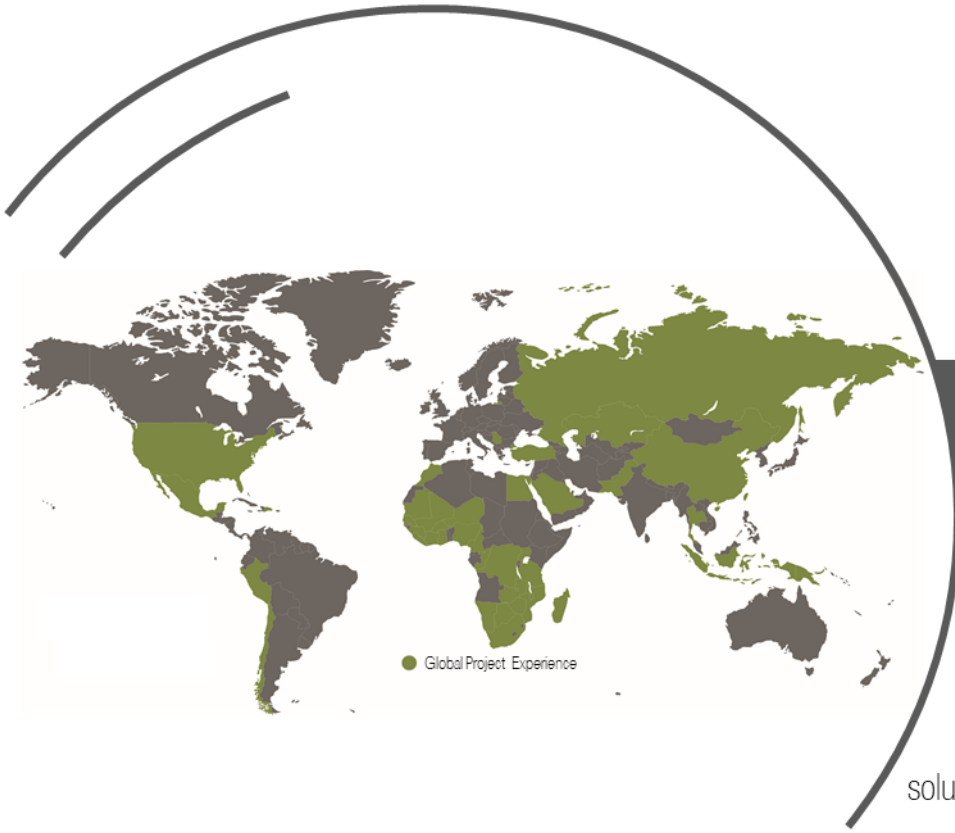

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Environmental Authorisation Process for the Expansion of the Copper Sunset Mining Right Area

Air Quality Specialist Study

Prepared for:
Copper Sunset Sands (Pty) Ltd

Project Number:
COP6679

May 2021

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This document has been prepared by Digby Wells Environmental.

Report Type:	Air Quality Specialist Study
Project Name:	Environmental Authorisation Process for the Expansion of the Copper Sunset Mining Right Area
Project Code:	COP6679

Name	Responsibility	Signature	Date
Matthew Ojelede Pr.Sci.Nat.	Report Compiler		February 2021
Barbara Wessels	Reviewer		February 2021

DETAILS AND DECLARATION OF THE SPECIALIST

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Brief Background of Specialist

Matthew has broad knowledge in the "*Atmospheric Sciences*" field, with more than 15 years of experience in academia and industry combined. He has garnered practical field experiences in setting up, monitoring and decommissioning ambient air quality units and stations, encompassing real-time particulate monitor – AQ-Mesh®, Grimm Aerosol monitor®, Met-One E-Sampler®, radiello® passive/diffusive samplers for environmental monitoring, indoor and outdoor air monitoring, industrial air quality (IAQ), personal sampling and breathing zone assessment.

He is currently registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions (Reg. No. 116980/18) and is a member of the National Association for Clean Air. He has authored and co-authored research articles and conference papers in peer-reviewed journals both locally and internationally.

Full name:	Matthew Ojelede
Title/Position:	Air Quality Specialist
Qualification(s):	BSc (Hon); MSc; PhD
Experience (years):	15 Years
Registration(s):	National Association for Clean Air (NACA) International Association for Impact Assessment South Africa (IAIAsa) South African Council for Natural Scientific Professions (SACNASP)

I, Matthew Ojelede, declare that: –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
    - I declare that there are no circumstances that may compromise my objectivity in performing such work;
    - I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

February 2021

Signature of the Specialist *Date*

Findings, recommendations and conclusions provided in this report are based on the best available scientific methods and the author's professional knowledge and information at the time of compilation. Digby Wells employees involved in the compilation of this report, however, accepts no liability for any actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, and by the use of the information contained in this document.

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Any recommendations, statements or conclusions drawn from or based on this report must clearly cite or make reference to this report. Whenever such recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety.

EXECUTIVE SUMMARY

Copper Sunset (Pty) Ltd (Copper Sunset) has an approved Mining Right (MR) (DMRE Ref. No. FS30/5/1/1/2/164 MR) and Environmental Management Programme (EMPr), in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA), for the mining of sand on the Farm Bankfontein No. 1849. The Mining Right was approved in 2008 and amended in 2011, 2016 and 2017 to incorporate additional areas into the Mining Right Area (MRA). This applicant now intends to expand its MRA to incorporate adjacent properties to extend the Life of Mine (LOM). The intent is to expand the current mining operations to include additional portions of the Remaining Extent (RE) of the Farm Bankfontein No. 9 and a portion of the RE of the Farm Zandfontein No. 259, situated in the Free State Province. The proposed extension of the MRA amounts to approximately 1642 ha (Bankfontein) and 1153.6 ha (Zandfontein), for the mining of sand. The extension of the existing MRA triggers activities incorporated in Listing Notice 1 and Listing Notice 2 of the Environmental Impact Assessment (EIA) Regulations, 2014 (GN R982 of 04 December 2014 as amended), promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The Listed Activities require a Scoping and Environmental Impact Reporting (S&EIR) process to be carried out as part of the Environmental Authorisation (EA) process.

Digby Wells Environmental (Digby Wells) was contracted by Copper Sunset to submit an application with respect to the aforementioned.

This Air Quality Impact Assessment (AQIA) forms part of a suite of specialist studies required in support of the EA and was undertaken to establish the air quality impacts associated with the future sand mining operation in the extension areas.

Findings from the AQIA show that the meteorology of the MRA assessed using three years' worth of model data from Lakes Software is dominated by winds from the north northeast (9.7%), north (9.6%), east (9.2%), and north northwest (8.6%), respectively. The average wind speed at the Project site is 2.8 m/s and calm conditions (<0.5 m/s) occurred for some 6.3% of the time. Wind speed capable of causing wind erosion i.e. ≥5.4 m/s occurred for about 5.5% of the time, which equates to about 20 days in a year.

Dustfall rates in the vicinity collected using the American Standard Test Method (ASTM) D1739, a total of 108 data sets from four sites (with 10 missing records), covering approximately two years (i.e. 27 months), have confirmed that exceedance of the non-residential limit occurred three times over the period. Despite the aforementioned, these sites were compliant, as exceedance in sequential months was not observed. These sites were compliant with the permissible frequency of exceedance (which is two within a year). Exceedance recorded in sequential months would have meant each of the sites was not compliant with the requirements of the regulation - GN R 827 of 1 November 2013. For most of the dustfall rates measured, levels were below the non-residential limit (1200 mg/m^2/d) for the 92nd percentile of the records.

Dispersion model predictions have shown that the areas where exceedances are likely to occur will be confined largely to within the MRA, with the likelihood of being compliant with the South African daily and annual limit values at the MR boundary.

