Tshipi Borwa Manganese Mine Environmental Management Plan Amendment: Air Quality Specialist Opinion as part of the Environmental Management Program

Project done on behalf of **SLR Consulting (Africa)(Pty) Ltd**

Project Compiled by
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Notice	Airshed Planning Professionals (Pty) Ltd is a consulting company located in Midrand, South Africa, specialising in all aspects of air quality, ranging from nearby neighbourhood concerns to regional air pollution impacts as well as noise impact assessments. The company originated in 1990 as Environmental Management Services, which amalgamated with its sister company, Matrix Environmental Consultants, in 2003.
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Revision Record

Revision Number	Date	Reason for Revision
Draft Rev 0	February 2017	Draft for client review
Final Rev 1	June 2017	Final
Final Rev 2	July 2017	Incorporate changes

Abbreviations

AEL	Atmospheric Emissions License
Airshed	Airshed Planning Professionals (Pty) Ltd
Australian EPA	Australian Environmental Protection Agency
AQA	Air Quality Act
DPM	Diesel Particulate Matter
EIA	Environmental Impact Assessment
EMP	Environmental Management Program
EMPR	Environmental Management Program Report
GHG	Greenhouse Gas
mamsl	mean sea level
MES	Minimum Emission Standards
m	metre
m^2	Metre squared
m/s	Metre per second
$mg/m^2.day$	Milligram per metre squared per day
NAAQS	National Ambient Air Quality Standards
NAEIS	National Atmospheric Emissions Inventory System
NAERR	National Atmospheric Emission Reporting Regulations
NDCR	National Dust Control Regulations
NPI	National Pollutant Inventory (Australia)
PM_{10}	Particulate Matter with an aerodynamic diameter of less than 10μ
$PM_{2.5}$	Particulate Matter with an aerodynamic diameter of less than 2.5μ
PPP	Pollution Prevention Plans
SAAQIS	South African Air Quality Information System
SANS	South African National Standards
tpa	tonnes per annum
tpd	tonnes per day
TSP	Total Suspended Particles
US-EPA	United States Environmental Protection Agency
VKT	Vehicle kilometres travelled
WB	The World Bank
WHO	World Health Organisation
°C	Degrees Celsius
$\mu g/m^3$	Microgram per cubic metre

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1 INTRODUCTION

Tshipi Borwa Manganese Mine, located near Hotazel in the Northern Cape, commenced with mine infrastructure in 2013. The diesel farm and a widened gravel road commenced without authorisation in terms of the National Environmental Management Act (NEMA). The mine is in the process of amending its approved Environmental Impact Assessment (EIA) and Environmental Management Program Report (EMPR) to include changes in the approved infrastructure.

Airshed Planning Professionals (Pty) Ltd was appointed by SLR Consulting (Africa) (Pty) Ltd to qualitatively assess the potential for air quality related impacts on the surrounding environment and human health from the unauthorised activities and the proposed changes in the mine infrastructure. This will be used to inform the Environmental Management Program (EMP).

1.1 Terms of Reference

The following tasks were conducted:

1. Review the Air Quality report conducted in 2009 for Ntsimbintle Mine considering the following:
    - Changed air quality legislation since 2009 and the implications of this on the new infrastructure layout; and
    - The significance the changed infrastructure and unauthorized activities may have on the original modelled air quality impacts.
2. The identification of new potential sensitive receptors within the vicinity of the mine; and
3. Provide a short report.

1.2 Brief process description

Tshipi Manganese Mine includes opencast mining, a processing plant, a power generation plant, as well as various support infrastructure and services. Underground mining and a sinter plant are also being considered.

1.2.1 Proposed changes to Approved Mine Infrastructure

The proposed changes in the mine infrastructure are listed in Table 1 indicating activities likely to give rise to air pollutants. The approved mine layout plan is provided in Figure 1 with the proposed mine layout plan shown in Figure 2.

Table 1: Proposed infrastructure changes with associated air pollution activities and expected pollutants

Proposed changes to Infrastructure	Additional Activities	Potential air pollutants
An increase in the number, position, volume and layout of waste rock dumps	Windblown dust Off-loading of waste rock Truck activity on waste rock dump	Particulates (TSP, PM_{10}, $PM_{2.5}$) Gaseous emissions (minor)
Change to the design, capacity and position of the sewage treatment plant	Waste water treatment emitting odorous emissions	Primarily Hydrogen Sulphide (H_2S), Ammonia (NH_3) and VOCs.
Change to the stormwater management system, position including additional storage	Construction of dam: • Land clearing; • Dozing and scraping • Loading and off-loading of topsoil • Windblown dust from topsoil piles	Particulates (TSP, PM_{10}, $PM_{2.5}$) Gaseous emissions (minor)
Change to the potable water storage facilities capacity and position	Construction of dam: • Land clearing; • Dozing and scraping • Loading and off-loading of topsoil • Windblown dust from topsoil piles	Particulates (TSP, PM_{10}, $PM_{2.5}$) Gaseous emissions (minor)
Change to the position of the office, plant and workshop	Construction activities • Land clearing; • Dozing and scraping • Loading and off-loading of topsoil • Windblown dust from topsoil piles	Particulates (TSP, PM_{10}, $PM_{2.5}$) Gaseous emissions (minor)
Change to the number and position, volume and layout of the product stockpiles	Windblown dust Off-loading of ore Front-end-loaders scraping material	Particulates (TSP, PM_{10}, $PM_{2.5}$) Gaseous emissions (minor)
Change to the design of the railway line and an increase in length	Windblown dust from railway truck Loading of ore	Particulates (TSP, PM_{10}, $PM_{2.5}$)
The establishment of an additional temporary run-off-mine (ROM) stockpile area	Windblown dust Off-loading and loading of ore Front-end-loaders scraping material	Particulates (TSP, PM_{10}, $PM_{2.5}$) Gaseous emissions (minor)
The establishment of a tyre bays	Limited emissions to air due to truck activity at tyre bays	
The establishment of additional weighbridges	Limited emissions to air due to truck activity at weighbridges	
The establishment of an additional topsoil stockpile area (No. 2)	Windblown dust Off-loading and loading of topsoil Front-end-loaders scraping material	Particulates (TSP, PM_{10}, $PM_{2.5}$) Gaseous emissions (minor)
Proposed additions		
Expand its approved topsoil stockpile (No. 1 and No. 2).	Windblown dust Off-loading of topsoil Front-end-loaders scraping material	Particulates (TSP, PM_{10}, $PM_{2.5}$) Gaseous emissions (minor)
Change in the positon of the 78Ml stormwater dam	Construction of dam: • Land clearing; • Dozing and scraping • Loading and off-loading of topsoil • Windblown dust from topsoil piles	Particulates (TSP, PM_{10}, $PM_{2.5}$) Gaseous emissions (minor)
To mine across the barrier pillar between the Tshipi Borwa Mine and the Mamatwan Mine as part of a joint mining agreement including associated increase in waste rock storage	Drilling and blasting Loading of ore and waste Haul trucks on unpaved roads	Particulates (TSP, PM_{10}, $PM_{2.5}$) Gaseous emissions (minor)

1.3 Site Description

Tshipi Borwa Manganese Mine is situated adjacent to the Mamatwan Mine, approximately 25 km south of Hotazel, 40 km north of Khatu and 50 km west of Kuruman. The site is surrounded by farmland used for grazing. The area surrounding the site is mostly flat.

