calculated by comparing modelled pollutant concentrations with South Africa's National Ambient Air Quality Standards (NAAQS). An HQ value less than 1 indicates that adverse health effects are not likely to occur.
- *Significance of health impact* was evaluated qualitatively using IFC HIA guidelines criteria covering questions related to magnitude, duration, frequency, and geographic extent

Key findings of the HIA include the following:

- Air Quality: Modelled emissions from both Scenario 1 and Scenario 2 remained below South Africa's National Ambient Air Quality Standards (NAAQS). SO_2 annual average predicted concentration (Scenario 1 and 2) is 3.67 µg/m³ in Scenario 1 and 3.12 µg/m³ in Scenario 2, remaining below the NAAQS of 50 µg/m³. PM_{10} (Scenario 2) annual average predicted concentration is 2.77 µg/m³, remaining below the NAAQS of 40 µg/m³. $PM_{2.5}$ and NO_2 (Scenario 2) predicted annual average concentrations are well below 5 µg/m³, indicating limited ambient impact.
- Sensitive Receptors: The study considered 15 critical sites, including schools, hospitals, and residential areas within a 15 km radius. Modelling confirmed that even at these sensitive locations, predicted concentrations remained within acceptable limits.
- Incremental Change of Health Risks: The projected increase in all-cause mortality risk due to additional emissions is under 1% for SO_2 and between 1 and 2% for PM_{10}.
- Hazard Quotient (HQ): All the HQs are less than one which indicates exposure is well within acceptable limits for the modelled exposure scenarios.
- Health Infrastructure: Local capacity, including hospitals and clinics supported by RPM's Platinum Health system, is deemed sufficient to manage any changes in community health burden.

The overall outcome of this HIA assessment finds the risk for the Rustenburg Platinum Mines, Mortimer Smelter Additional Slag Cleaning operations as follows:

- SO_2 associated risk = Very Low (Severity = Medium and Probability = Very Low)
- PM_{10} associated risk = Low (Severity = Medium and Probability = Low)

These risk ratings were informed by:

- The predicted ambient concentrations of the pollutants as provided by the AIR (WSP, 2025) and the annual concentrations observed at the Air Quality Monitoring Stations which are under the respective NAAQS limits for each pollutant.
- Severity assessment for both SO_2 and PM_{10}:
  - The AP-HRA informed assessment indicated by risks of all-cause mortality (Table 3.2) is assessed as Medium
- Probability assessment for SO_2:
  - The Hazard Quotients that are less than 0.3 for SO_2 based on NAAQS and is assessed as Very Low.
- Probability assessment for PM_{10}:
  - The Hazard Quotients that are less than 0.7 for PM_{10} based on NAAQS and is assessed as Low.
  - It is to be noted that the Low probability rating for PM_{10} results predominantly from the already high baseline PM_{10} levels.

ACRONYMS AND ABBREVIATIONS

AAP	Anglo American Platinum Ltd
ACP	Anglo Platinum Converting Process
AEL	Atmospheric Emission Licence
AIR	Atmospheric Impact Report
AQA	Air Quality Act
AQMS	Air Quality Monitoring Station
ASC	Additional Slag Cleaning
DEA	Department of Environmental Affairs
ERF	Exposure Response Function
HIA	Health Impact Assessment
HQ	Hazard Quotient
IFC	International Finance Corporation
LM	Local Municipality
MES	Minimum Emissions Standard
NAAQS	National Ambient Air Quality Standards
NEMA	National Environmental Management Act
NEMAQA	National Environmental Management: Air Quality Act 39 of 2004
NO_2	Nitrogen Dioxide
NO_X	Oxides of Nitrogen
PGM	Platinum Group Metals
PM	Particulate Matter
PM_{10}	Particulate Matter with Aerodynamic Diameter less than 10-micron metres
$PM_{2.5}$	Particulate Matter with Aerodynamic Diameter less than 2.5-micron metres
RR	Relative Risk
RPM	Rustenburg Platinum Mines
SANS	South Africa National Standards
SO_2	Sulphur dioxide
TRV	Toxicological Reference Values
UN	United Nations
UNEP	United Nations Environment Programme
U.S. EPA	United States Environmental Protection Agency
WACS	Waterval ACP Converter Slag
WHO	World Health Organisation

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1 INTRODUCTION AND BACKGROUND

Rustenburg Platinum Mines (RPM) - Anglo American Platinum Ltd (AAP) owns and operates the Mortimer Smelter located in the North West Province. To accommodate the constraints experienced at the AAP Waterval Smelter, AAP is proposing to develop an additional slag cleaning (ASC) Project and associated sulphur dioxide (SO_2) abatement plant at the Mortimer Smelter which is currently under care and maintenance. The existing Atmospheric Emission License (AEL) for the current primary smelting operations (valid until 30 September 2026) will require amendment. The amendment will include the existing authorised primary smelting process and the proposed additional slag cleaning operations. The main operations will however be additional slag cleaning and only require primary smelting operations on an ad hoc basis and at no time would these operations be capable of operating simultaneously. (WSP, 2025). WSP Group Africa (Pty) Ltd (WSP) was appointed to compile an Atmospheric Impact Report (AIR) in support of the Basic Assessment (BA) required for the environmental authorisation of RPM project.

Prime Africa was subsequently appointed by WSP to conduct a health impact assessment to assess the risks of associated health outcomes from the changes in ambient air emissions related to the AAP project.

Health Impact Assessments (HIA) have become an increasingly integral component of environmental and social risk management frameworks in development projects worldwide. Among international development institutions, the International Finance Corporation (IFC) plays a leading role in promoting the use of HIA, particularly in sectors with significant health externalities such as industrial sectors (IFC, 2009). The WHO (1999) defines an HIA as “a combination of procedures, methods, and tools by which a policy, program, or project may be judged as to its potential effects on the health of a population and the distribution of those effects within the population”. Health impacts are considered as part of the Environmental and Social Impact Assessment (ESIA) process, particularly for projects that pose potentially significant health risks. HIA under the IFC framework is not a standalone process but is integrated within the broader ESIA.

A Rapid Appraisal HIA approach was used in the current study to assess the health impacts associated with the operation of the Anglo American Platinum Ltd (AAP) proposed additional slag cleaning (ASC) Project and associated sulphur dioxide (SO_2) abatement plant at the Mortimer Smelter near the town of Northam in the North West province of South Africa. Currently the primary smelter operations at the site are under care and maintenance. The assessment quantifies the health outcomes of ambient air pollution resulting from the proposed new operations at the Mortimer smelter plant, where Mortimer furnace will be converted from being a primary furnace treating Platinum Group Metals (PGM) concentrate to be able to operate in addition as a slag cleaning furnace, treating converter slag and converter slag tailings (WACS and WACS tailings) from the Waterval Smelter Complex located in Rustenburg, South Africa (Ndlovu, 2025).

In the current HIA study the two air pollution scenarios assessed in the AIR for the Mortimer Smelter were assessed. The AIR included dispersion modelling of sulphur dioxide (SO_2), particulate matter (PM), nitrogen oxides (NO_x) and dust fallout (calculated and modelled as Total Suspended Particulates (TSP)).

2 METHODOLOGY AND INPUTS

2.1 Overview

A Rapid Appraisal Health Impact Assessment was conducted to assess the health impacts on the surrounding population in terms of the risk of premature mortality based on the quantitative results from the AERMOD dispersion modelling scenarios conducted as part of the AIR.

The appraisal applies a risk assessment approach, following the guidelines of the IFC (IFC, 2009). The assessment of health risk is informed by both an air pollution health risk assessment (AP-HRA) as guided by WHO (WHO, 2016a) and a Hazard Quotient (HQ) assessment that follows internationally recognised methodologies for risk evaluation. Specifically, the HQ assessment is based on frameworks outlined by the U.S. EPA (1989), Health Canada (2017), and is aligned with the WHO's air quality risk assessment guidelines (WHO, 2000). The approach is further supported by the United Nations Environment Programme (UNEP, 2018), which endorses the HQ method for evaluating the health implications of industrial pollutant emissions. In the South African context, the National Ambient Air Quality Standards (NAAQS) serve as health-protective reference concentrations in the absence of formal national toxicological reference values (DEA, 2009).