A summary of the predicted Ground Level Concentrations (GLC) is given below:

- Areas where the predicted daily GLC of $PM_{2.5}$ will exceed the standard (40 µg/m³) will be confined within the MRA. The predicted GLCs at the selected monitoring locations were below the standard. The predicted annual GLC of $PM_{2.5}$ will not exceed 20 µg/m³ (annual standard) onsite and at the selected sensitive receptors;
- The areas where the 24-hour standard of 75 µg/m³ are likely to be exceeded will be confined within the MRA. Predicted GLCs at the selected sensitive receptors were lower than the daily standard. The predicted annual GLC at these receptors will be lower than the South African standard; and
- The predicted dustfall rates onsite and at selected sensitive receptors (with simulations for no mitigation and with mitigation) have been assessed. The simulated dustfall rates confirmed that the areas where the residential limit (600 mg/m^2/d) and the non-residential limit (1,200 mg/m^2/d) values will be exceeded are likely to be confined within the MRA. The dustfall rates predicted at selected sensitive receptors were lower than both limit values. Also, with mitigation measures in place, the footprint where exceedances are likely to shrunk further within the MRA.

The impacts of the proposed sand mining planned for the extension areas were evaluated using a risk matrix that considers the nature, significance, extent, duration, and probability of impacts occurring (Appendix A). Based on this rating system, impacts on the surroundings with mining occurring are deemed “negligible negative” without mitigation.

To curtail emissions from mining operations from impacting receptors outside the MRA, mitigation, and management interventions are crucial. Some of the suggested mitigation measures and management interventions recommended are repeated, and they include:

- Application of dust suppressants or binders on haul roads and exposed areas, setting maximum speed limits on haul roads and to have these limits enforced; and
- Mining judiciously, by opening up areas schedule for excavation in phases.

If mine management implements the recommended mitigation measures outlined in this report, emissions are likely to be curtailed to below standards within the MRA, ensuring compliance with regulatory requirements at nearby receptors.

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LIST OF ACRONYMS, ABBREVIATIONS AND DEFINITION

AERMOD	American Meteorological Society/United States Environmental Protection Agency Regulatory Model
AQIA	Air Quality Impact Assessment
CRR	Comments and Response Report
DEA	Department of Environmental Affairs
DMRE	Department of Mineral Resources and Energy
EA	Environmental Authorisation
EMPr	Environmental Management Plan Report
GLC	Ground Level Concentrations
LOM	Life of Mine
MM5	Mesoscale model - Fifth generation
MR	Mining Right
MRA	Mining Right Area
NDCR	National Dust Control Regulations (GN R827 of 2013)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEMAQA	National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004)
PM_{10}	Particulate Matter less than 10 microns in diameter
$PM_{2.5}$	Particulate Matter with Aerodynamic Diameter less than 2.5 Micron
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)
RE	Remaining Extent
TSP	Total Suspended Particulates
USEPA	The United States Environmental Protection Agency
WBG	World Bank Group
WHO	World Health Organisation

Legal Requirement		Section in Report
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of-	Iii, iv
	(i) the specialist who prepared the report; and	Iii, iv
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Iii, iv
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Iii, iv
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
cA	And indication of the quality and age of the base data used for the specialist report;	Section 6
cB	A description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6.2
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 6.2
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of the equipment and modelling used;	Section 6
(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure inclusive of a site plan identifying site alternatives;	Section 3
(g)	an identification of any areas to be avoided, including buffers;	N/A
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 7
(k)	any mitigation measures for inclusion in the EMPr;	Section 9
(l)	any conditions/aspects for inclusion in the environmental authorisation;	Section 9
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 10
(n)	a reasoned opinion (Environmental Impact Statement) -	Section 14

Legal Requirement		Section in Report
	whether the proposed activity, activities or portions thereof should be authorised; and	Section 14
	if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 14
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 12
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
(q)	any other information requested by the competent authority.	N/A

1. Introduction

Copper Sunset (Pty) Ltd (Copper Sunset) has an approved Mining Right (MR) with the Department of Mineral and Energy (DMRE) (Ref. No. FS30/5/1/1/2/164 MR) and Environmental Management Programme (EMPr), in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA), for the mining of sand on the Farm Bankfontein No. 1849. The MR was approved in 2008 and amended in 2011, 2016 and 2017 to incorporate additional areas into the Mining Right Area (MRA).

The existing operations are situated on the Farm Bankfontein No. 1849, the Remaining Extent (RE) of the Farm Zandfontein No. 259, a portion of the RE of the Farm Bankfontein No. 9, and a portion of the RE of the Farm Rietfontein No. 152, situated in the Free State Province.

The applicant now intends to expand its MRA to incorporate adjacent properties to extend the Life of Mine (LOM). The intent is to expand the current mining operations to include additional portions of the Remaining Extent (RE) of the Farm Bankfontein No. 9 and a portion of the RE of the Farm Zandfontein No. 259. The proposed extension of the MRA amounts to approximately 1642 ha (Bankfontein) and 1153.6 ha (Zandfontein), for the mining of sand.

The extension of the existing MRA triggers activities incorporated in Listing Notice 1 and Listing Notice 2 of the Environmental Impact Assessment (EIA) Regulations, 2014 (GN R982 of 04 December 2014 as amended), promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The Listed Activities require a Scoping and Environmental Impact Reporting (S&EIR) process to be carried out as part of the authorisation process.

Digby Wells Environmental (Digby Wells) has been appointed by Copper Sunset as the independent Environmental Assessment Practitioner (EAP) to conduct the required environmental authorisation process to expand their existing and approved MR for the mining of sand over the proposed areas.

This project, therefore, serves as the Air Quality Impact Assessment (AQIA) which forms part of a suite of specialist studies required. The AQIA study is undertaken in support of this authorisation.

2. Project Locality

The Copper Sunset Project Area is located within Viljoensdrif, a coal-mining village. The area is under the jurisdiction of the Metsimaholo Local Municipality, located in the Fezile Dabi District Municipality, Free State Province. The Project area is near the Vaal River and Lethabo Power Station, New Vaal Colliery, Afrimat, Vaal Racecourse and residential. The site is located approximately 8 kilometres (km) south of Vereeniging, 10 km south-east from Vanderbijlpark and 13 km north-east from Sasolburg. Table 2-1 provides the location of the mine in relation to the nearest towns.

Table 2-1: Summary of the Copper Sunset Project Location Details

Province	Free State
District Municipality	Fezile Dabi District Municipality
Local Municipality	Metsimaholo Local Municipality
Nearest Town	Vereeniging (8 km), Vanderbijlpark (10 km), Sasolburg (13 km).
Property Name and Number	Farm Bankfontein No. 1849, the Remaining Extent (RE) of the Farm Zandfontein No. 259, a portion of the RE of the Farm Bankfontein No. 9 and a portion of the RE of the Farm Rietfontein No. 152.

Figure 2-1 provides the Local Setting map for the Project area. Also, it shows the existing MRA and the proposed Mining Right Extension Area.