Operating mines located in relatively close proximity to the mine include AssMang's N'Chwaning and Gloria mines and Samancor's Wessels and Mamatwan mines. The N'Chwaning (shafts 2 and 3), Gloria and Wessels mines are exclusively underground operations, whereas opencast mining is practiced at Mamatwan. Mamatwan is also the only mine in the area that currently has on-site sintering (Krause & Liebenberg-Enslin, 2009).

1.4 Assumptions and Limitations

The study followed a qualitative approach, with no emissions quantified for the proposed changes or additions to the mine infrastructure layout plan.

The following was assumed:

- The mining rate would remain the same; and
- The modelled impacts from the 2009 study were used to qualitatively assess the potential for any increases in ground level concentrations.

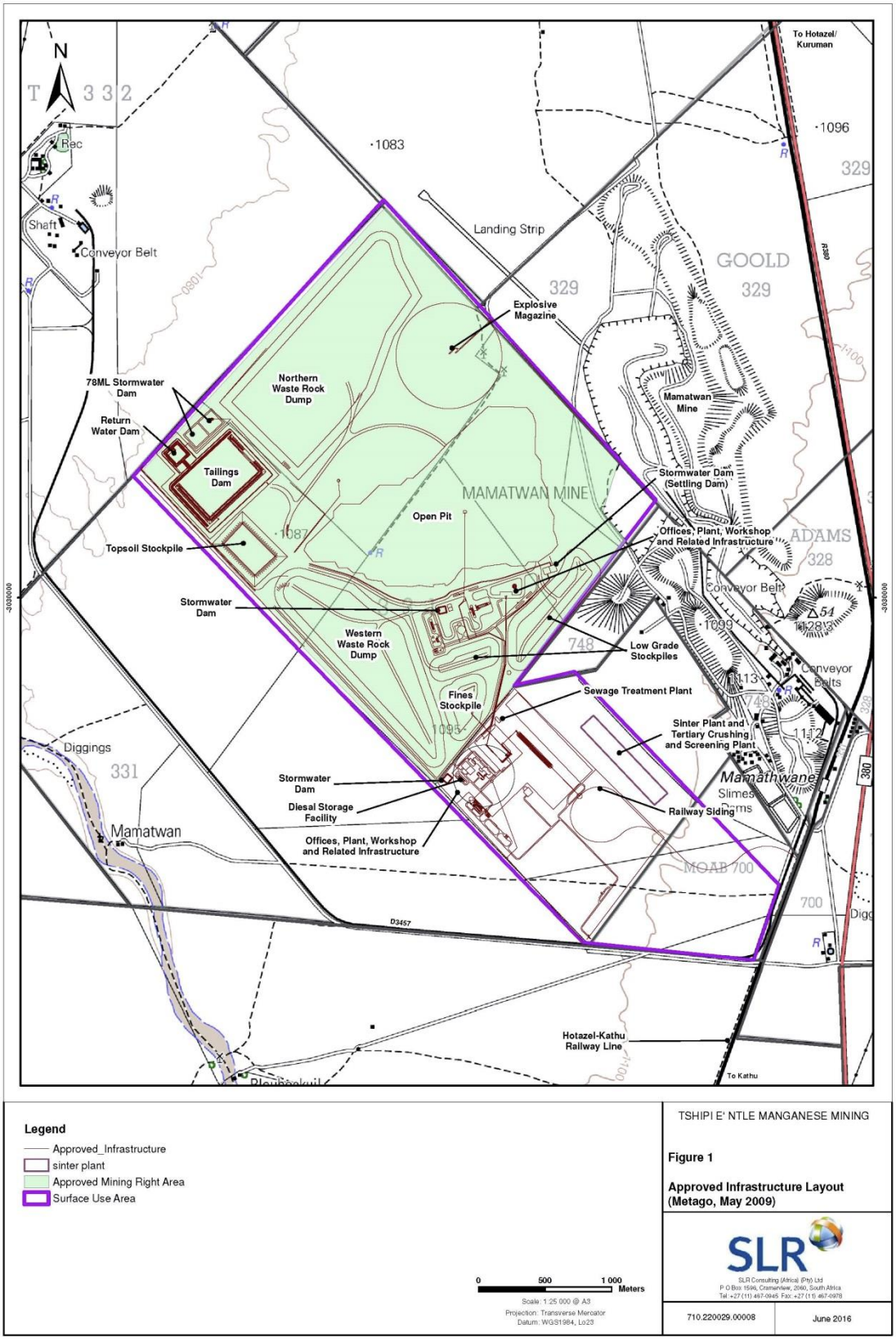

Figure 1: Approved Tshipi Borwa Mine Infrastructure Layout (May 2009)