There were two scenarios evaluated. Scenario 1 assesses SO_2 emissions applicable to primary smelting operations and to note that the current AIR (WSP) only evaluated SO_2 emissions as these will change due to the new abatement technology and stack location and dry granulation operations to be installed. The AIR notes that the Airshed (2023) report assessed existing Primary Smelter operations and the predicted concentrations of NO_2, PM_{10} and $PM_{2.5}$ and these are accepted to remain the same for purposes of the current AIR. Scenario 2 assesses emissions applicable to the proposed Additional Slag Cleaning (ASC) operations and SO_2, NO_2, PM_{10} and $PM_{2.5}$ emissions were modelled.

2.2 Sources of air pollutants

The main point sources of ambient emissions that were identified in the AIR (WSP, 2025) relating to Scenario 1 include the following sources of SO_2 emissions:

Point sources:

- Flash drier
- Electric furnace
- New abatement stack

Line sources:

- Bouyant source from dry slag granulation
- Roads – SO_2 emissions from vehicles associated with primary smelting

During the primary smelting operation, the largest source of emissions of SO_2 (90% of total emissions) are from the Mortimer Smelter stack emissions.

The main point sources of ambient emissions that were identified in the AIR (WSP, 2025) relating to Scenario 2 include the following sources of SO_2 emissions:

Point sources:

- Flash drier
- Electric furnace
- New abatement stack
- Rotary driers (two)

Line sources:

- Bouyant source from dry slag granulation

In terms of particulate matter emissions (PM_{10}, $PM_{2.5}$ and TSP) the main activities for sources of these according to the AIR (WSP, 2025) is from material handling and stockpile management and sources are related to the handling of raw materials and products.

2.3 Existing Ambient Pollutant concentrations

Existing information on ambient pollution concentrations in the vicinity of the Mortimer Smelter operations consists of daily and annual running average ambient concentrations of particulate matter (PM_{10}) and sulphur dioxide (SO_2) recorded at four Ambient Air Quality Monitoring Stations (AAQMS) obtained through WSP from AAP. Data was not available for $PM_{2.5}$ and NO_2. These AAQMS are Fridge Plant, Hostel, 4B Decline and Bierspruit (Figure 2-1) for the years 2019 to 2024. It should be noted that data recovery from the stations was low for the period reviewed, therefore data must be viewed with caution (WSP, 2025). During the period of 2019 to end of the first quarter of 2024 the Mortimer Smelter plant was fully operational and thereafter from the second quarter of 2024 the plant was put on care and maintenance. The daily average concentrations and annual running average for PM_{10} is shown in Figure *2-2* and that of SO_2 in Figure *2-3*.

The maximum annual average concentrations of PM_{10} remained within the NAAQS limit of 40 µg/m^3 at all the stations over the 2019 to 2024 period. The annual running average for PM_{10} concentrations measured over the assessment period (2019 to 2024) was 19.06 µg/m^3 at Bierspruit, 25.8 µg/m^3 at Decline, 21.3 µg/m^3 at Fridge and 22.24 µg/m^3 at Hostel AQMS. The daily (24-hour) average concentrations for PM_{10} were mostly within the NAAQS limit (75 µg/m^3) with some exceedances recorded. Only at the 4B Decline station were there multiple exceedances recorded for 2024 with 24 exceedances, well above the allowable four exceedances. It is however to be noted that the Mortimer smelter was under care and maintenance in 2024 indicating that other surrounding sources are the main contributors to PM_{10} emissions (WSP, 2025).

The maximum annual average concentrations of SO_2 remained within the NAAQS limit of 50 µg/m^3 at all stations over the 2019 to 2024 period. The annual running average for SO_2 concentrations measured over the assessment period (2019 to 2024) was 1.91 µg/m^3 at Bierspruit, 4.8 µg/m^3 at Decline, 5.0 µg/m^3 at Fridge and 9.6 µg/m^3 at Hostel AQMS. The daily (24-hour) concentrations of SO_2 remained within the NAAQS limit (125 µg/m^3) at all AQMS over the 2019 to 2024 period. The hourly concentration ranges for SO_2 are also recorded at the AQMS for the period of 2019 – 2024 with all stations compliant with NAAQS limit of 350 µg/m^3 and only two exceedances were recorded at the Hostel AQMS but are within the allowable exceedances of 88.

Figure 2-1: Ambient Air Quality Monitoring Stations

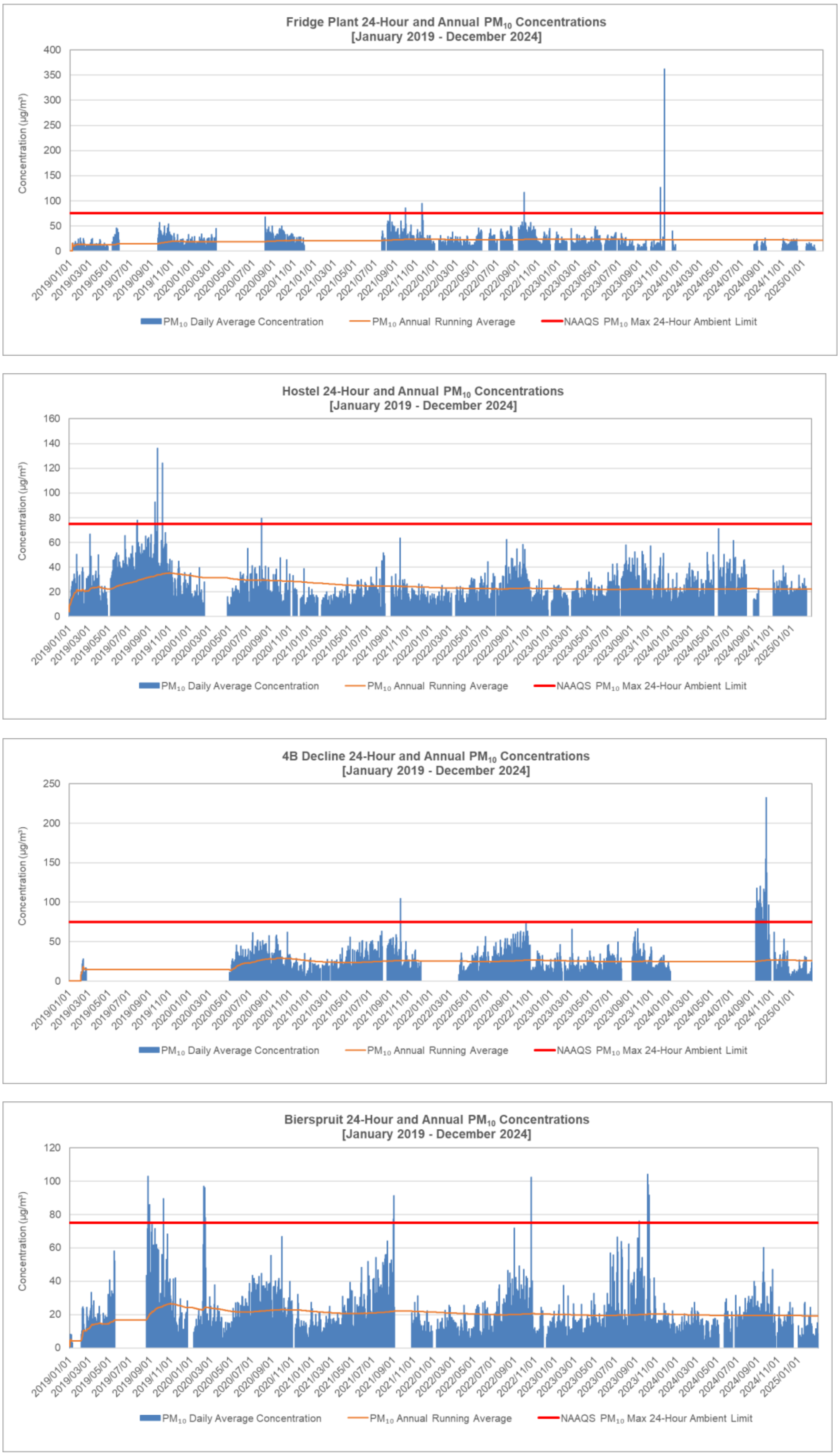

Figure 2-2: Daily and annual running average concentrations of PM_{10} at the AQMS from 2019 to 2025