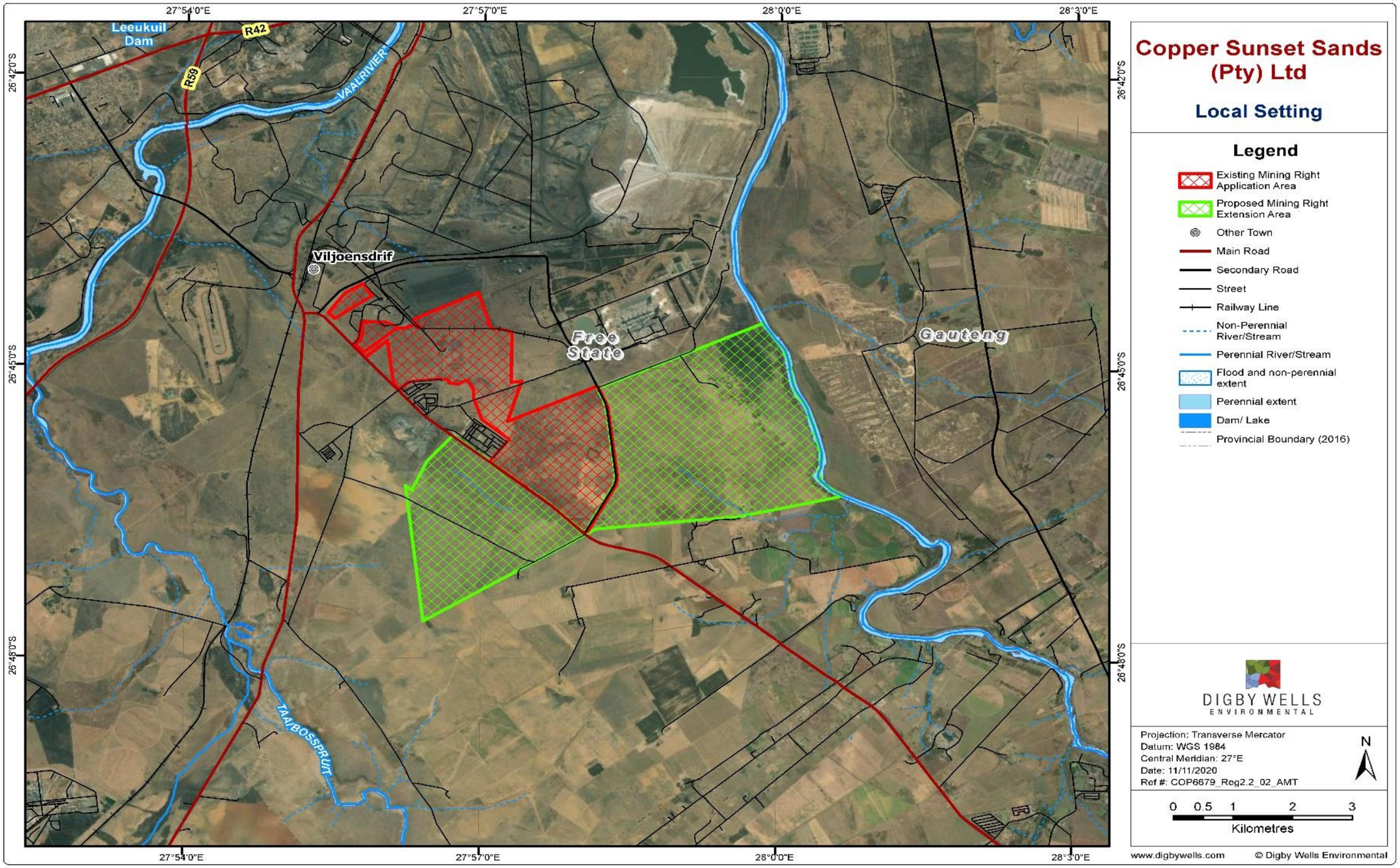


Figure 2-1: Local Setting

3. Description of the Activities to be Undertaken

Copper Sunset began sand mining in 2009. There are currently about nine months left of the Life of Mine (LOM). Therefore, Copper Sunset wishes to expand the MRA to include additional portions of the RE of the Farm Bankfontein No. 9 and a portion of the RE of the Farm Zandfontein No. 259. .The intention of the Application is to maximise the mineral resource and to further extend the LoM.The mining infrastructure already established will be used for the expanded areas.However, mobile offices will be established at the entrances to the new mining areas. A total of two new mobile office areas, each approximately 1 ha, will be established at each mining area when mining commences. The mobile office areas will include the following:

- Mobile offices;
- Hydrocarbon storage tank (14,000 L) with associated bund. Equipment will be refueled in the area;
- Waste storage area;
- Parking area for the storage of mobile infrastructure; and
- A generator and solar panels to provide electricity to the offices.

The sand deposit lies between 0.4 – 5 m below the surface. Strip mining will be utilised to recover the resource, with the sand mined in strips of 30 – 35 m in width and 0.4 - 5 m in depth. The length of the strips is dependent on the area to be mined but approximate lengths are in the region of 180 – 600 m. The type of sand present in the mining area includes building sand and plaster sand.

The mining method to be applied includes:

- Stripping and stockpiling of topsoil;
- Construction of a temporary haul road (20 m wide and length approximately 10 km);
- Mining of the sand resource including screening;
- Backfilling of the mined excavations with stockpiled topsoil; and
- Concurrent rehabilitation.

Figure 3-1 indicates the area where the offices will be placed as well as the mining sequence.

3.1. Resource Deposit

Copper Sunset is applying for an extension to their Mining Right Area (MRA) to include adjacent farms to continue mining general sand (90% plaster and 10% building sand) and clay. Copper Sunset intends to supply several clients with building and plaster sand for use mainly in the construction industry. The deposit extends over an area of 2795.7 ha. The deposit is known to have an average thickness of 5 m. The current mining rate for Copper

Sunset is approximately 2 000 m^3 per day. This is expected to continue, and at this rate the proposed extension area will extend the LOM for Copper Sunset by approximately 20 years.

3.2. Establishment Phase

During the establishment phase of the proposed project, the following activities will be undertaken:

- Site Clearance: Vegetation and topsoil will be removed with a bulldozer and stockpiled along the mined-out strip; and
- Construction of a haul road (20 m width) to gain access to the sand mining area.

No permanent infrastructure will be constructed on site for the sand mining operation. All machineries will be mobile and brought in by Copper Sunset. This will include:

- Placement of mobile office;
- Establishment of parking area;
- Establishment mobile screening plant; and

Placement of portable toilets, a hydrocarbon storage tank and water bowser.Figure 3-1 provides an indication of the proposed office locations and the mining area.

3.3. Operational Phase

The operation will make use of a fleet of tipper trucks, front-end loaders, excavators, water trucks, tractor and bulldozers. Mining will commence with the removal of vegetation by means of a bulldozer. The topsoil will be removed by a bulldozer to a depth of approximately 0.3 – 0.4 m and stockpiled in a separate area for use during rehabilitation. The commencement of mining in the extension areas will initially be on the sand deposit on the eastern portion of the RE of Bankfontein No. 9 RE (Eastern Block), thereafter on the western portion of the RE of Bankfontein No. 9 RE (Western Block) and lastly on a portion of the RE of Zandfontein No. 259.

During the operational phase of the proposed project, the following activities will be undertaken:

- Strip mining will take place in sequences of 30 – 50 m wide to extract the sand by means of light weight excavators;
- A screening process will be utilised where required should sand become contaminated with unusable particles;
- The customer trucks (100-200 trucks per day) will enter via the haul road into the mining area. The haul road will be constructed as a loop to allow continuous flow of traffic. The mined-out sand / screened sand will be placed directly onto the customers trucks;

- The refuelling of equipment will take place at the mobile office areas within the expanded mining area;
- Water will be abstracted from an authorised borehole, located at the existing Copper Sunset MRA. This borehole is authorised by the Department of Water and Sanitation (DWS) under Water Use Licence (WUL) No. 08/C22F/AG/2315 granted 18 September 2013. It is anticipated that water will only be required for potable water and dust suppression on the expansion area. The amount of water used will remain within the limits of the existing license; and
- No mining will take place within a 100 m buffer from the edge of the Vaal River.