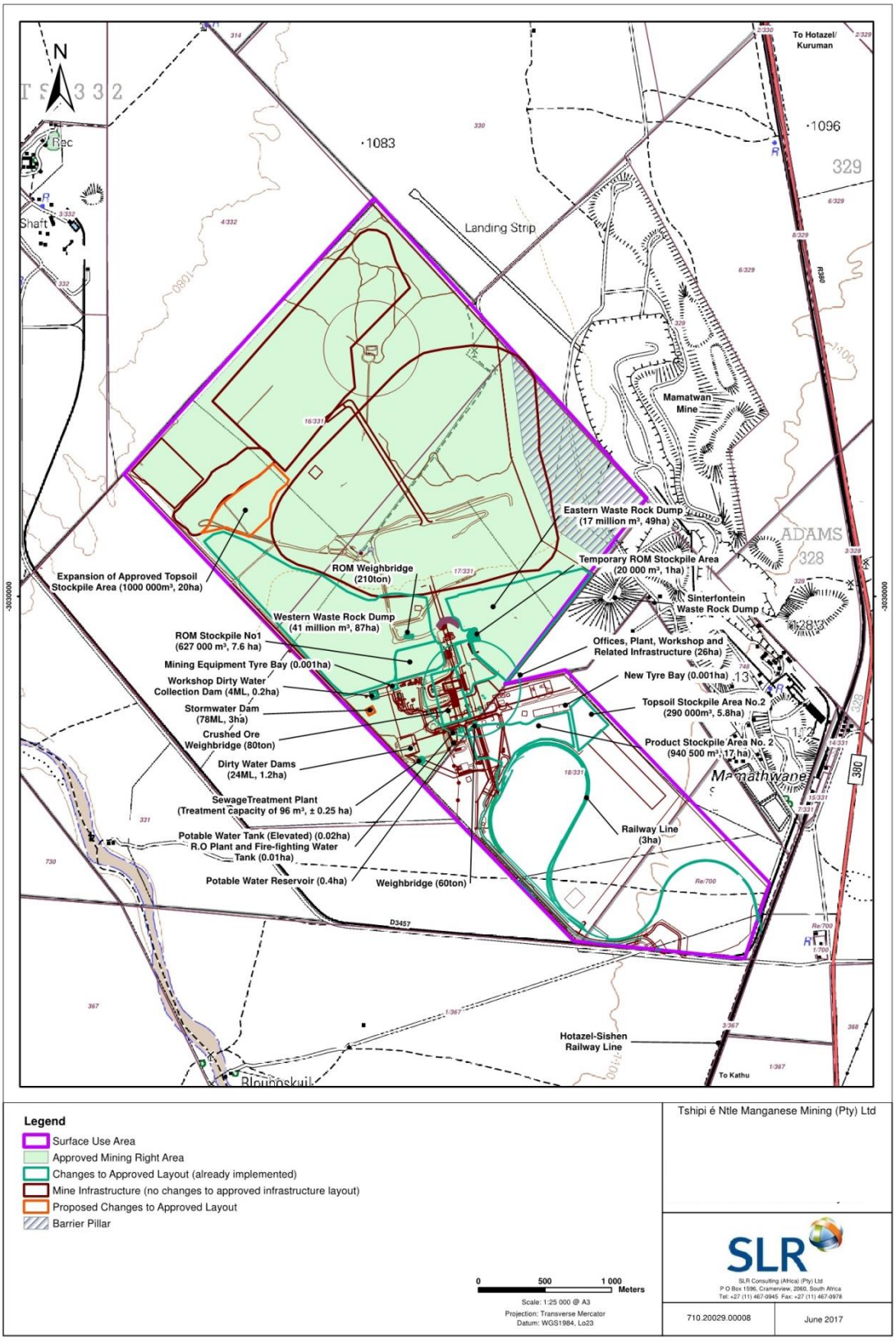

Figure 2: Proposed Tshipi Borwa Mine Infrastructure Layout

2 LEGAL REVIEW

The Air Quality Impact Assessment as part of the EIA conducted for the Ntsimbintle Manganese Mining Operations (Tshipi Borwa Mine) was done in April 2009. Subsequently, there have been additions and changes to the National Environmental Management: Air Quality Act (Act no.39 of 2004). The Act commenced with on 11 September 2005 as published in the Government Gazette on 9 September 2005 with sections omitted from the implementation (Sections 21, 22, 36 to 49, 51(1)(e),51(1)(f), 51(3), 60 and 61). The Act was fully implemented on 1 April 2010, including Section 21 on the Listed Activities and Minimum National Emission Standards (MES) with the revised MES published on 22 November 2013 (Government Gazette 37054, Notice No. 893). Amendments to the Act, primarily pertaining to administrative aspects, were published in 2014 (Government Gazette 37666, Notice No. 390 on 14 May 2014).

Air quality legislation that came into play after April 2009 that is relevant to the project is provided in Table 2.

Table 2: Legislation applicable to the project

Air Quality Legislation	Implementation/ revision dates	Affected Project Activity
National Framework	updated in 2013	Industry legal responsibilities
Section 21 – Listed Activities	Implemented:1 April 2010 Revised: 22 November 2013	Sinter Plant
National Ambient Air Quality Standards (NAAQS)	24 December 2009 29 July 2012	PM_{10} and $PM_{2.5}$ ground level concentrations as a result from the mining activities
National Dust Control Regulations (NDCR)	1 November 2013	Dust fallout rates as a result from the mining activities
Declare Greenhouse Gas (GHG) as priority pollutants	8 January 2016	N.A. [(a)]
National Pollution Prevention Plans (PPP) regulations	8 January 2016	N.A.[(a)]
Regulation on Administrative Fines	18 March 2016	Sinter Plant requires an AEL
National Atmospheric Emission Reporting Regulations (NAERR)	2 April 2015	Emissions reporting on mining operations Emissions reporting on Listed Activity (Sinter Plant)

Notes: (a) only apply to direct emission of GHG in excess of 0.1 Megatonnes (Mt) annually measured as carbon dioxide equivalents (CO_2-eq)

2.1 National Framework

The National Framework (first published in Government Gazette Notice No. 30284 of 11 September 2007) was updated in 2013) and provides national norms and standards for air quality management to ensure compliance. The National Framework states that aside from the various spheres of government responsibility towards good air quality, industry too has a responsibility not to impinge on everyone's right to air that is not harmful to health and well-being. Industries therefore should take reasonable measures to prevent such pollution order degradation from occurring, continuing or recurring.

In terms of AQA, certain industries have further responsibilities, including:

- Compliance with any relevant national standards for emissions from point, non-point or mobile sources in respect of substances or mixtures of substances identified by the Minister, MEC or municipality.
- Compliance with the measurements requirements of identified emissions from point, non-point or mobile sources and the form in which such measurements must be reported and the organs of state to whom such measurements must be reported.

- Compliance with relevant emission standards in respect of controlled emitters if an activity undertaken by the industry and/or an appliance used by the industry is identified as a controlled emitter.
- Compliance with any usage, manufacture or sale and/or emissions standards or prohibitions in respect of controlled fuels if such fuels are manufactured, sold or used by the industry.
- Comply with the Minister's requirement for the implementation of a pollution prevention plan in respect of a substance declared as a priority air pollutant.
- Comply with an Air Quality Officer's legal request to submit an atmospheric impact report in a prescribed form.
- Taking reasonable steps to prevent the emission of any offensive odour caused by any activity on their premises.
- Furthermore, industries identified as Listed Activities have further responsibilities, including:
    - Making application for an AEL and complying with its provisions.
    - Compliance with any minimum emission standards in respect of a substance or mixture of substances identified as resulting from a listed activity.
    - Designate an Emission Control Officer **if** required to do so.
    - Section 51 of the Air Quality Act lists possible offences according to the requirements of the Act with Section 52 providing for penalties in the case of offences.

2.2 Listed activities

At the time of the EIA, Minimum Emission Standards (MES) were still in the process of being developed and the study evaluated emissions against the then proposed MES for the ferromanganese industry. Sinter Plants fall under Category 4: Metallurgical Industry and requires an Atmospheric Emission License (AEL) to operate. There are two sets of MES applicable to:

- *New Plants* (plant or process where the application in terms of NEMA was made on or after 1 April 2010); and
- *Existing Plants* (plant or process that was legally authorised to operate before 1 April 2010 or where an application in terms of NEMA was made before 1 April 2010).