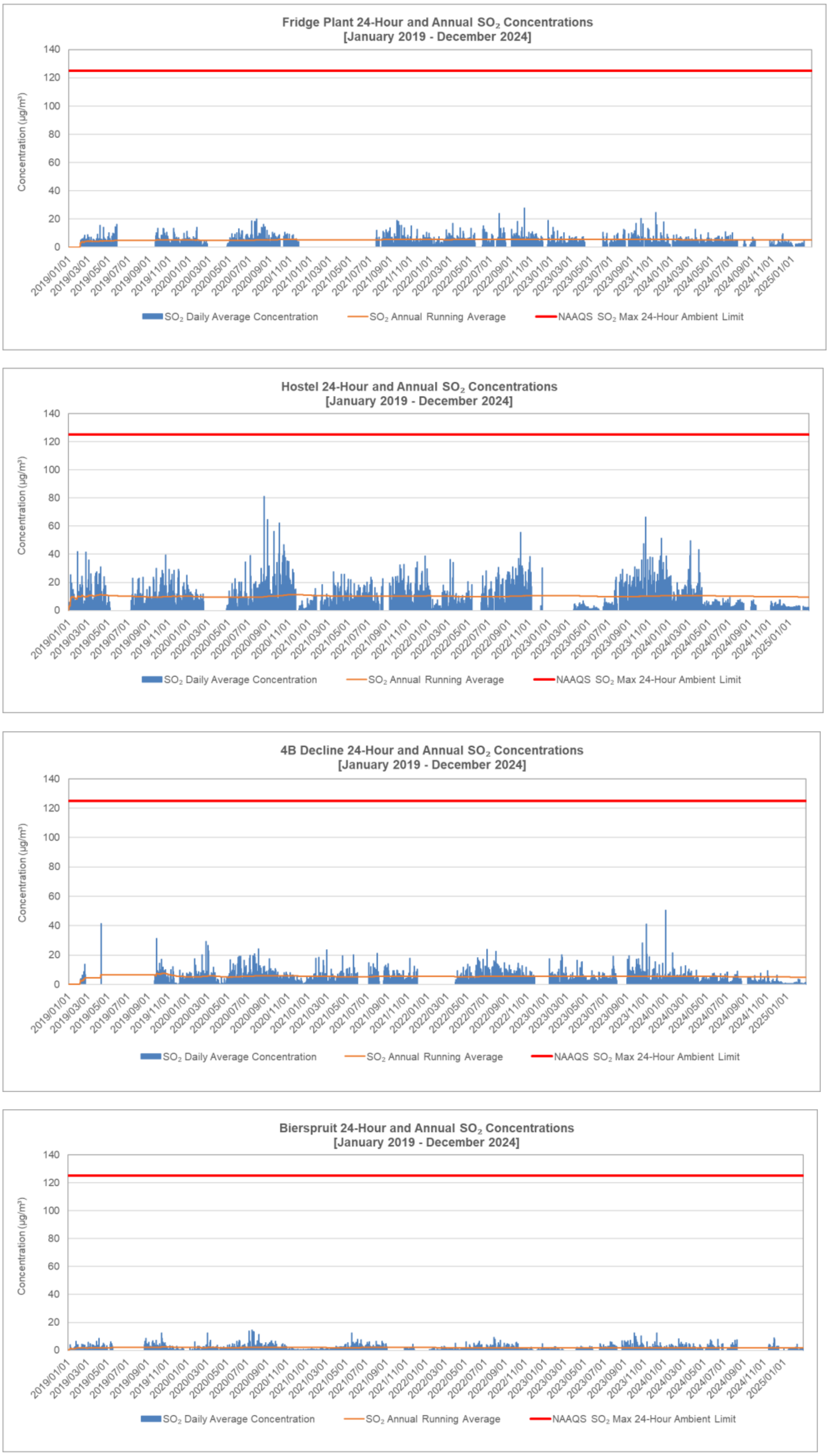

Figure 2-3: Daily and annual running average SO_2 concentrations at the AQMS from 2019 to 2025

2.4 Mortimer smelter plant and study area

The Mortimer smelter plant is located on a portion of the property Turfbult 404 KQ at the Union Mine Operations in the Moses Kotane local municipality (LM), Bojanala Platinum District Municipality in the North West province. Nearby towns include Northam and Swartklip (2.5 km north of the site) in the Thabazimbi LM. Bojanala Platinum District Municipality falls within the Waterberg-Bojanala Priority area. This area was designated in 2012 and introduced as part of the National Environment Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEMA: AQA) in South Africa to direct resources into areas of poor air quality (WSP, 2025).

The study area consists of the dispersion modelled domain area (15 km x 15 km) centred over the Mortimer Smelter site and is largely rural with several village settlements within Moses Kotane LM and the town of Swartklip in Thabazimbi LM. Land use within the study area includes the mining and processing areas of the Union Mine and Mortimer Smelter plant and the residential areas. The study area extends between the North West Province and Limpopo province.

There are 15 air quality discreet receptors that were identified for inclusion in the study as indicated in Table *2-1* (WSP, 2025) and illustrated in Figure *2-4*. The receptors were selected based on their proximity to the study site and where sensitive individuals may be impacted. The receptors include one town (Swartklip, Thabazimbi LM), two hospitals (Thabazimbi LM), six villages (five in Moses Kotane LM and one in Thabazimbi LM), one informal settlement (Moses Kotane LM) and five schools (one in Thabazimbi LM and four in Moses Kotane LM).

Table 2-1: Sensitive receptor sites in the study area

Receptor ID	Sensitive Receptor Name	Type of receptor
R1	Sefikile residential area	Residential
R2	Makuka Secondary School	School
R3	Sefikile Primary School	School
R4	Hlatini Village	Residential
R5	Ga-Ramosidi residential area	Residential
R6	Informal settlement	Residential
R7	Etafeni Village	Residential
R8	Mantserre residential area	Residential
R9	Mamodimakwana Primary School	Residential / School
R10	Modise Commercial High School	Residential / School
R11	Mopanye residential area	Residential
R12	Swartklip residential area	Residential
R13	Francois Uys Covid Hospital	Residential / Medical
R14	Platinum Health Union Hospital	Residential / Medical
R15	Laerskool Platina	Residential / School