3.4. Rehabilitation Phase

Sand mining will cease once the resource has been extracted. Concurrent rehabilitation will be implemented during the sand mining process. The areas which have been mined of sand will be backfilled with the waste material from the screening plant which will be covered with topsoil stockpiled during the operational phase. The area will be leveled and then contoured to avoid ponding of water. The overall site topography is anticipated to be slightly lower as a result of the removal of sand. The area will then be allowed to naturally re-vegetate. Where vegetation is not being well established, an indigenous seed mix will be utilised to improve vegetation establishment.

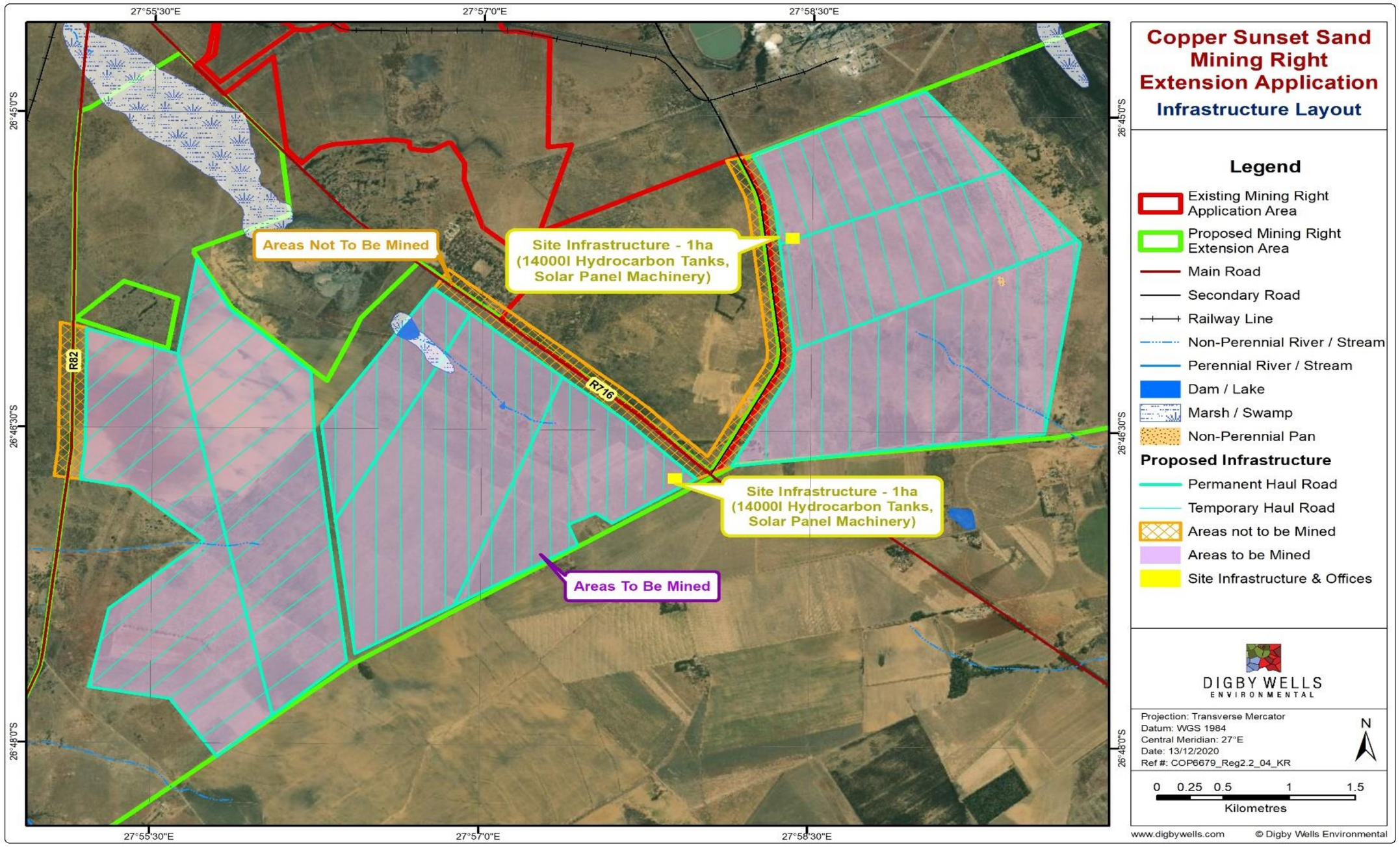


Figure 3-1: Proposed Mine Layout

4. Relevant Legislation, Standards, and Guidelines

The legislation, regulation, and guidelines considered in this air quality report are tabulated and discussed briefly in Table 4-1. The applicable standards in terms of compliance are discussed in Section 4.1 below.

Table 4-1: Applicable Legislation, Regulations, Guidelines, and By-Laws

Legislation, Regulation, Guideline, or By-Law	Applicability
National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) as Amended The NEMA is the statutory framework to enforce Section 24 of the Constitution of the Republic of South Africa …(Section 24: ***the right to a healthy environment and the right to have the environment protected).*** The NEMA is intended to promote co-operative governance and ensure that the rights of people are upheld, but also recognising the necessity of economic development.	Principles from NEMA are relevant to air pollution, Section 24(4) b(i) … "the investigation and assessment of the potential impacts of activities that require authorisation or permission.", and Section 24(7).
National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) The prevailing legislation in the Republic of South Africa with regards to the Air Quality field is the National Environment Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEM: AQA). According to the Act, the DEA, the provincial environmental departments and local authorities (district and local municipalities) are separately and jointly responsible for the implementation and enforcement of various aspects of NEM: AQA. A fundamental aspect of the new approach to air quality regulation, as reflected in the NEM: AQA is the establishment of National Ambient Air Quality Standards (NAAQS). These standards provide the goals for air quality management plans and also provide the benchmark by which the effectiveness of these management plans is measured. The NEM: AQA provides for the identification of priority pollutants and the setting of ambient standards with respect to these pollutants.	NEM:AQA puts in place various measures for the prevention of pollution and national norms and standards for the regulation of air quality in South Africa.

Legislation, Regulation, Guideline, or By-Law	Applicability
NEM:AQA National Dust Control Regulation 2013 (GN No. 827 of 2013) The Minister of Water and Environmental Affairs, released on 01 November 2013 the National Dust Control Regulation, in terms of Section 53, read with Section 32 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004)(NEM:AQA). In the published National Dust Control Regulations, terms like target, action, and alert thresholds were omitted. Another notable observation was the reduction of the permissible frequency of exceedance from three to two incidences within a year. The standard adopted a more stringent approach than previously and would require dedicated mitigation plans now that it is in force.	The purpose of these Regulations is to prescribe general measures for the control of dust in all areas.

4.1. Applicable South African Standard

According to the World Health Organization (WHO, 2000), guidelines provide a basis for protecting public health from adverse effects of air pollution and for eliminating or reducing minimum ambient levels of pollutants that are known or likely to be hazardous to human health and wellbeing. Once the guidelines are adopted as standards, they become legally enforceable. These standards prescribe the allowable ambient concentrations of pollutants which are not to be exceeded during a specified period in a defined area. If the air quality guidelines/standards are exceeded, the ambient air quality is poor and the potential for health effects is greatest.

The NEMA as amended provides a legislative framework for environmental management in South Africa. Principles from NEMA are relevant to air pollution, Section 24(4) b(i) … "*the investigation and* assessment of the potential impacts of activities that require authorisation or permission.", and Section 24(7) *(a) Investigation of the environment likely to be significantly affected by the proposed activity …; (b) investigation of the potential impact. including cumulative effects,…; (c) investigation of mitigation measures to keep adverse impacts to a minimum* .