Table 3: Applicable Listed Activity for Sinter Plant Operations

Category 4 - Metallurgical Industry; Subcategory 4.5 – Sinter Plants				
Description:	Sinter plants for the agglomeration of fine ore using heating process, including sinter cooling where applicable			
Application:	All installations			
Substance or Mixture of Substances			**Plant Status**	**mg/Nm³ under normal conditions of 6% 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

2.3 National Ambient Air Quality Standards

The South African Bureau of Standards (SABS) assisted the Department of Environmental Affairs (DEA) in the development of ambient air quality standards. National Ambient Air Quality Standards (NAAQS) were determined based on international best practice for $PM_{2.5}$ PM_{10}, SO_2, NO_2, ozone (O_3), CO, lead (Pb) and benzene. The NAAQS were published in the Government Gazette (no. 32816) on 24 December 2009, thus after the EIA was competed. NAAQS for $PM_{2.5}$ was published on 29 July 2012. The NAAQS for are listed in Table 4.

Table 4: South African national ambient air quality standards (Government Gazette 32816, 2009)

Pollutant	Averaging Period	Limit Value (µg/m³)	Limit Value (ppb)	Frequency of Exceedance	Compliance Date
Benzene	1 year	10	-	0	Immediate – 31 Dec 2014
	1 year	5[(b)]	-	0	1 Jan 2015
CO	1 hour	30 000	26 000	88	Immediate
	8 hour[(c)]	10 000	8 700	11	Immediate
NO_2	1 hour	200	106	88	Immediate
	1 year	40	21	0	Immediate
PM_{10}	24 hour	120	-	4	Immediate – 31 Dec 2014
	24 hour	75[(b)]	-	4	1 Jan 2015
	1 year	50	-	0	Immediate – 31 Dec 2014
	1 year	40[(b)]	-	0	1 Jan 2015
$PM_{2.5}$	24 hour	65		4	Immediate – 31 Dec 2015
	24 hour	40[(b)]	-	4	1 Jan 2016 – 31 Dec 2029
	24 hour	25	-	4	1 Jan 2030
	1 year	25	-	0	Immediate – 31 Dec 2015
	1 year	20[(b)]	-	0	1 Jan 2016 – 31 Dec 2029
	1 year	15	-	0	1 Jan 2030
SO_2	10 minutes	500	191	526	Immediate
	1 hour	350	134	88	Immediate
	24 hour	125	48	4	Immediate
	1 year	50	19	0	Immediate

Notes:

[1]The number of averaging periods where exceedance of limit is acceptable.

[2]Date after which concentration limits become enforceable.

2.4 National Regulations for Dust Deposition

South Africa's Draft National Dust Control Regulations were published on the 27 May 2011 with the dust fallout standards passed and subsequently published on the 1st of November 2013 (Government Gazette No. 36974). These are called the National Dust Control Regulations (NDCR). The purpose of the regulations is to prescribe general measures for the control of dust in all areas including residential and light commercial areas. SA NDCRs that were published on the 1st of November 2013. Acceptable dustfall rates according to the regulation are summarised in Table 5.

Table 5: Acceptable dustfall rates

Restriction areas	Dustfall rate (D) in mg/m²-day over a 30 day average	Permitted frequency of exceedance
Residential areas	D < 600	Two within a year, not sequential months.
Non-residential areas	600 < D < 1 200	Two within a year, not sequential months.

The regulation also specifies that the method to be used for measuring dustfall and the guideline for locating sampling points shall be ASTM D1739 (1970), or equivalent method approved by any internationally recognized body. It is important to note that dustfall is assessed for nuisance impact and not inhalation health impact.

2.5 National Atmospheric Emission Reporting Regulations (NAERR)

The National Atmospheric Emission Reporting Regulations (NAERR) was published on the 2nd of April 2015 by the Minister of Environmental Affairs. The regulation aims to standardize the reporting of data and information from an identified point, non-point and mobile sources of atmospheric emissions to an internet-based National Atmospheric Emissions Inventory System (NAEIS), towards the compilation of atmospheric emission inventories (DEA , 2015).

Annexure 1 of the NAERR classify **mines** (holders of a mining right or permit in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)) as a data provider under **Group C**. **Listed Activity** as published in terms of Section 21(1) of the AQA falls under **Group A**.

Sections of the regulation that applies to data providers are summarized below.

With regards to registration, the regulation stipulates that:

(a) A person classified as a data provider must register on the NAEIS within 30 days from the date upon which these Regulations came into effect;
(b) A person classified as a data provider and who commences with an activity or activities classified as emission source in terms of the regulation 4(1) after the commencement of these Regulations, must register on the NAEIS within 30 days after commencing with such an activity or activities.

With regards to reporting and record keeping, the regulation stipulates that:

(a) A data provider must submit the required information for the preceding calendar year, as specified in Annexure 1 to these Regulations, to the NAEIS by 31 March of each calendar year.
(b) A data provider must keep a record of the information submitted to the NAEIS for five years and such record must, on request, be made available for inspection by the relevant authority.

With regards to verification of information, the regulation requires data providers to verify requested information within 60 days after receiving the written request from the relevant authority.

2.6 Greenhouse Gas Emissions

Regulations pertaining to Greenhouse Gas (GHG) reporting using the NAEIS was published in January 2016 (Government Gazette 39578, Volume 607 of 8 January 2016).

The South African mandatory reporting guidelines focus on the reporting of Scope 1 emissions only. The three broad scopes for estimating GHG are:

- Scope 1: All direct GHG emissions.
- Scope 2: Indirect GHG emissions from consumption of purchased electricity, heat or steam.
- Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities not covered in Scope 2, outsourced activities, waste disposal, etc.

The NAEIS web-based monitoring and reporting system will also be used to collect GHG information in a standard format for comparison and analyses. The system forms part of the National Atmospheric Emission Inventory component of the South African Air Quality Information System (SAAQIS).

The DEA is working together with local sectors to develop country specific emissions factors in certain areas; however, in the interim the Intergovernmental Panel on Climate Change's (IPCC) default emission figures may be used to populate the SAAQIS GHG emission factor database. These country specific emission factors will replace some of the default IPCC emission factors. It has been indicated that these factors will only be published towards the end of 2015 (Jongikhaya, 2015). For this assessment, IPCC emission factors have been used.

Also, a carbon tax bill will be introduced for a further round of public consultation. The Carbon Tax Policy Paper (Department of National Treasury, 2013) stated consideration will be given to sectors where the potential for emissions reduction is limited.

3 QUALITATIVE AIR QUALITY ASSESSMENT

3.1 2009 Air Quality Impact Assessment

The air quality impact assessment conducted for the then proposed Ntsimbintle Mine assessed the potential health and nuisance impacts from PM_{10}, manganese, SO_2, NOx, Diesel Particulate Matter (DPM) and CO due to the mining operations per the approved infrastructure layout (Figure 1).

Two scenarios were assessed, namely:

- **Scenario 1**: Included opencast and underground mining, processing and the beneficiation of manganese ore as well as the power generation; and
- **Scenario 2**: Included underground mining, the rehabilitation of the open cast mining area, processing and the beneficiation of manganese ore as well as the power generation plant.