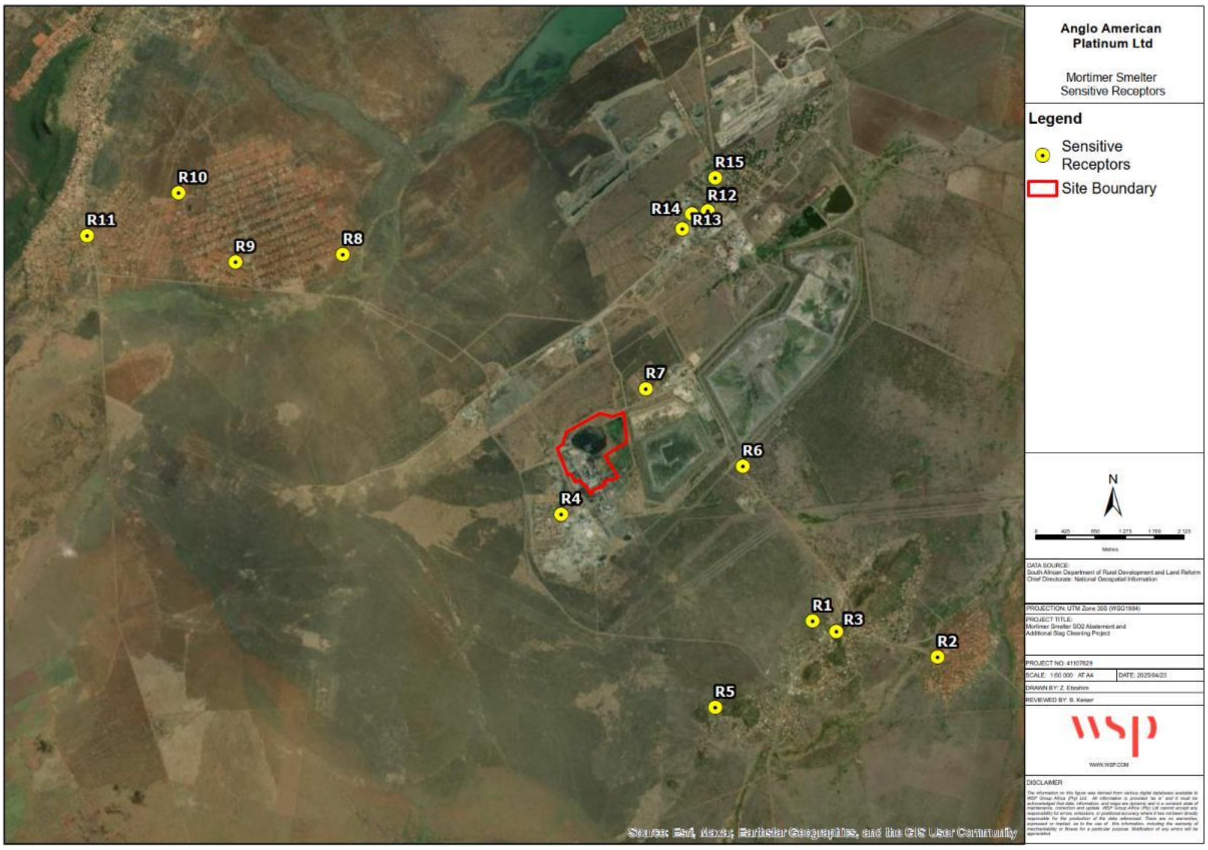

Figure 2-4: Identified Sensitive Receptor Points (WSP, 2025)

2.5 Modelled emissions and scenarios

Dispersion modelling is required to estimate the effects of the Mortimer Smelter operation emissions on the ambient concentrations of pollutants and to describe these spatially. The modelled concentrations of air pollutants are used to quantify the health risks associated with the operations of the Mortimer Smelter.

The dispersion modelling for the health impact assessment was carried out by WSP following Modelling Regulations (DEA, 2014). The SCREEN view and AERMOD dispersion modelling software suites were utilised in the AIR as recommended within the Modelling Regulations and recognised internationally by organisations such as the United States Environmental Protection Agency (EPA).

The SCREEN View model was applied to compare the maximum predicted concentrations of the different proposed input parameters (stack height and stack exit temperatures for primary smelting and Additional Slag Cleaning operations) and the outcome was to determine the worst-case input options for the proposed stack to be incorporated in the AERMOD dispersion model (WSP, 2025). The other, less impactful options would result in lower predicted concentrations than the modelling option that was assessed (WSP, 2025).

AERMOD is a Level Two and new generation dispersion model that is designed for short-range dispersion (<50km) of airborne pollutants in steady state plumes including treatment of both surface and elevated sources and both simple and complex terrain. The model uses hourly sequential meteorological files with pre-processors to generate flow and stability regimes for each hour that cumulatively offer long-term ambient concentrations whilst also capturing short-term peaks (WSP, 2025). The AERMOD model was used to predict the potential air quality impacts associated with the existing and proposed operations at the Mortimer Smelter site. The ground level downwind concentrations of sulphur dioxide (SO_2), particulate matter with diameter less than 2.5 µm ($PM_{2.5}$), particulate matter with diameter less than 10 µm (PM_{10}) and nitrogen dioxide (NO_2) for the Mortimer Smelter operations was predicted by the model.

The dispersion modelling domain covered an area of 15 km x 15 km centred over the Mortimer Smelter site ensuring that all sensitive receptors (see Section 2.4) were included. Furthermore, the model had a multi-tiered grid resolution (as specified in the Modelling Regulations) and comprised of the following (WSP, 2025):

- 50 m grid spacing up to 500 m from the site.
- 100 m grid spacing up to 1 km from the site.
- 250 m grid spacing up to 2 km from the site.
- 500 m grid spacing exceeding 5 km from the site.

Two modelling scenarios were run in AERMOD:

- Scenario 1: Assessing Primary Smelting operations for SO_2 for short-term (1-hour and 24-hour) and long-term (annual). Using data representing the years 2022 to 2024.
- Scenario 2: Additional Slag Cleaning operations for SO_2, NO_X, TSP (reported as dust fallout), PM_{10} and $PM_{2.5}$ for short-term (1-hour, 24-hour, and 30-day) and long-term (annual). Using data representing the years 2022 to 2024.

The isopleth maps of the long term predicted ambient SO_2, NO_X, PM_{10} and $PM_{2.5}$ concentrations are presented in Figure 2-5 to Figure 2-8(WSP, 2025). The predicted concentrations are shown as isopleth lines of equal concentration, in µg/m^3 for the respective NAAQS averaging periods. The isopleths for the respective NAAQS averaging period are depicted as a green coloured line on the maps, Sensitive receptors closest to the Mortimer site boundary are indicated by points on the maps (WSP, 2025).