NEM:AQA is the prevailing legislation in the Republic of South Africa with regards to Air Quality. NEM:AQA forms one of the many pieces of legislation that falls under the ambit of the NEMA. NEM:AQA puts in place various measures for the prevention of pollution and national norms and standards for the regulation of air quality in South Africa. It also authorizes the Minister of Environmental Affairs to enforce its provisions through the issuance of policy documents and regulations. As in section 24G of NEMA, section 22A of NEM:AQA has a provision for administrative fines for contraventions. In line with NEM:AQA, the Department of Environmental Affairs (DEA) published the National Ambient Air Quality Standards for particulate matter with an aerodynamic diameter less than 10 microns (PM_{10}) and for gases ((GN R 1210 of 24 December 2009). This was followed by the publication of the standard for

particulate matter with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$), (GN R486 of 29 June 2012). These standards are depicted in Table 4-2 and Table 4-3.

Table 4-2: National Ambient Air Quality Standards for Particulate Matter (PM_{10}) (2009)

Averaging Period	Limit Value (µg/m³)	Limit Value (ppb)	Frequency of Exceedance	Compliance Date
National Ambient Air Quality Standard for Nitrogen Dioxide (NO_2)				
1 hour	200	106	88	Immediate
1 year	40	21	0	Immediate
The reference method for the analysis of NO2 shall be ISO 7996.				
National Ambient Air Quality Standard for Particulate Matter (PM_{10})				
24 hours	75		4	1 January 2015
1 year	40		0	1 January 2015
The reference method for the determination of the PM_{10} fraction of suspended particulate matter shall be EN 12341.				
National Ambient Air Quality Standard for Carbon Monoxide (CO) mg/m³				
1 hour	30	26 (ppm)	88	Immediate
8 hours (calculated on 1 hourly averages)	10	8.7 (ppm)	11	Immediate
The reference method for the analysis of CO shall be ISO 4224.				

Table 4-3: National Ambient Air Quality Standards for Particulate Matter ($PM_{2.5}$) (2012)

National Ambient Air Quality Standards for Particulate Matter (PM2.5)			
Averaging Period	**Limit Value (µg/m³)**	**Frequency of Exceedance**	**Compliance Date**
24 hours	40	0	1 January 2016 – 31 December 2029
24 hours	25	0	01 January 2030
1 year	20	0	1 January 2016 – 31 December 2029
1 year	15	0	01 January 2030
The reference method for the determination of $PM_{2.5}$ fraction of suspended particulate matter shall be EN 14907.			

The DEA further released the National Dust Control Regulations (NDCR), the acceptable dustfall (particulate matter with an aerodynamic diameter less than 45 µm (considered as Total Suspended Particulate (TSP) as described by the World Bank Group [WBG] (WBG, 1998))

limits for residential and non-residential areas (GN R 827 of 1 November 2013). The dust fallout standard is given in Table 4-4 below.

Table 4-4: Dust Fall Standards (NDCR, 2013)

Restriction Areas	Dustfall rate (mg/m^2/day, 30-days average)	Permitted Frequency of exceeding dust fall rate
Residential Area	< 600	Two within a year, not sequential months
Non-Residential Area	< 1200	Two within a year, not sequential months

5. Assumptions, Limitations, and Exclusions

Assumptions, limitations, and exclusions pertaining to this Project are discussed in Table 5-1.

Table 5-1:Assumptions, Limitations, and Exclusions

Assumption, Limitation, or Exclusion	Consequence
Excavation will take place at a maximum depth of 5m	Positive impact due to pit retention
Baseline was assessed with dustfall records only. No PM_{10} or $PM_{2.5}$ records were available for assessment	No implication on the project
The uncertainty associated with dispersion models	Since mining activities were selected to demonstrate the worst-case scenario, the predicted concentrations may have resulted in an overestimation

6. Basline and Impact Assessment Methodology

The methodology adopted in this AQIA study encompasses two components, an environmental baseline assessment, and an environmental impact assessment. The baseline component characterises, mainly, the ambient air quality of the current Project area and extended extent. The second component involves the use of a computational air dispersion model to predict future emissions from “the Project” and the degree of impact on the receiving environment.

6.1. Climate

The climate of the Project area was assessed using site-specific MM5 modeled meteorological data set for three calendar years (2017 – 2019) obtained from the Lakes Environmental Software. The Pennsylvania State University / National Centre for Atmospheric Research (PSU/NCAR) mesoscale model (known as MM5) is a limited-area, non-hydrostatic, terrain-following sigma-coordinate model, which was designed to simulate or predict mesoscale atmospheric circulation. This data has been tested extensively and is extremely accurate.

Modeled meteorological data was obtained for a point in the proposed Project area near Vereeniging (26.765883 S, 27.968611 E). Data availability was 100%.

Wind roses comprise 16 spokes which represent the directions from which winds blew during the period. The colours reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence. The figure given at the bottom of the legend described the frequency with which calm conditions (wind speed below 0.5 m/s) occur.

Modeled meteorological data from Lakes Environmental (hereafter Lakes) encompassing parameters such as temperature, relative humidity, wind speed, and direction for the Project area are discussed (Table 6-1).

6.1.1. Temperature

The monthly temperatures for the Project site (three-year average) are presented in Table 6-1 and Figure 6-2. The data indicate that the monthly temperature average varied between 10°C - 22°C. Ambient temperatures were observed to be higher during the summer months.

6.1.2. Rainfall

The total monthly rainfall records (three-year average) are provided in Figure 6-1. Based on the rainfall data, the summer months (December – February) received most of the rainfall (i.e. >62%) with December and February being the peak rainfall months (Figure 6-1), followed by Spring with 22% and Autumn with 15%. While Winter (June – August), received the least rainfall.

6.1.3. Relative Humidity

The relative humidity per month (three-year average) ranged between 41% and 58% (Table 6-1 and Figure 6-2). Ravi *et al*., (2006)[1], investigated the effect of near-surface air humidity on soil erodibility. Results show that the *threshold friction velocity* required for fine particulate matter to be airborne decreases with increasing values of relative humidity between about 40% and 65%, while above and below this range the threshold friction velocity increases with air humidity i.e. In air-dry soils (RH < 65%), the soils are too dry for the liquid-bridge bond to exist. However, with humidity conditions (RH > 65%) water condenses into liquid and forms bridges between the soil grains, and then the liquid-bridge bonding dominates, increasing the *threshold friction velocity*. The relative humidity will favour wind erosion based on the above-mentioned.

[1] Ravi S; Zobeck TM; Over TM; Okin GS; D'Odorico P (2006) On the effect of moisture bonding forces in air-dry soils on threshold frictional velocity of wind erosion. *Sedimentology, 53, 597-609*

Table 6-1: Climate Statistics

Parameters	3-year average												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Temp. (◦C)	21	22	22	20	17	14	11	10	13	16	18	21	17
Total Mon. Rain (mm)	121	140	79	28	1	0	0	6	28	65	83	234	785
Rel. Hum. (%)	50	53	55	55	56	58	57	52	46	44	42	41	51