Since Scenario 1 was found to be the worst case scenario from an air quality perspective, the comparison to the expected changes in air quality impacts from the proposed 2017 mine infrastructure changes is based on the 2009 Scenario 1.

The main findings from the April 2009 air quality impact assessment for Scenario 1 can be summarised as follows:

- **PM_{10} ground level concentrations**: The modelled annual average and highest daily average incremental and cumulative unmitigated PM_{10} concentrations at the Ntsimbintle boundary were well above the NAAQSs. The annual NAAQS of 40 µg/m³ was exceeded at the Ntsimbintle boundary and the old Middelplaats mine. The daily NAAQS of 75 µg/m³ was exceeded at the Ntsimbintle boundary and a number of identified sensitive receptors (A. Pyper, the old Middelplaats mine and N. Fourie). Mitigation of fugitive dust sources resulted in an average reduction of 87% in predicted PM_{10} concentrations, with only exceedances of the annual and daily PM_{10} NAAQS at the mine boundary and not at any of the sensitive receptors.

  Vehicle entrained dust from unpaved roads were predicted to result in the most significant unmitigated and mitigated PM_{10} concentrations contributing, on average, 88% and 67% respectively.

- **Manganese ground level concentrations**: The modelled annual average incremental unmitigated Mn concentration at the Ntsimbintle boundary was 20.1 µg/m³ and cumulative concentration at 20.7 µg/m³ with the annual WHO guideline at 0.15 µg/m³. Exceedances were also predicted at A. Pyper, the old railway housing, the old Middelplaats mine and N. Fourie. With mitigation in place the impact reduced on average by 69%.

  Manganese dust as a result of crushing and screening operations contributed most significantly, 61%, to the predicted unmitigated Mn concentrations. With mitigation measures in place, emissions from the sinter plant contributed most significantly to predicted manganese concentrations.

- **SO_2 ground level concentrations**: The modelled annual, highest daily and highest hourly average incremental and cumulative SO_2 concentrations at the Ntsimbintle boundary were below the NAAQSs for annual and daily averages but exceeded the hourly limit at the Ntsimbintle boundary but not at any of the sensitive receptors.

  Sinter plant emissions were estimated to be the most significant contributor, contributing on average 89%, to predicted incremental SO_2 concentrations.

- **NO_2 ground level concentrations**: The modelled annual and highest hourly average incremental and cumulative NO_2 concentrations at the Ntsimbintle boundary was below the NAAQS for annual averages but marginally exceeded the hourly limit at the Ntsimbintle boundary but not at any of the sensitive receptors.

  Sinter plant emissions were estimated to be the most significant contributor, contributing on average 39%, to predicted

incremental NO_2 concentrations.

- **DPM ground level concentrations**: The modelled annual average incremental DPM concentration at the Ntsimbintle boundary was above the SANS annual limit of 5 µg/m³, but not at the sensitive receptors.
- **CO ground level concentrations**: Modelled highest hourly average incremental CO concentration at the Ntsimbintle boundary and at any of the discreet receptors was well below the NAAQS.
- **Dustfall impacts**: The modelled maximum daily incremental unmitigated dustfall level at the Ntsimbintle boundary was above the NDCR residential dustfall limit, but within the non-residential limit. With mitigation in place the impacts reduced.

3.2 Qualitative Air Quality Impact Assessment for the proposed changes to the mine infrastructure

3.2.1 Proposed changes to Approved Mine Infrastructure

The proposed changes in the mine infrastructure are listed in Table 1. The approved mine layout plan is provided in Figure 1 with the proposed mine layout plan shown in Figure 2.

The most significance changes likely to have an impact on the ambient air quality are (as listed in Table 1) i) the number, position, volume and layout of waste rock dumps; ii) changes to the number and position of the product stockpiles; iii) establishment of an additional temporary run-off-mine (ROM) stockpile area; iv) establishment of an additional topsoil stockpile area (No.2); and v) proposed expansion of the topsoil stockpile (No. 1 and No. 2). These sources are likely to result in more truck activity on additional unpaved roads (specifically off-loading of waste rock), more sources that are prone to windblown dust and additional materials transfer points (loading and off-loading of waste rock, topsoil, ore and tipping of fines). Most of these sources are located some distance from the mine boundary, more towards the central part of the mining operations (Figure 2). Even so, there is still a potential for increases in PM_{10} ground level concentrations and dust fallout rates specifically to the north-west of the mine mainly due to the increase of fugitive dust sources.

The sewerage plant would mainly result in odorous emissions and these are likely to have localised impacts (within the mine boundary). It is unlikely that the changes proposed in Table 1 would have a significant impact on air quality.

Similarly, the changes to the stormwater management system, position including additional storage, potable water storage facilities capacity and position and the change in position of the 78ML stormwater dam (Table 1) would not have an impact on air quality during the operational phase. Only during construction of the storm water dams would there be the potential for increased PM_{10} concentrations and dust fallout rates most likely to the western side of the mine boundary.

The change to the position of the office, plant and workshop is unlikely to result in noticeable changes in air pollutants during both the construction phase and the operational phase.

Change to the design of the railway siding and an increase in length (Table 1) might result in an increased in PM_{10} concentrations and dustfall rates due to the location of the siding closer to the western boundary of the mine. The longer rail line would only impact should the train trucks be loaded and not covered – potential windblown dust sources.

It is unlikely that the establishment of tyre bays and additional weighbridges would have any significant air quality impacts unless the tyres burn at the tyre bays.

The proposed mining of the barrier pillar between the Tshipi Borwa Mine and the Mamatwan Mine as part of a joint mining agreement including associated increase in waste rock storage (Table 1) might result in higher PM_{10} concentrations and dustfall rates due to additional loading and unloading of ore and waste, additional haul roads and additional drilling and blasting. The significance of these increases dust impacts might be slight due to the location of the barrier pillars between the two mining areas and far from either mine's boundary.

4 CONCLUSION

4.1 Main Findings

The main findings from the qualitative assessment of the proposed changes to the Tshipi Borwa Manganese mine infrastructure are as follow:

- The draft NAAQSs and MES used in the 2009 air quality study, conducted before these limits and standards were finalised, are the same as the NAAQSs (published December 2009, and July 2012) and the MES (published April 2010, and revised November 2013). The Sinter Plant would require an AEL to operate, but the increased fuel storage farm falls below the Listed Activity requirement and would therefore not required an AEL.
- The mine would have to report annually, before 31 March, on NAEIS on both the Sinter Plant and the mining operations emissions.
- The following changes to the mine infrastructure are likely to result in increased PM_{10} ground level concentrations and dust fallout rates specifically to the north-west of the mine mainly due to the increase of fugitive dust sources:
  - increase in the number, position, volume and layout of waste rock dumps;
  - changes to the number and position of the product stockpiles;
  - establishment of an additional temporary run-off-mine (ROM) stockpile area;
  - establishment of an additional topsoil stockpile area (No. 2);
  - proposed expansion of the topsoil stockpile (No. 1 and No. 2);
  - change to the design of the railway line and an increase in length (less significant source); and
  - proposed mining of the barrier pillar between the Tshipi Borwa Mine and the Mamatwan Mine as part of a joint mining agreement including associated increase in waste rock storage.
- The following changes to the mine infrastructure are unlikely to result in any changes to the ambient air quality (only potential impacts during construction):
  - changes to stormwater management system, position including additional storage and change in the position of the 78ML stormwater dam;
  - changes to the potable water storage facilities capacity and position (only potential impacts during construction);
  - the position of the office, plant and workshop;
  - the establishment of a tyre bay; and
  - the establishment of additional weighbridges.
- No additional sensitive receptors could be identified.