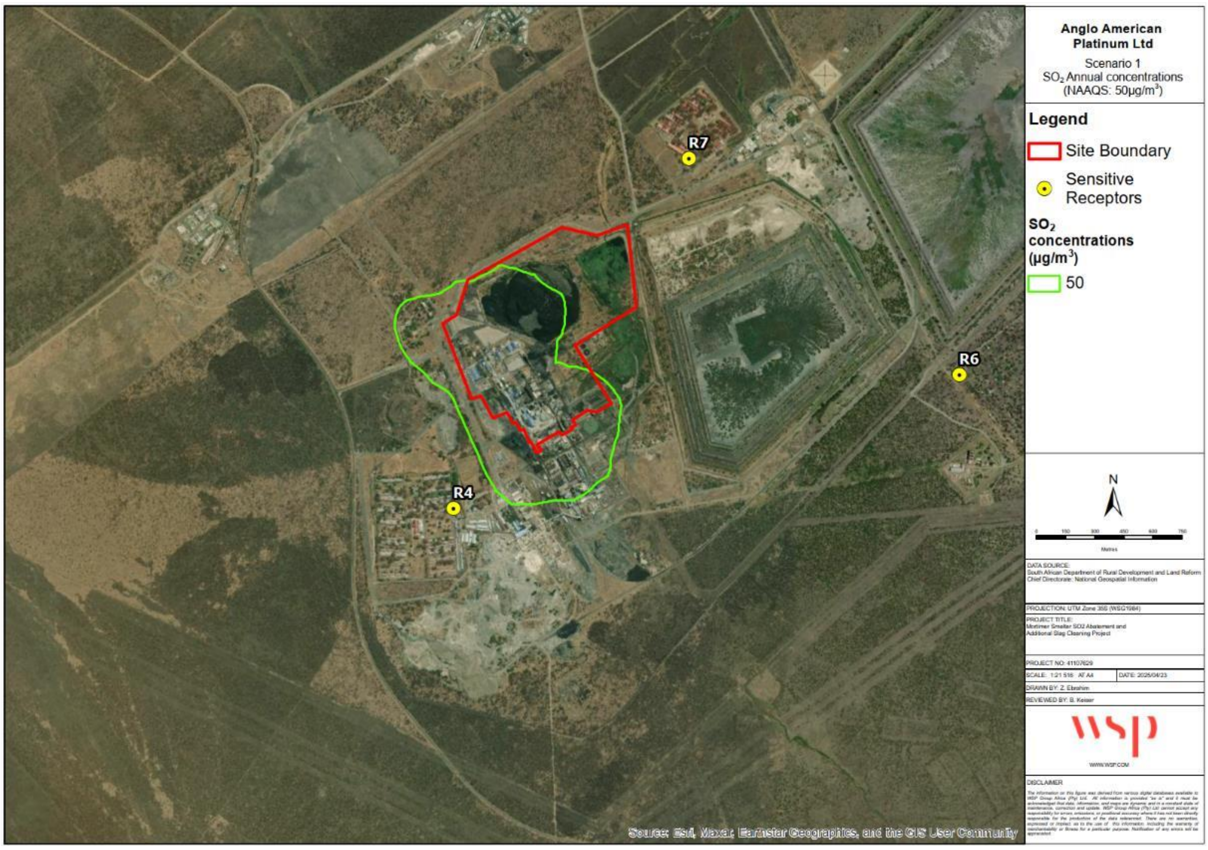

Figure 2-5: Scenario 1 predicted SO_2 Annual concentrations

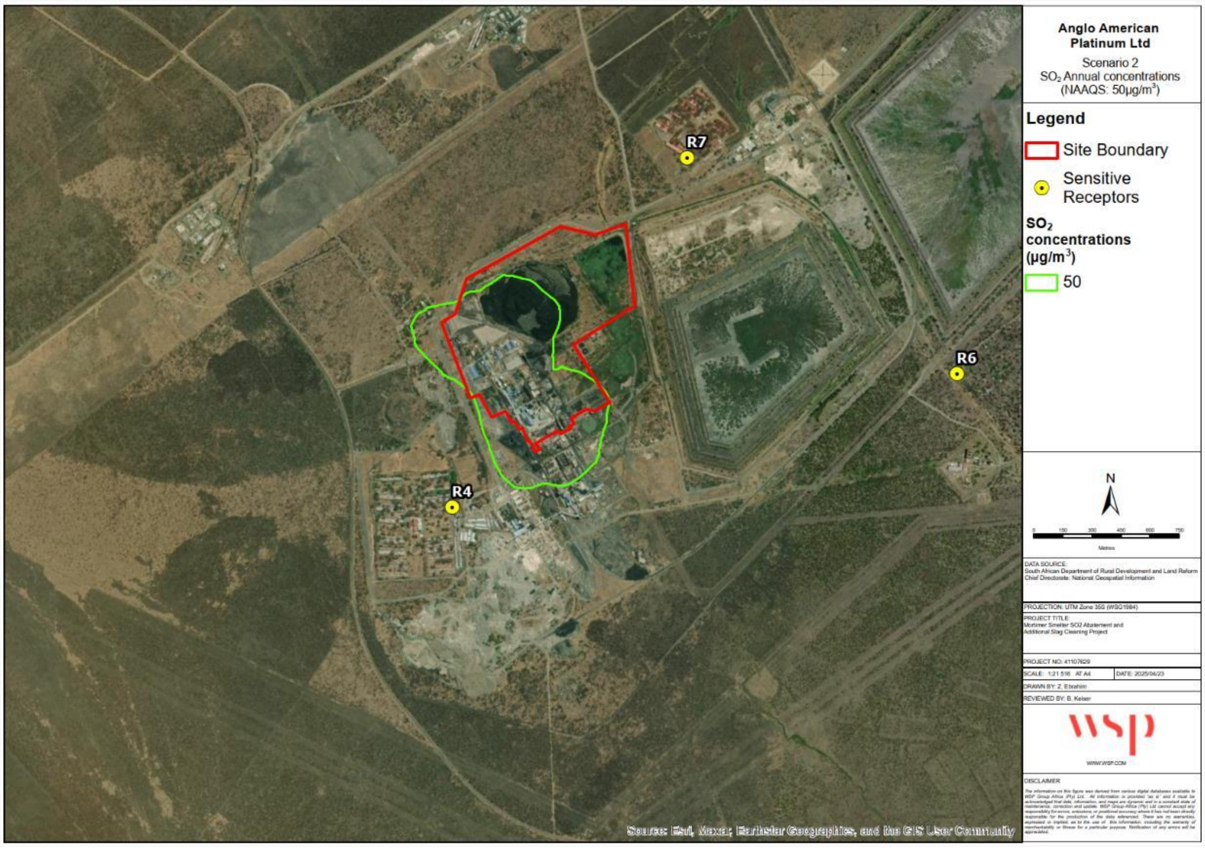

Figure 2-6: Scenario 2 predicted SO_2 Annual concentrations

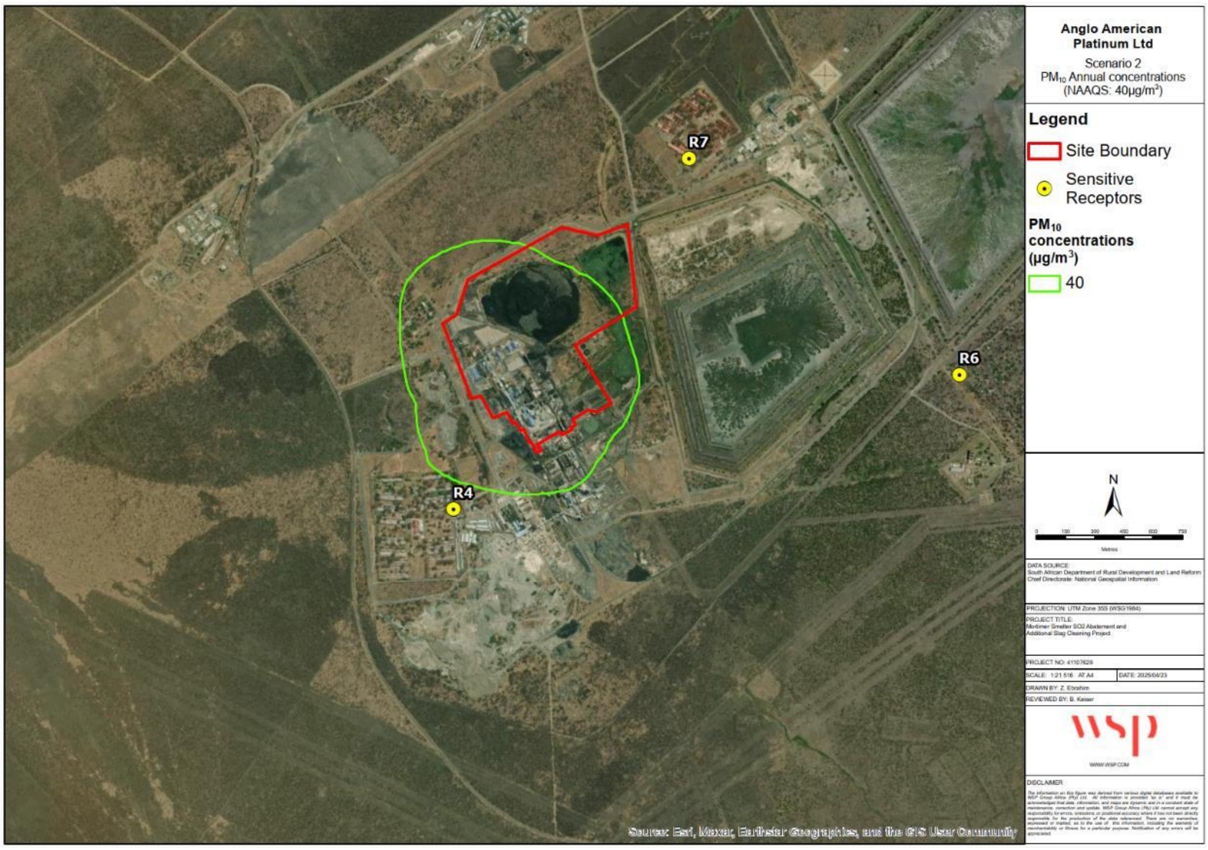

Figure 2-7: Scenario 2 predicted PM_{10} Annual concentrations

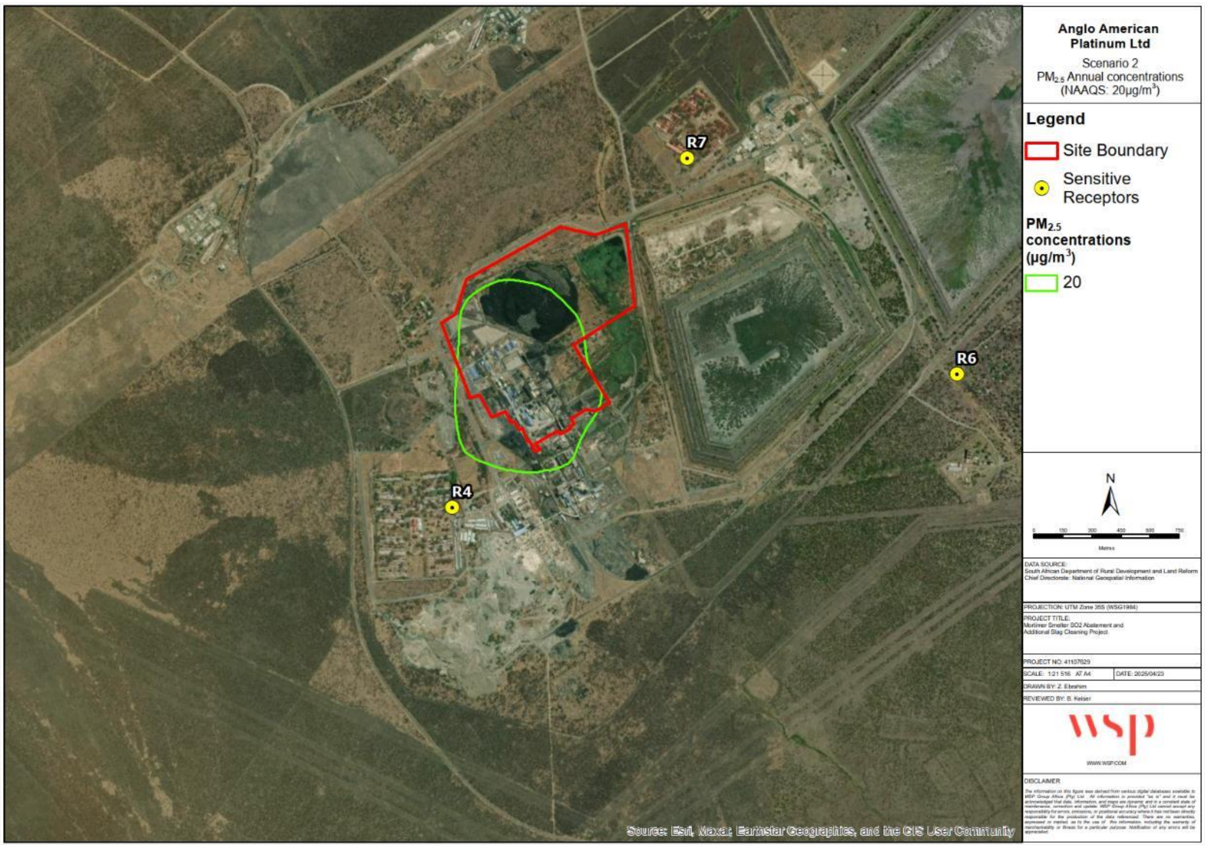

Figure 2-8: Scenario 2 predicted $PM_{2.5}$ Annual concentrations

2.6 Population exposure

The population exposure in the modelled study area was estimated at a spatial resolution of municipality and municipal wards for the data from the AERMOD dispersion model scenario runs. In each ward, the number of people exposed to different concentration ranges for each pollutant were determined per scenario. Only the population within the modelling domain was estimated. It should be noted that the predicted emissions in the area within the Mortimer Smelter site boundary was excluded from the HIA, as ambient air quality objectives are applied to areas outside the facility fence line as defined in the Modelling Regulations (WSP, 2025).

The assessment of pollution exposure in the HIA was executed as follows:

- AERMOD dispersion model outputs were used to spatially apportion SO_2, PM_{10}, $PM_{2.5}$, NO_2 and TSP (30-day) concentrations. The coordinates of the receptors (x;y) from the output files were attributed to specific administrative boundaries.
- Administrative boundaries included municipalities and municipal wards and where data was available towns for settlements. The predicted annual ambient concentrations for each pollutant were then averaged for the entire spatial unit.
- Population density (population numbers per ward) was obtained from Census 2011 (Stats SA, 2012), given that the latest Census 2022 metadata which includes ward level numbers has not been released. The population numbers in each ward were extrapolated to 2024 values by using growth factors determined using the United Nations population prospects growth forecasts (United Nations, 2024). The latest available mid-year population estimates from Stats SA (Stats SA, 2024a,b) were used as a local data comparative measure. For the modelling domain that did not cover entire ward areas an estimate of the total population was made based on the towns and settlements that fell within the modelling domain, using information from the 2011 Census and extrapolating to 2024.

Table 2-2: Population numbers per ward area within the modelling domain

Local Municipality	Ward ID	Census 2011 population (portion in modelled domain)	Calculated 2024 Population
Moses Kotane	63705005	8,211	10,152
Moses Kotane	63705007	7,286	9,008
Moses Kotane	63705008	1,999	2,471
Thabazimbi	93601005	3,517	4,348

2.7 Health risks and impact

The health risk assessment involved the quantitative determination of the incremental individual risk of the population due to exposures to the modelled (predicted) impacts of the industrial emissions on air concentrations, from the operations at the Mortimer Smelter for two modelled scenarios.

The risk assessment, assessing and ranking the impacts was conducted using the IFC HIA guidelines (IFC, 2009). The assessment utilised quantitative and qualitative approaches.

The health risk was informed by three sets of analysis:

1) Evaluating the health risk in the exposed population, associated with predicted ambient emissions from the Mortimer Plant through the use of exposure-response functions (ERFs) and considering the increased relative risk of premature all-cause mortality from the predicted ambient concentrations of pollutants in each scenario.
2) Using the Hazard Quotient (HQ) approach to further evaluate the potential for adverse health effects in the exposed population to provide additional insights for assessing the likelihood of the risks associated with the project.
3) The significance of the impact was assessed using a set of questions related to several critical elements as recommended in the IFC guidelines (IFC, 2009).

These are detailed further in the sections that follow.

2.7.1 Incremental change in health risk using exposure response functions (ERFs)

To evaluate the health risk in a population, associated with air pollution, the use of exposure-response functions (ERFs) is recommended by the WHO, following the principles for air pollution health risk assessments (AP-HRA) published by WHO (WHO, 2016a).

ERFs are based on Relative Risk (RR) estimates derived from primary epidemiological studies. Relative Risk functions estimate the likelihood of health outcomes occurring in a population exposed to a higher level of air pollution relative to that in a population with a lower exposure level (WHO, 2016a). RR is usually expressed as the proportional increase in the assessed health outcome associated with a given increase in pollutant concentrations, measured in µg/m^3. The WHO (2016a) notes that "*the RR estimate cannot be assigned to a specific person; it describes risk in a defined population, not individual risk.*"

ERF studies and relative risks based on primary epidemiological studies within South Africa are not readily available. The WHO (2016a) recommends using ERFs from other countries where country-specific studies are not available.

The HIA considered the health effects of the pollutants in terms of the increased risk for all-cause mortality and ERFs were obtained from the WHO systematic reviews (2020 & 2021) and meta-analyses conducted for the 2021 update of the WHO Global Air Quality Guidelines for indoor and ambient air pollution. For particulate matter an updated review of the WHO systematic review which included the 46 studies from the systematic review and a further 60 studies (included studies from 2018 to May 2023) was used in this HIA assessment. Although, the authors of the systematic reviews propose RRs for various cause-specific mortality (e.g. respiratory), assessing this effect with that of all-cause mortality would amount to double-counting of the effects of the pollutants and thus only all-cause mortality effect was assessed.

All-cause mortality provides a measure of all the deaths that occur within the population from any natural causes. It includes natural deaths from all causes of death as provided in the WHO (2016b) International statistical classification of diseases and related health problems (ICD-10).

In South Africa all-cause mortality makes up 90.2% of total deaths in the country (Stats SA, 2025).

The baseline incidence rate of the health outcome was determined based on published data from the year 2021 from Stats SA (Stats SA, 2025). The ERFs describing the change in incidence in relation to changes in exposure (RRs) and the baseline incidence is summarised in Table 2-3.