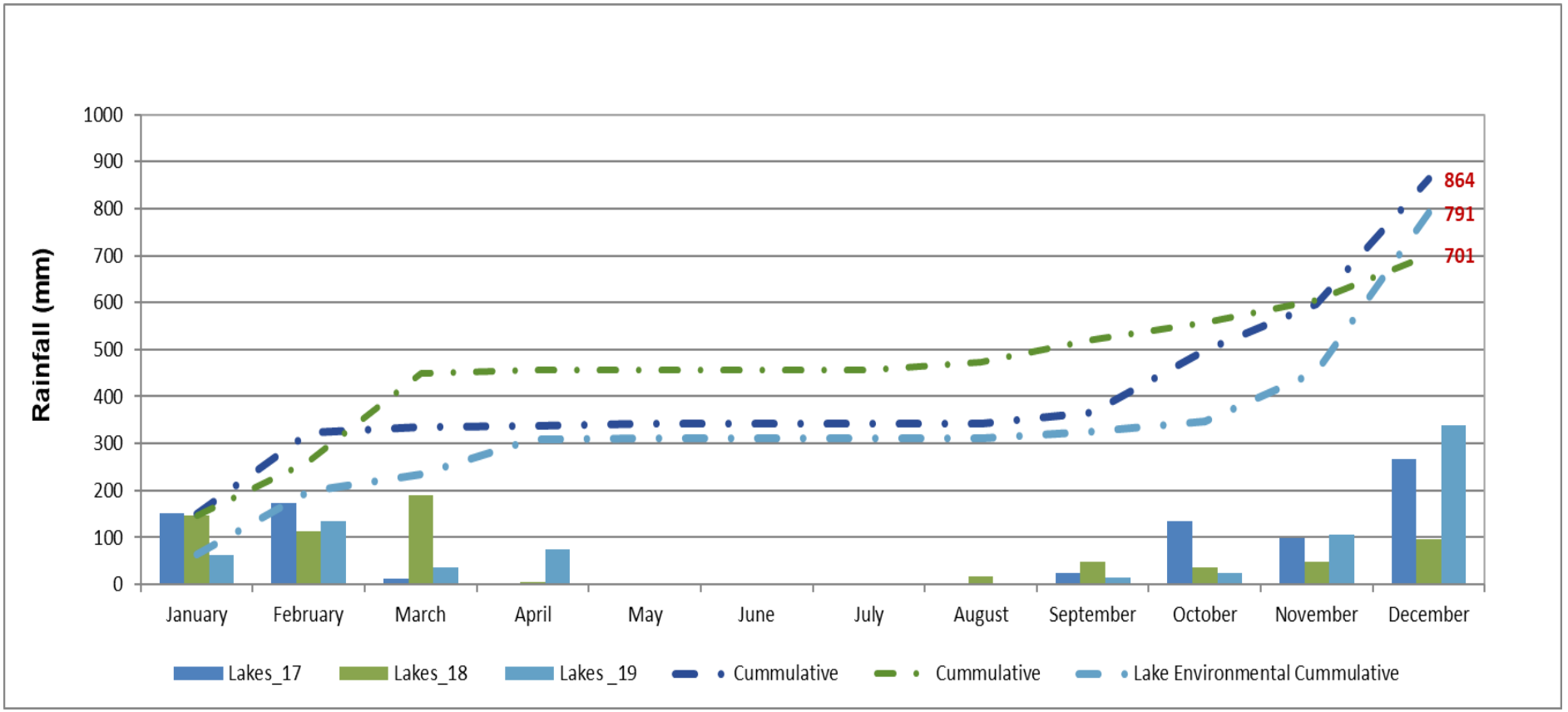


Figure 6-1: Rainfall (three-Year Average)

(Source: Lakes Environmental Data)

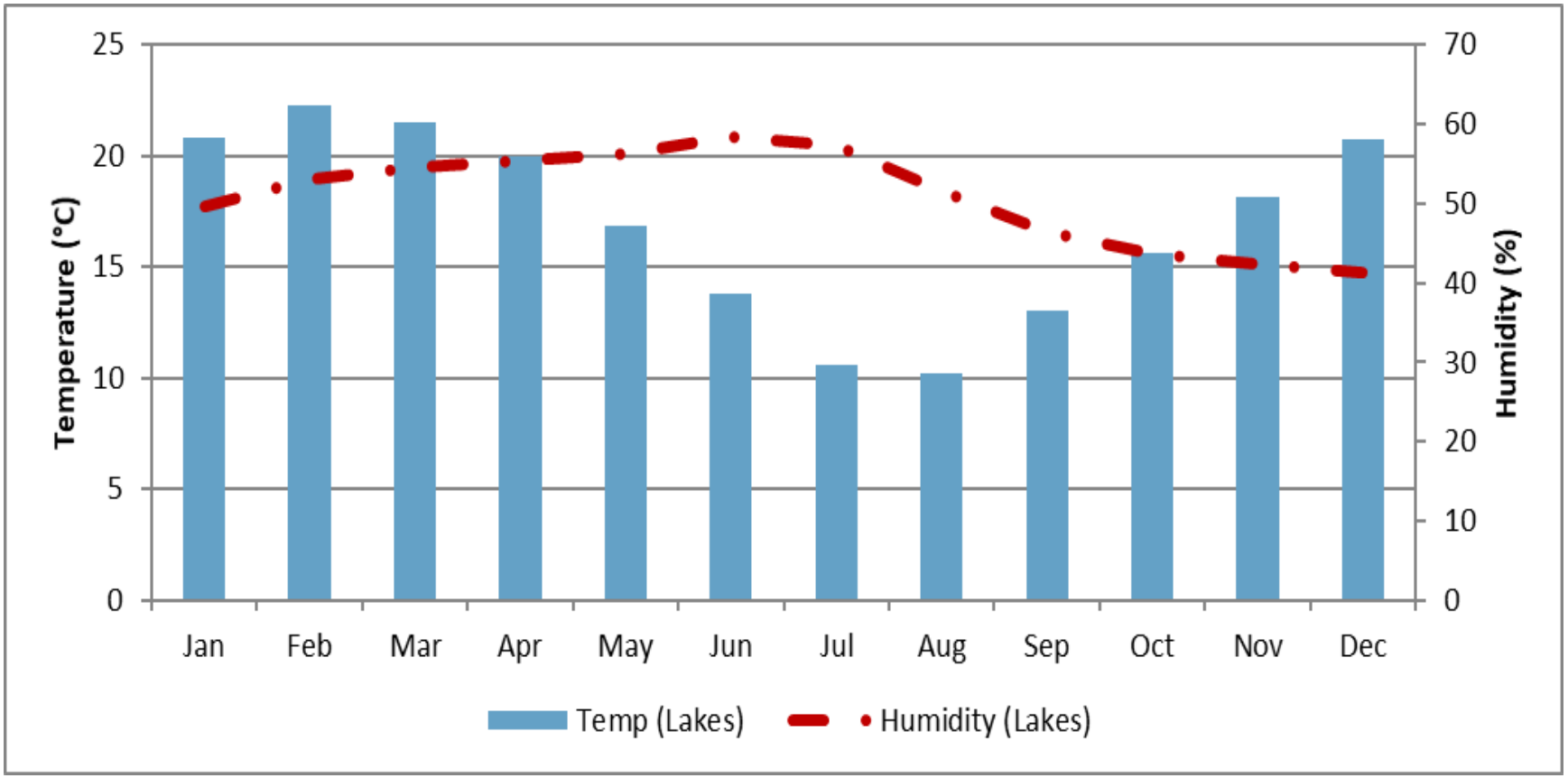


Figure 6-2: Monthly Averages Temperature and Humidity

(Source: Lakes Environmental Data)

6.1.3.1. Wind Speed

Hourly meteorological data from the modeled data was analysed and used to understand the prevailing wind patterns at the Project area. Data was used to assess the wind speed and wind direction regime on site.

The wind rose for the Project area is depicted in Figure 6-3. The dominant winds are from the north northeast (9.7%), north (9.6%), east (9.2%), and north northwest 8.6%) respectively. The wind directions for the different seasons are depicted in Figure 6-4.