4.2 Conclusion

There is a potential for increased PM_{10} ground level concentrations and dust fallout rates specifically to the west and north-west of the mine mainly due to the increase of fugitive dust sources. No increases in SO_2, NO_2, Mn and CO are foreseen. DPM concentrations might increase due to the increased truck activity but it is unlikely to exceed the guideline.

4.3 Recommendations

- A comprehensive dust management plan is required for the mine with specific mitigation measures, the frequency of application and the responsible divisions and persons indicated. This should follow on the dust management measures recommended in Section 7 of the 2009 air quality report (Krause & Liebenberg-Enslin, 2009).
- It is further recommended that the proposed dust fallout and PM_{10} monitoring network proposed in Section 7.3 of the 2009 air quality report (Krause & Liebenberg-Enslin, 2009) be implemented before any changes or additions to the mine infrastructure are allowed.

5 ISSUES RAISED BY INTERESTED AND AFFECTED PARTIES (IAPS)

As part of the environmental amendment process to cater for infrastructure layout changes, a public consultation process was undertaken and managed by SLR. In this regard, the table below summarises the issues and concerns raised by IAPs including a response.

Table 6: Comments raised by IAPs

IAP	Date of comment	Issue raised	Response
Andrew Pyper	*30 July 2013 at the general public meeting*	*What specialist work was undertaken for the air emissions licence?*	Tshipi currently does not have an air emissions licence. It is however important to note that when the Sinter plant is established, Tshipi will need to apply for an air emissions licence. As part of applying for this licence an air quality assessment will need to be undertaken in support of the air emissions licence application.
		I would like to propose that a micro-climatic investigation be undertaken with regards to the effect that opencast mining has on the micro-climate. The opencast mining results in a heat island whereby the incoming solar is reflected differently to if it were to fall onto flat ground. This therefore affects the circulation of air and affects the climate on a localised scale. Backfilling would help to lessen this by reducing the void into which the sun's heat pours and it would allow for the heat energy to be reflected in a more normal manner.	The air quality specialist study undertaken as part of the approved EMPr (Metago, May 2009) qualitatively commented on the micro-climate. In this regard, as the variables affecting climate are regional or even global in scale (atmospheric circulation patterns, the atmospheric radiation balance etc.) it is unlikely that mining on a local or sub regional scale will have noticeable climatological effects. In order to undertake an investigation to determine potential changes in the micro-climate of the area surrounding the mine specific meteorological baseline characterisation could be done. This would require long term historical as well as on-site meteorological data neither of which is available at present. As part of the monitoring programme for the Tshipi Borwa Mine Tshipi is required to establish a meteorological station.
Andrew Pyper	*30 July 2013 at the general public meeting*	*Vegetation is susceptible to both diesel fumes as well as diesel spills. Some sort of investigation should be undertaken in which the issue is studied from a grazing perspective and the impact that this will have on livestock. Tshipi should take remedial measures to avoid or lessen the impact that such spills and emissions have on surrounding flora.*	With regards to diesel fumes, as part of the approved EMPr (Metago, May 2009), an independent specialist was appointed to undertake an air quality assessment. The main emissions of concern that were identified for the mine include inhalable particulate matter less than 10 microns in size (PM_{10}), larger total suspended particulates (TSP) that relate to dust fallout, Mn concentrations, SO_2, NO_2 and gaseous emissions mainly from vehicles and generators. With reference to Appendix F, vehicle and generator emissions are unlikely to exceed the guidelines. Management actions focus on the implementation of emission control measures and monitoring.
Machiel Andries Kruger	*05 July 2013 as part of a social scan*	*There is so much dust. The plants are covered in dust and in some instances, these plants almost appear white from all the dust sitting on the leaves and branches.*	The air quality specialist study undertaken as part of the approved EMPr (Metago, May 2009) qualitatively commented on the impacts of dust towards vegetation. In this regard unlike sulphur dioxide and oxides of nitrogen, limited information is available on the effects of dust on vegetation. While there is little direct evidence of what the impact of dust fall on vegetation is in a South African context, a review of European studies has shown the potential for reduced growth and photosynthetic activity in sunflower and cotton plants exposed to dust fall rates greater than 400 mg/m²/day. Based on current monitoring data, dust fallout results along the western boundary of the mine remain below 400 mg/m²/day. Dust fallout results along the northern and southern boundary have been known to exceed 400 mg/m²/day. Dust fallout results exceed the 400 mg/m²/day along the eastern boundary of the mine, as that is near the Mamatwan operation and the central section of the mine also exceeds 400 mg/m²/day as this is in the midst of the Tshipi operations.

IAP	Date of comment	Issue raised	Response
			Dust fallout may have an influence on vegetation in the unmitigated scenario, with the implementation of management actions Tshipi should be able to manage the generation of dust at the mine.

6 BIBLIOGRAPHY

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Department of National Treasury. (2013). *Carbon Tax Policy Paper.*

Jongikhaya, W. (2015, August 6). Technical Guidelines for Monitoring, Reporting and Verification of Greenhouse Gas Emissions by Industry.

Krause, N., & Liebenberg-Enslin, H. (2009). *Air Quality Impact Assessment for the Proposed Ntsimbintle Manganese Mining.* Metago Engineering Services (Pty) Ltd.

FULL CURRICULUM VITAE

Name of Firm	Airshed Planning Professionals (Pty) Ltd
Name of Staff	Hanlie Liebenberg-Enslin
Profession	Managing Director / Air Quality Scientist
Date of Birth	09 January 1971
Years with Firm/ entity	18 years
Nationalities	South African

MEMBERSHIP OF PROFESSIONAL SOCIETIES

- International Union of Air Pollution Prevention and Environmental Protection Associations (IUAPPA) – President 2010–2013, Board member 2013-present
- Member of the National Association for Clean Air (NACA) - President 2008-2010, NACA Council member 2010 –2014

KEY QUALIFICATIONS

Hanlie Liebenberg-Enslin started her professional career in Air Quality Management in 2000 when she joined Environmental Management Services (EMS) after completing her Master's Degree at the University of Johannesburg (then Rand Afrikaans University) in the same field. She is one of the founding members of Airshed Planning Professionals in 2003 where she has worked as a company Director until May 2013 when she was appointed as Managing Director. She has extensive experience on the various components of air quality management including emissions quantification for a range of source types, simulations using a range of dispersion models, impacts assessment and health risk screening assessments. She has worked all over Africa and has an inclusive knowledge base of international legislation and requirements pertaining to air quality.