Table 2-3: Indicator pollutant, baseline incidence and relative risks for all-cause mortality

Indicator Pollutant	Health Outcome	Baseline data (Stats SA, 2025)	Relative Risk or Hazard Ratio per 10 μg/m³	Reference (RR)
$PM_{2.5}$	All-cause Mortality	0.913%	1.136	Orellano et al., 2024
PM_{10}	All-cause Mortality	0.913%	1.095	Orellano et al., 2024
SO_2	All-cause Mortality	0.913%	1.0059	Orellano et al., 2021
NO_2	All-cause Mortality	0.913%	1.02	Huangfu & Atkinson, 2020

2.7.2 Hazard Quotient (HQ) approach

The Hazard Quotient (HQ) risk assessment metric is used to evaluate the potential for adverse health effects from exposure to air pollutants. It is defined as the ratio of the estimated or modelled environmental concentration of a pollutant to its corresponding Toxicological Reference Value (TRV). TRVs are critical benchmarks used to evaluate the potential health risks associated with exposure to chemical substances, including air pollutants.

The Hazard Quotient is derived using the following formula:

$$\mathrm{HQ} = \frac{\text{Estimated Exposure}}{\text{Toxicological Reference Value (TRV)}}$$

Where,

- The Estimated Exposure is the exposure concentration in μg/m^3. This included the current ambient concentrations across the monitoring stations and the predicted ambient concentrations from the AERMOD dispersion modelling for each pollutant. Both annual and daily ambient concentrations are used in the assessment.
- TRV is the respective concentration value limits for South Africa from the National Ambient Air Quality Standards (NAAQS). The NAAQS serve as regulatory benchmarks for acceptable pollutant concentrations for South Africa. Annual limits used:
    - Annual limits:
        - SO_2 – 50 μg/m^3
        - PM_{10}, $PM_{2.5}$ and NO_2 – 40 μg/m^3
    - Daily (24-hour) limits:
        - SO_2 – 125 μg/m^3
        - PM_{10}, and $PM_{2.5}$ – 75 μg/m^3

Evaluation of the HQ value was then used to inform the risk rating. An HQ value greater than 1 indicates that adverse health effects are possible whereas an HQ less than 1 indicates that adverse health effects are not likely to occur. (U.S. EPA, 1989; U.S. EPA, 2024)

2.7.3 Qualitative measure of the significance of the impact of the health risks

The significance of the impact was assessed using a set of questions related to several critical elements as recommended in the IFC guidelines (IFC, 2009). The questions relate to the critical elements influencing the potential impacts including magnitude, duration, frequency and geographical limits.

The following list of questions was used in the assessment:

Magnitude

- Will there be a large change over health-related baseline data?
- Is there local capacity to absorb the change?
- Are the predicted changes likely to exceed internationally recognized standards?
- Will there be persistent cumulative additions that will eventually lead to threshold exceedances?

Duration

- What is the anticipated length of time the changes will last (days, years, decades)?
- How rapidly will the predicted changes occur (during a specific project phase such as planning, construction, operations, decommissioning)?

Frequency

- How often will the change be observable—intermittent (what is the interval), continuous?

Geographical

- Can geographical limits of health impacts be local, regional, or national?

The risk analysis matrix in Figure *2-9* was used to assess the overall risk of the project based on the probability or likelihood and severity of the consequences of the risk.

		PROBABILITY			
		Very Low	Low	Medium	High
SEVERITY	Very High	Medium	High	Very High	Very High
	High	Low	Medium	High	Very High
	Medium	Very Low	Low	Medium	High
	Low	Very Low	Very Low	Low	Medium

Figure 2-9: Risk-Ranking Matrix (adapted from IFC, 2009)

2.8 Assumptions and limitations

The following assumptions and limitations of the HIA are noted:

- Assumptions and limitations of the AERMOD modelling and modelled ambient air concentrations for SO_2, NO_X, PM_{10}, $PM_{2.5}$ and TSP for the two scenarios are provided in the AIR report (WSP, 2025). An important point from the AIR to state here again is that "Of the options assessed in Screen3, it was assumed by selecting the worst-case option for further analysis in AERMOD implies that should AAP decide to implement another option which had improved Screen3 predictions, its impacts on the environment would be less than those modelled in AERMOD in this AIR."
- It is assumed that the population numbers estimated based on extrapolations of available population ward, settlements or towns to a 2024 representative value are the best available values to use in this assessment.
- The exposure response functions (ERFs) used in the study are based on large sets of epidemiological study data on air pollution, however there is not a sufficient database of primary epidemiological evidence on air pollution for South Africa and therefore international studies from the WHO were used as recommended by the WHO (WHO, 2016a)

3 RESULTS AND DISCUSSION

3.1 Health risks findings

3.1.1 Exposed population and predicted ambient pollutant concentrations

The total exposed population for the year 2024 within the study area which includes three wards in Moses Kotane Local Municipality and one ward in Thabazimbi Local Municipality is estimated at 25,980.

The average annual predicted ambient concentrations over 2022 to 2024 for the two scenarios modelled is summarised in Table 3-1. Scenario 1 only included SO_2 for primary smelting operations and Scenario 2 for the additional slag cleaning included ambient predicted emissions for SO_2, NO_2, PM_{10} and $PM_{2.5}$.

Table 3-1: Annual average predicted concentrations of pollutants across 2022 - 2024 in all wards

Scenario	Predicted annual average concentrations (µg/m³)			
	SO_2	PM_{10}	$PM_{2.5}$	NO_2
1. Primary Smelting operations	3.67	Not modelled	Not modelled	Not modelled
2. Additional Slag Cleaning operations	3.12	2.77	0.68	0.41

3.1.2 Results of incremental change of health risk

The potential increase in health risk of premature all-cause mortality attributable to the associated predicted annual average emissions of the Mortimer Smelter was estimated for the two modelled scenarios. This analysis informed the risk level assessment in conjunction with the ambient annual running average concentrations of SO_2 and PM_{10} across the four monitoring stations. Data was not available from the monitoring stations for $PM_{2.5}$ and NO_2 and the final risk level assessment is therefore limited to SO_2 and PM_{10}. This analysis in turn informs the impact significance discussed in Section 3.2.

While the AIR did assess Dust fallout (modelled as total suspended particles, TSP), this pollutant was not assessed in terms of the potential increase in premature all-cause mortality. TSP includes a wide range of particle sizes, and health effects and ERF functions are focused on the finer particle sizes of PM_{10} and $PM_{2.5}$. The health effect risks associated with the finer particulate matter is assessed in this HIA assessment in relation to PM_{10} risks. Dust health impacts to surrounding communities may include eye irritation and exacerbate asthma symptoms in sensitive individuals. The AIR assessment found no exceedances of the national dust control regulations both on site and at identified sensitive receptors and the dust fallout rates are predicted to remain low at all sensitive receptors, below the Residential Standard (Dust fallout rate of below 600 mg/m^2/day).

The health effect risks associated with the finer particulate matter is assessed in relation to PM_{10} risks.

The risk assessment in relation to the increased SO_2 associated risk of all-cause mortality in relation to the baseline incidence level within the exposed population (Table 3-2) found that in both Scenario 1 and Scenario 2 that the risk as measured by incidence increases by less than 1%. The risks associated with PM_{10} as measured by incidence increases by between 1% and 2%. These modelled increases in all-cause mortality risk reflect a health impact which contributes to the burden of disease.

Table 3-2: Summary of risk level assessment findings for increased health outcome risk resulting from Scenarios 1 and 2

Pollutant	Potential increase of the risk of all-cause mortality	
	Mortimer Plant Scenario 1	Mortimer Plant Scenario 2
SO_2	<1%	<1%
PM_{10}	Not assessed*	1 – 2%
$PM_{2.5}$	Not assessed*	<1%
NO_2	Not assessed*	<1%
* predicted ambient concentrations were not modelled in AERMOD (see Section 2.5) and thus could not be assessed here for Scenario 1		

3.1.3 Hazard Quotients (HQ)

The Hazard Quotient (HQ) values for Scenario 1 and Scenario 2 for both annual and 24-hour (daily) ambient concentrations of SO_2 and PM_{10} across the dispersion modelled domain are presented in

Table *3-3*. These values were obtained by dividing the ambient concentrations from the air quality monitoring stations and the added impact of predicted ambient concentrations (from dispersion modelling) by the corresponding Toxicological Reference Values (TRVs), consistent with the NAAQS.