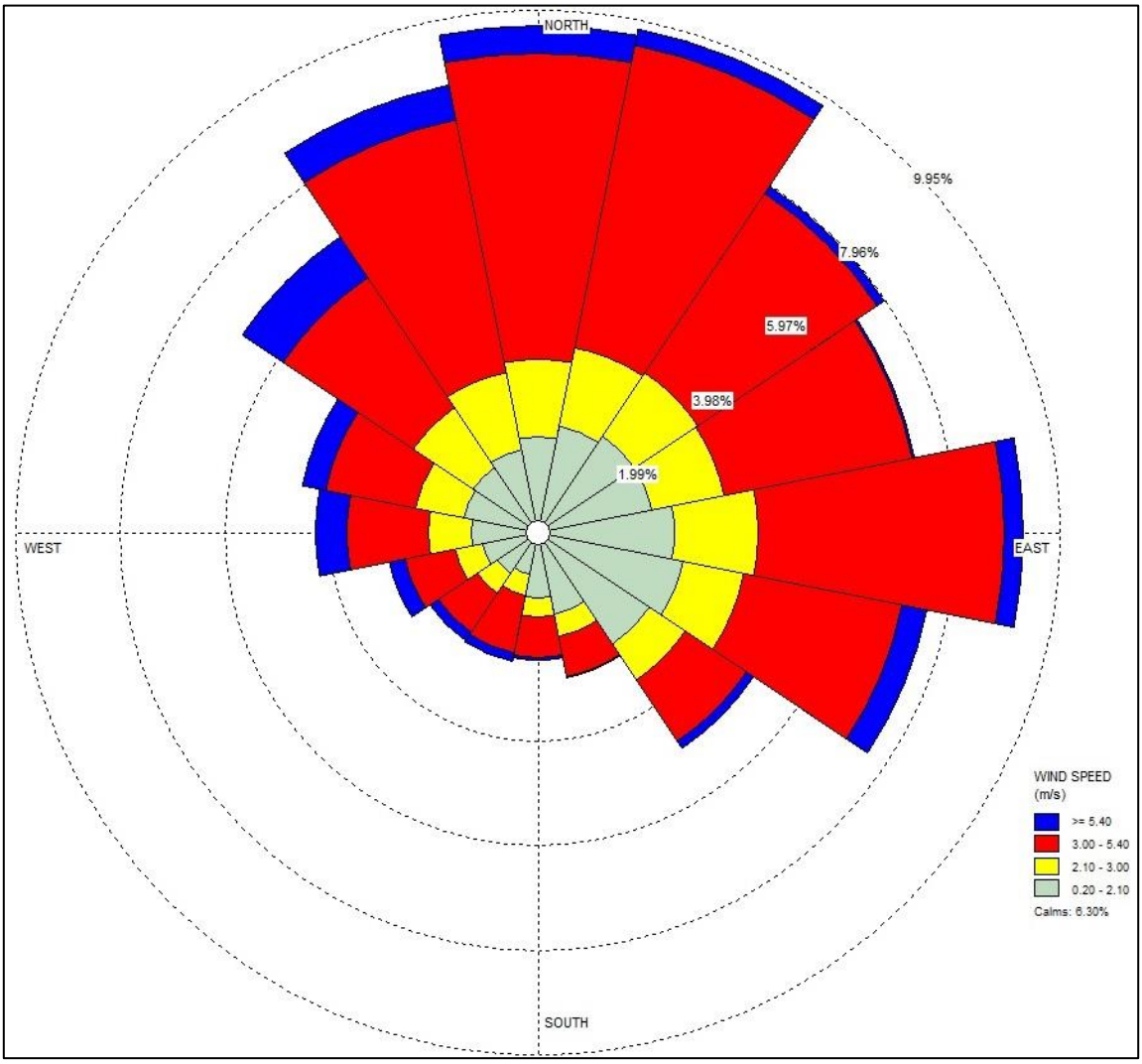


Figure 6-3: Surface Windrose

(Source: Lakes Environmental)

The average wind speed at the Project site is 2.8 m/s and calm conditions (<0.5 m/s) occurred for some 6.3% of the time. Wind speed capable of causing wind erosion i.e. ≥5.4 m/s occurred for about 5.5% of the time (Figure 6-5). This equates to about 20 days in a year.

This is made up of five days in summer, one day in autumn, five days in winter, and nine days in springs.

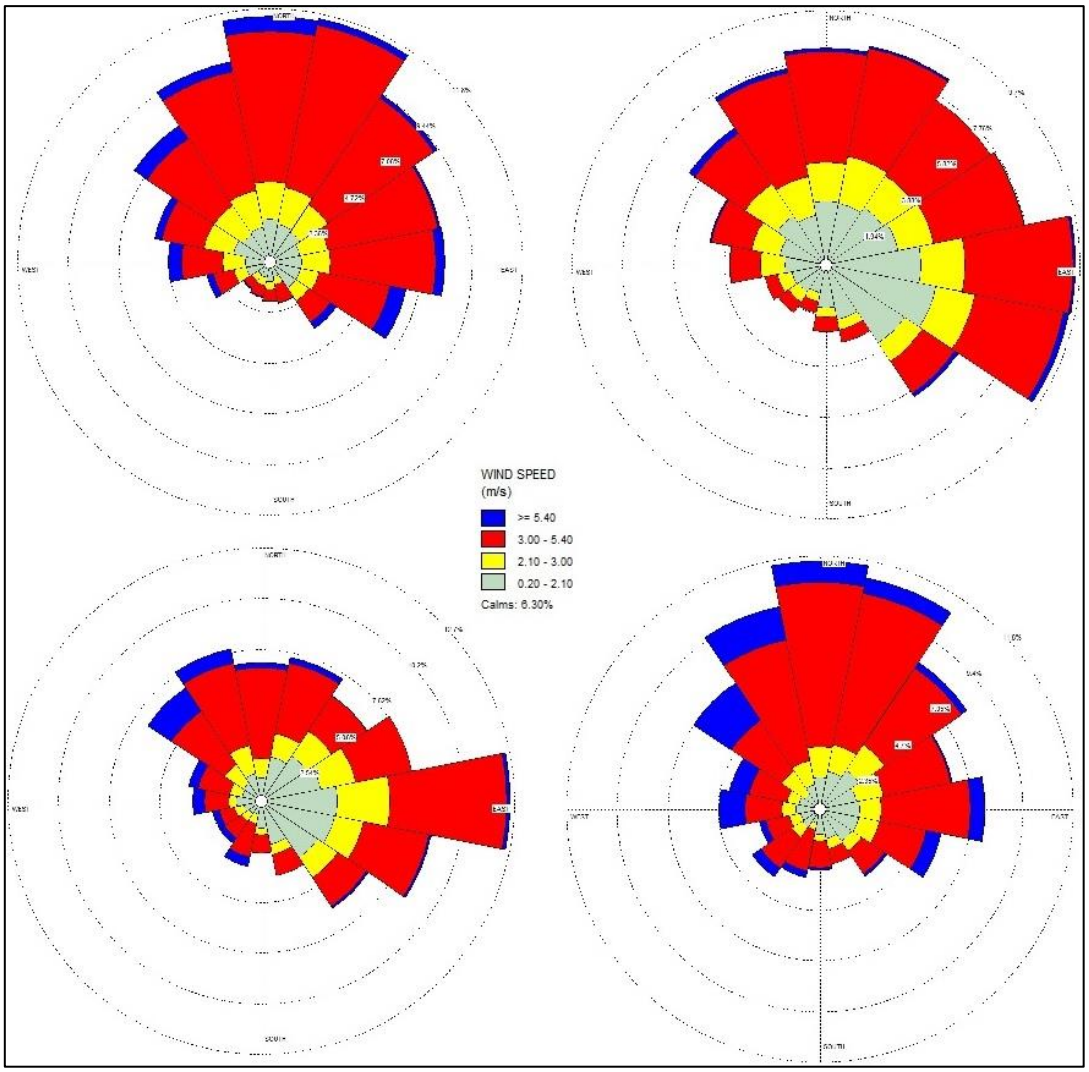


Figure 6-4: Seasonal Windrose

(Source: Lakes Environmental)