She has developed technical and specialist skills in various modelling packages including the industrial source complex models (ISCST3 and SCREEN3), EPA Regulatory Models (AERMOD and AERMET), UK Gaussian plume model (ADMS), EPA Regulatory puff based model (CALPUFF and CALMET), puff based HAWK model and line based models such as CALINE. Her experience with emission models includes Tanks 4.0 (for the quantification of tank emissions) and GasSim (for the quantification of landfill emissions).

Having worked on projects throughout Africa (i.e. South Africa, Mozambique, Botswana, Namibia, Malawi, Kenya, Mali, Democratic Republic of Congo, Tanzania, Madagascar, Guinea and Mauritania) Hanlie has developed a broad experience base. She has a good understanding of the laws and regulations associated with ambient air quality and emission limits in South Africa and various other African countries, as well as the World Bank Guidelines, European Community Limits and World

Health Organisation.

Being an avid student, she received her PhD in 2014, specialising in Aeolian dust transport. Hanlie is also actively involved in the National Association for Clean Air and is their representative at the International Union of Air Pollution Prevention and Environmental Protection Associations.

RELEVANT EXPERIENCE

Air Quality Management Plans and Strategies

Provincial Air Quality Management Plan for the Limpopo Province (March 2013); Mauritius Road Development Agency Proposed Road Decongestion Programme (July 2013); Transport Air Quality Management Plan for the Gauteng Province (February 2012); Gauteng Green Strategy (2011); Air Quality and Radiation Assessment for the Erongo Region Namibia as part of a Strategic Environmental Assessment (June, 2010); Vaal Triangle Airshed Priority Area AQMP (March, 2009); Gauteng Provincial AQMP (January 2009); North West Province AQMP (2008); City of Tshwane AQMP (April 2006); North West Environment Outlook 2008 (December 2007); Ambient Monitoring Network for the North West Province (February 2007); Spatial Development Framework Review for the City of uMhlathuze (August 2006); Ambient Particulate Pollution Management System (Anglo Platinum Rustenburg):

Hanlie has also been the Project Director on all the listed Air Quality Management plan developments.

Mining and Ore Handling

Hanlie has undertaken numerous air quality impact assessments and management plans for coal, platinum, uranium, copper, cobalt, chromium, fluorspar, bauxite and mineral sands mines. These include air quality impact assessments for: Trekkopje Uranium Mine near Swakopmund; Bannerman Uranium Project; Langer Heinrich Uranium Mine, Valencia Uranium Mine, Etango (Husab) Project, Rössing South Uranium Mine (Namibia); Sishen Iron Ore Mine (Kathu); Kolomela Iron Ore Mine (Postmasburg); Thabazimbi Iron ore Mine (Thabazimbi); UKM Manganese Mine (Hotazel); Everest Platinum Mine (Steelpoort); Murowa Diamond Mine (Zimbabwe); Jwaneng Diamond Mine (Botswana); Sadiola Gold Mine (Mali); North Mara Gold Mine (Tanzania); Tselentis Coal mine (Breyeton); Lime Quarries (De Hoek, Dwaalboom, Slurry); Beesting Colliery (Ogies); Anglo Coal Opencast Coal Mine (Heidelberg); Klippan Colliery (Belfast); Beesting Colliery (Ogies); Xstrata Coal Tweefontein Mine (Witbank); Xstrata Coal Spitskop Mine (Hendrina); Middelburg Colliery (Middelburg); Klipspruit Project (Ogies); Rustenburg Platinum Mine (Rustenburg); Impala Platinum (Rustenburg); Buffelsfontein Gold Mine (Stilfontein); Kroondal Platinum Mine (Kroondal); Lonmin Platinum Mine (Mooinooi); Rhovan Vanadium (Brits); Macauvlei Colliery (Vereeniging); Voorspoed Gold Mine (Kroonstad); Pilanesberg Platinum Mine (Pilanesberg); Kao Diamond Mine (Lesotho); Modder East Gold Mine (Brakpan); Modderfontein Mines (Brakpan); Bulyanhulu North Mara Gold Mine (Tanzania); Gold Mine (Tanzania); Zimbiwa Crusher Plant (Brakpan); RBM Zulti South Titanium mining (Richards Bay); Premier Diamond Mine (Cullinan).

Metal Recovery

Air quality impact assessments have been carried out for Smelterco Operations (Kitwe, Zimbia); Waterval Smelter (Amplats, Rustenburg); Hernic Ferrochroime Smelter (Brits); Rhovan Ferrovanadium (Brits); Impala Platinum (Rustenburg); Impala Platinum (Springs); Transvaal Ferrochrome (now IFM, Mooinooi), Lonmin Platinum (Mooinooi); Xstrata Ferrochrome Project Lion (Steelpoort); ArcelorMittal South Africa (Vandebijlpark, Vereeniging, Pretoria, Newcastle, Saldanha); Hexavalent Chrome Xstrata (Rustenburg); Portland Cement Plant (DeHoek, Slurry, Dwaalboom, Hercules, Port Eelizabeth); Vantech Plant (Steelpoort); Bulyanhulu Gold Smelter (Tanzania), Sadiola Gold Recovery Plant (Mali); RBM Smelter Complex (Richards Bay); Chibuto Heavy Minerals Smelter (Mozambique); Moma Heavy Minerals Smelter (Mozambique); Boguchansky Aluminium Plant (Russia); Xstrata Chrome CMI Plant (Lydenburg); SCAW Metals (Germiston).

Chemical Industry

Comprehensive air quality impact assessments have been completed for AECI (Pty) Ltd Operations (Modderfontein); Kynoch Fertilizer (Potchefstroom), Foskor (Richards Bay) and Omnia (Rustenburg).

Petrochemical Industry

Numerous air quality impact assessments have been completed for SASOL operations (Sasolburg); Sapref Refinery (Durban); Health risk assessment of Island View Tank Farm (Durban Harbour).

Pulp and Paper Industry

Air quality studies have been undertaken or the expansion of Mondi Richards Bay, Multi-Boiler Project for Mondi Merebank (Durban), impact assessments for Sappi Stanger, Sappi Enstra (Springs), Sappi Ngodwana (Nelspruit) and Pulp United (Richards Bay).

Power Generation

Air quality impact assessments have been completed for numerous Eskom coal fired power station studies including the Coal 3 Power Project near Lephalale, Komati Power Station and Lethabo Power Stations. In addition to Eskom's coal fired power stations, projects have been completed for the proposed Mmamabula Energy Project (Botswana); Morupule Power Plant (Botswana) and NamPower Erongo Power Project (Namibia).