The results indicate that for each scenario, the HQ values for both SO_2 and PM_{10} are well below 1, indicating that exposure is well within acceptable limits for the modelled exposure scenarios.

Table 3-3: Hazard Quotient (HQ) results for SO_2 and PM_{10} (the annual and 24-hour concentrations used in the calculations below include both the baseline concentrations plus the additional effects of the respective scenarios)

Scenario	Annual				24-Hour			
	SO_2 (µg/m³)	**HQ (SO_2)**	PM_{10} (µg/m³)	**HQ (PM_{10})**	SO_2 (µg/m³)	**HQ (SO_2)**	PM_{10} (µg/m³)	**HQ (PM_{10})**
1. Primary Smelting operations	8.97	**0.18**			32.70	**0.26**		
2. Additional Slag Cleaning operations	8.42	**0.17**	25.17	**0.63**	28.14	**0.23**	31.81	**0.42**
TRV (SO_2 annual) = 50 µg/m³ (South African NAAQS) TRV (PM_{10} annual) = 40 µg/m³ (South African NAAQS) TRV (SO_2 24-Hour) = 125 µg/m³ (South African NAAQS) TRV (PM_{10} 24-Hour) = 75 µg/m³ (South African NAAQS)								

3.2 Health impact findings

The assessment of the health impact significance was based on the set of questions (as explained in Section 2.7.3) recommended by the IFC HIA Guidelines (IFC, 2009) and the summary of this assessment is provided in Table 3-4. This assessment further informed the HIA risk matrix for determining the final overall risk rating of the assessment together with the health risk findings in Section 3.1.1, Section 3.1.2 and Section 3.1.3

Table 3-4: Assessment of the impact significance of Scenario 1 and Scenario 2 at the Mortimer Plant (IFC HIA Guidelines, IFC 2009)

Questions	Scenario 1	Scenario 2
Magnitude:		
Will there be a large change over health-related baseline data?	No. Evidence from health risk assessment (Section 3.1) shows additional ambient concentrations from scenario will not result in large change remaining well within NAAQS limits. The HQ values for both SO_2 and PM_{10} are well below 1, indicating that exposure is well within acceptable limits and that under the modelled exposure scenarios. (see Table 3.3).	No. Evidence from health risk assessment (Section 3.1) shows additional ambient concentrations from scenario will not result in large change remaining well within NAAQS limits. The HQ values for both SO_2 and PM_{10} are well below 1, indicating that exposure is well within acceptable limits for the modelled exposure scenarios (see Table 3.3).
Is there local capacity to absorb the change?	Yes. Applicable irrespective of scenario: RPM operates an integrated healthcare system through Platinum Health, a wholly owned subsidiary. System includes primary, secondary and tertiary healthcare, occupational health services, pharmaceutical services and workplace wellness programmes.; AAP have prevention, care and rehabilitation service programmes for HIV/AIDS and Tuberculosis (TB) and chronic diseases like diabetes and hypertension AAP have community health initiatives such as mobile clinics, Smart lockers for collection of chronic medications and AAP collaborate with health departments to improve health services in four provinces which includes North West. Sources: (https://www.platinumhealth.co.za/wp-content/uploads/Platinum-Health-HMO-Profile-updated-30-January-2020.pdf); (https://www.angloamericanplatinum.com/sustainability/health.aspx); (https://www.angloamericanplatinum.com/sustainability/communities/our-communities) In close proximity to the Mortimer Plant site within 3 km are the Francois Uys covid hospital and the Platinum Health Union Hospital. Other hospitals or clinics within or near to the exposed population area include two clinics in Northam about 24km from Mortimer Plant site; The Motlhabe Clinic 35km away; and the Moruleng Community Health Centre 28km away.	
Are the predicted changes likely to exceed internationally recognized standards?	The National Ambient Air Quality Standards (NAAQS) of South Africa provide a benchmark for air quality management and governance and are guided by two South Africa National Standards (SANS), SANS 69:2004 and 1929:2005. The SANS 1929:2005 sets the limit values for common pollutants. The impacts to ambient air quality from the proposed project activities are such that the changes are not likely to exceed the NAAQS in the surrounding communities. Even at the closest residential receptor at Hlatini Staff village where ambient concentrations are higher than further away, the annual ambient concentrations remain below the NAAQS for SO_2, PM_{10}, $PM_{2.5}$ and NO_2 in both Scenario 1 and Scenario 2. Scenario 1 PM concentrations and NO_2 were analysed in the impact study conducted by Airshed (Airshed, 2023) and were below NAAQS limits at all sensitive receptors.	

Questions	Scenario 1	Scenario 2
	The HQ values reported in Table 3.3 are all well below 1, indicating that exposure is well within acceptable limits for the modelled exposure scenarios. The WHO 2021 Global Air Quality Guidelines (AQGs) provide updated, health-based recommendations for the maximum allowable concentrations of key air pollutants, focusing on minimizing the risk of mortality and morbidity. These values are significantly more stringent than previous WHO guidelines. The guidelines do not prescribe legal standards but serve to inform policy. These values are significantly more stringent than the current NAAQS limits, which remain the legal requirements for South Africa. For annual average concentrations, the WHO recommends limits of 5 µg/m³ for $PM_{2.5}$, 15 µg/m³ for PM_{10}, and 10 µg/m³ for NO_2. No annual guideline is proposed for SO_2 due to insufficient evidence of long-term effects at low concentrations. For 24-hour averages, the recommended limits are 15 µg/m³ for $PM_{2.5}$, 45 µg/m³ for PM_{10}, 25 µg/m³ for NO_2, and 40 µg/m³ for SO_2. Using these AQGs as guidelines, all HQ parameters, except for PM_{10}, remain below 1. With respect to PM_{10}, the baseline (i.e. “no project” level ambient concentrations from all sources of air pollution) HQ = 1.49, which implies that the baseline HQ already exceeds the WHO 2021 AQGs. The additional HQ contribution of Scenario 2 is HQ = 0.18.	
Duration:		
What is the anticipated length of time the changes will last (days, years, decades)?	The plant is currently under care and maintenance for operations associated with Scenario 1.	Changes will last for the duration of the operations of the plant and for the length of time as stipulated in the plant’s Atmospheric Emission License (AEL)
How rapidly will the predicted changes occur (during a specific project phase such as planning, construction, operations, decommissioning)?	Not assessed	During operations phase at the Mortimer Plant.
Frequency:		
How often will the change be observable—intermittent (what is the interval), continuous?	Not assessed	Continuous
Geographical:		
Can geographical limits of health impacts be local, regional, or national?	Local. Exposed population 25,980 people	Local. Exposed population 25,980 people

4 OVERALL CONCLUSION

The overall outcome of this HIA assessment finds the risk for the Anglo American Platinum Ltd Mortimer Smelter Additional Slag Cleaning operations as follows:

- SO_2 associated risk = Very Low (Severity = Medium and Probability = Very Low)
- PM_{10} associated risk = Low (Severity = Medium and Probability = Low)

These risk ratings were informed by:

- The predicted ambient concentrations of the pollutants as provided by the AIR (WSP, 2025) and the annual concentrations observed at the Air Quality Monitoring Stations which are under the respective NAAQS limits for each pollutant.
- Severity assessment for both SO_2 and PM_{10}:
  - The AP-HRA informed assessment indicated by risks of all-cause mortality (Table *3-2*) is assessed as Medium
- Probability assessment for SO_2:
  - The Hazard Quotients that are less than 0.3 for SO_2 based on NAAQS and is assessed as Very Low.
- Probability assessment for PM_{10}:
  - The Hazard Quotients that are less than 0.7 for PM_{10} based on NAAQS and is assessed as Low.
  - It is to be noted that the Low probability rating for PM_{10} results predominantly from the already high baseline PM_{10} levels.

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