Apart from Eskom projects, heavy fuel oil power station assessments have also been completed in Kenya (Rabai Power Station) and Namibia (Arandis Power Plant).

Waste Disposal

Air quality impact assessments, including odour and carcinogenic and non-carcinogenic pollutants were undertaken for the proposed Coega Waste Disposal Facility (Port Elizabeth); Boitshepi Waste Disposal Site (Vanderbijlpak); Umdloti Waste Water Treatment Plant (Durban).

Cement Manufacturing

Impact assessments for ambient air quality have been completed for the PPC Cement Alternative Fuels Project (which included the assessment of the cement manufacturing plants in the North West Province, Gauteng and Western).

Vehicle emissions

Platinum Highway (N1 to Zeerust); Gauteng Development Zone (Johannesburg); Gauteng Department of Roads and Transport (Transport Air Quality Management Plan); Mauritius Road Development Agency (Proposed Road Decongestion Programme); South African Petroleum Industry Association (Impact Urban Air Quality).

Government Strategy Projects

Hanlie was the project Director on the APPA Registration Certificate Review Project for Department of Environmental Affairs (DEA); Green Strategy for Gauteng (2011).

EDUCATION

Ph.D Geography	University of Johannesburg, RSA (2014) Title: *A functional dependence analysis of wind erosion modelling system parameters to determine a practical approach for wind erosion assessments*
M.Sc Geography and Environmental Management	University of Johannesburg, RSA (1999) Title: *Air Pollution Population Exposure Evaluation in the Vaal Triangle using GIS*
B.Sc Hons. Geography	University of Johannesburg, RSA (1995) GIS & Environmental Management
B.Sc Geography and Geology	University of Johannesburg, RSA (1994) Geography and Geology

ADDITIONAL COURSES AND ACADEMIC REVIEWS

External Examiner (January 2016)	MSc Candidate: Ms M Grobler Evaluating the costs and benefits associated with the reduction in SO_2 emissions from Industrial activities on the Highveld of South Africa Department of Chemical Engineering, University of Pretoria
External Examiner (August 2014)	MSc Candidate: Ms Seneca Naidoo Quantification of emissions generated from domestic fuel burning activities from townships in Johannesburg Faculty of Science, University of the Witwatersrand
Air Quality Law– Lecturer (2012 -2016)	Environmental Law course: Centre of Environmental Management.
Air Quality law for Mining – Lecturer (2014)	Environmental Law course: Centre of Environmental Management .
Air Quality Management – Lecturer (2006 -2012)	Air Quality Management Short Course: NACA and University of Johannesburg , University of Pretoria and University of the North West
ESRI SA (1999)	ARCINFO course at GIMS: Introduction to ARCINFO 7 course
ESRI SA (1998)	ARCVIEW course at GIMS: Advanced ARCVIEW 3.1 course

COUNTRIES OF WORK EXPERIENCE

South Africa, Mozambique, Botswana, Namibia, Malawi, Mauritius, Kenya, Mali, Zimbabwe, Democratic Republic of Congo, Tanzania, Zambia, Madagascar, Guinea, Russia , Mauritania and Saudi Arabia.

EMPLOYMENT RECORD

March 2003 - Present

Airshed Planning Professionals (Pty) Ltd, (previously known as Environmental Management Services cc until March 2003), Managing Director and Principal Air Quality Scientist, Midrand, South Africa.

January 2000 – February 2003

Environmental Management Services CC, Senior Air Quality Scientist.

May 1998 – December 1999

Independent Broadcasting Authority (IBA), GIS Analyst and Demographer.

February 1997 – April 1998

GIS Business Solutions (PQ Africa), GIS Analyst

January 1996 – December 1996

Annegarn Environmental Research (AER), Student Researcher

LANGUAGES

	Speak	Read	Write
English	Excellent	Excellent	Excellent
Afrikaans	Excellent	Excellent	Excellent

CONFERENCE AND WORKSHOP PRESENTATIONS AND PAPERS

- Cooperation on Air Pollution in Southern Africa: Issues and Opportunities. SLCPs: Regional Actions on Climate and Air Pollution. Liebenberg-Enslin, H. 17th IUAPPA World Clean Air Congress and 9th CAA Better Air Quality Conference. Clean Air for Cities - Perspectives and Solutions. 29 August - 2 September 2016, Busan Exhibition and Convention Center, Busan, South Korea.
- A Best Practice prescription for quantifying wind-blown dust emissions from Gold Mine Tailings Storage Facilities. Liebenberg-Enslin, H., Annegarn, H.J., and Burger, L.W. VIII International Conference on Aeolian Research, Lanzhou, China. 21-25 July 2014.
- Quantifying and modelling wind-blown dust emissions from gold mine tailings storage facilities. Liebenberg-Enslin, H. and Annegarn, H.J. 9th International Conference on Mine Closure, Sandton Convention Centre, 1-3 October 2014.
- Gauteng Transport Air Quality Management Plan. Liebenberg-Enslin, H., Krause,N., Burger, L.W., Fitton, J. and Modisamongwe, D. National Association for Clean Air Annual Conference, Rustenburg. 31 October to 2 November 2012. Peer reviewed.
- Developing an Air Quality Management Plan: Lessons from Limpopo. Bird, T.; Liebenberg-Enslin, H., von Gruenewaldt, R., Modisamongwe, D. National Association for Clean Air Annual Conference, Rustenburg. 31 October to 2 November 2012. Peer reviewed.
- Modelling of wind eroded dust transport in the Erongo Region, Namibia, H. Liebenberg-Enslin, N Krause and H.J. Annegarn. National Association for Clean Air (NACA) Conference, October 2010. Polokwane.
- The lack of inter-discipline integration into the EIA process-defining environmental specialist synergies. H. Liebenberg-Enslin and LW Burger. IAIA SA Annual Conference, 21-25 August 2010.

Workshop Presentation. Not Peer Reviewed.

- A Critical Evaluation of Air Quality Management in South Africa, H Liebenberg-Enslin. National Association for Clean Air (NACA) IUAPPA Conference, 1-3 October 2008. Nelspuit.
- Vaal Triangle Priority Area Air Quality Management Plan – Baseline Characterisation, R.G. Thomas, H Liebenberg-Enslin, N Walton and M van Nierop. National Association for Clean Air (NACA) conference, October 2007, Vanderbijl Park.
- Air Quality Management plan as a tool to inform spatial development frameworks – City of uMhlathuze, Richards Bay, H Liebenberg-Enslin and T Jordan. National Association for Clean Air (NACA) conference, 29 – 30 September 2005, Cape Town.

CERTIFICATION

I, the undersigned, certify that to the best of my knowledge and belief, these data correctly describe me, my qualifications, and my experience.

25/07/2017

Full name of staff member: Hanlie Liebenberg-Enslin