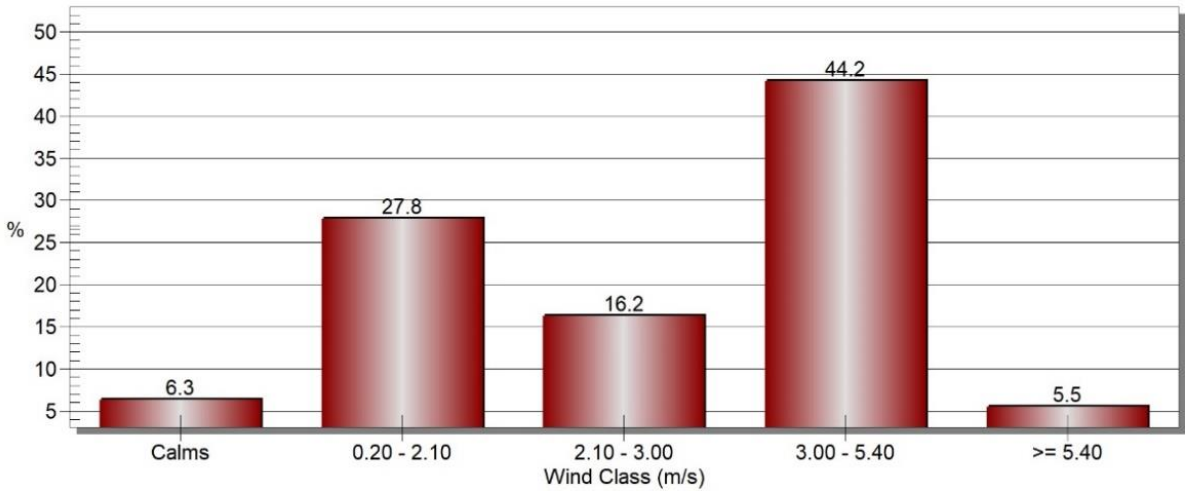


Figure 6-5: Wind Class Frequency

(Source: Lakes Environmental)

6.2. Existing Air Quality

The historical ambient air quality data for the area, comprising mainly of dustfall records for the period 2013-2015 were used to assess background air quality. Data encompassing other pollutants were not available for evaluation.

6.2.1. TSP

Archived dust deposition data collected using the ASTM D1739 for the area was used to assess background scenarios in the Project area. The monitoring locations and other contributing sources to the background air quality in the area are depicted in Figure 6-6. Data for 26 months, from August 2013 to October 2015 from four sites were obtained and the graphs showing the result are depicted below (Figure 6-7 to Figure 6-9). Based on reports from the National Occupational Health and Safety Consultants for the period, all the dust monitoring sites were classified as non-residential. The site names are replaced with acronyms in the graphs, i.e. At Main Gate (AMG); Behind Workshop (BW), Haul Road from Quarry (HRQ), and Behind Washing Plant (BWP). The dustfall rates were compared with the South African Government Notice 827 in Gazette 36974, 1 November 2013 *Dust Control Regulations*. The results are summarised below:

- BW was an exceedance in December 2013 (**1,489** mg/m^{2}d) and June 2014 (**1,342** mg/m^2/d) respectively. These monitoring locations are within the mine boundary and are most likely impacted by the sand mining activities. Mine-related localised activities result in particulates being airborne, deposited, and re-suspended. Thus leading to the high dustfall rates measured on-site; and
- BWP measured exceedances in November 2013 (**3,855** mg/m^{2}d). The dustfall rate measured was more than three times the non-residential limit of 1,200 mg/m^2/d.

Despite the above, for the 26 months, only the aforementioned exceedances were recorded and none occurred in sequential months.

6.2.2. PM_{10}

The ambient concentrations of fine particulate matter with an aerodynamic diameter less than 10 microns could not be determined as data was not available for evaluation. If this is made available in future, it will be analysed and used to comprehensively assess daily PM_{10} variability on site.

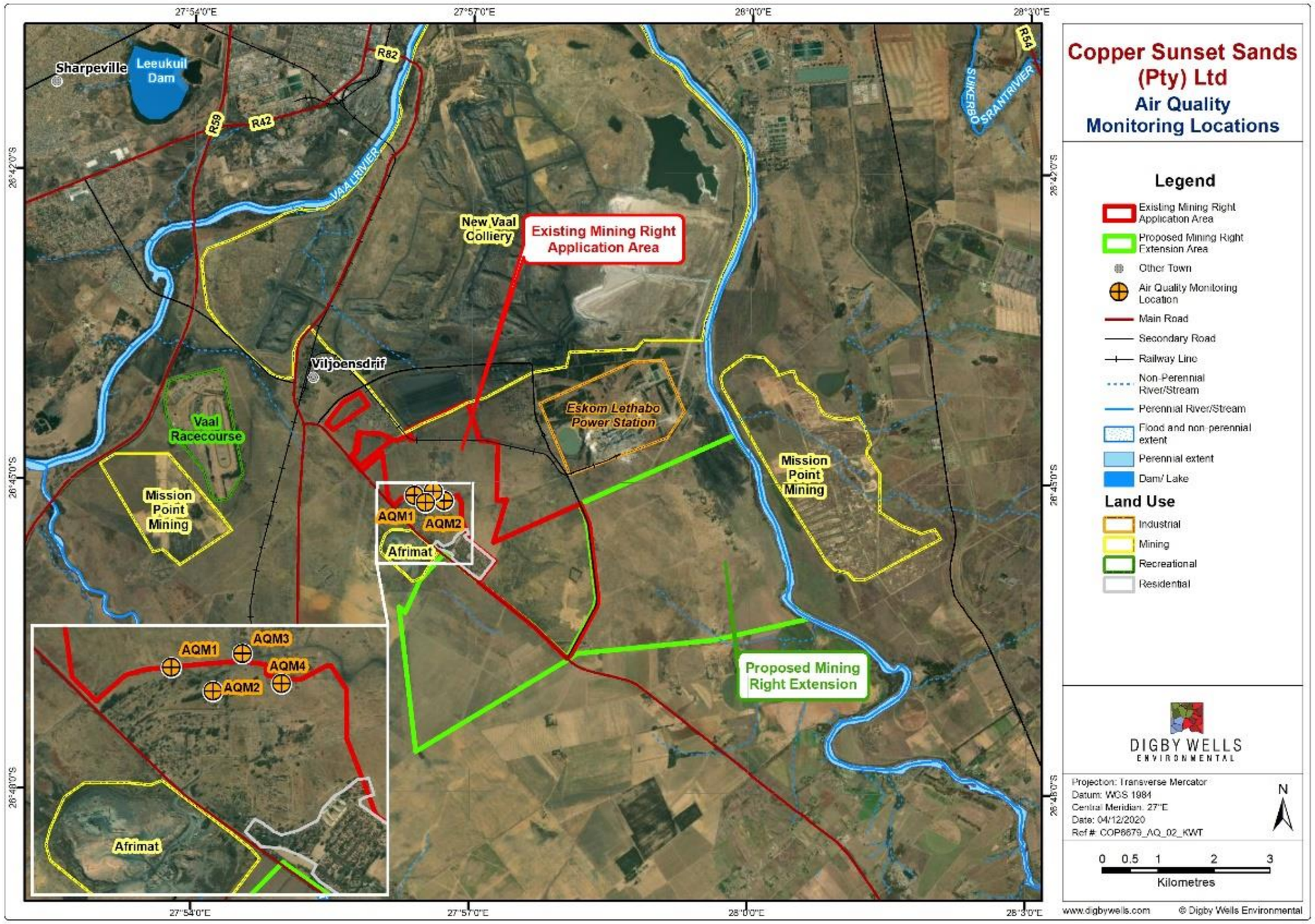
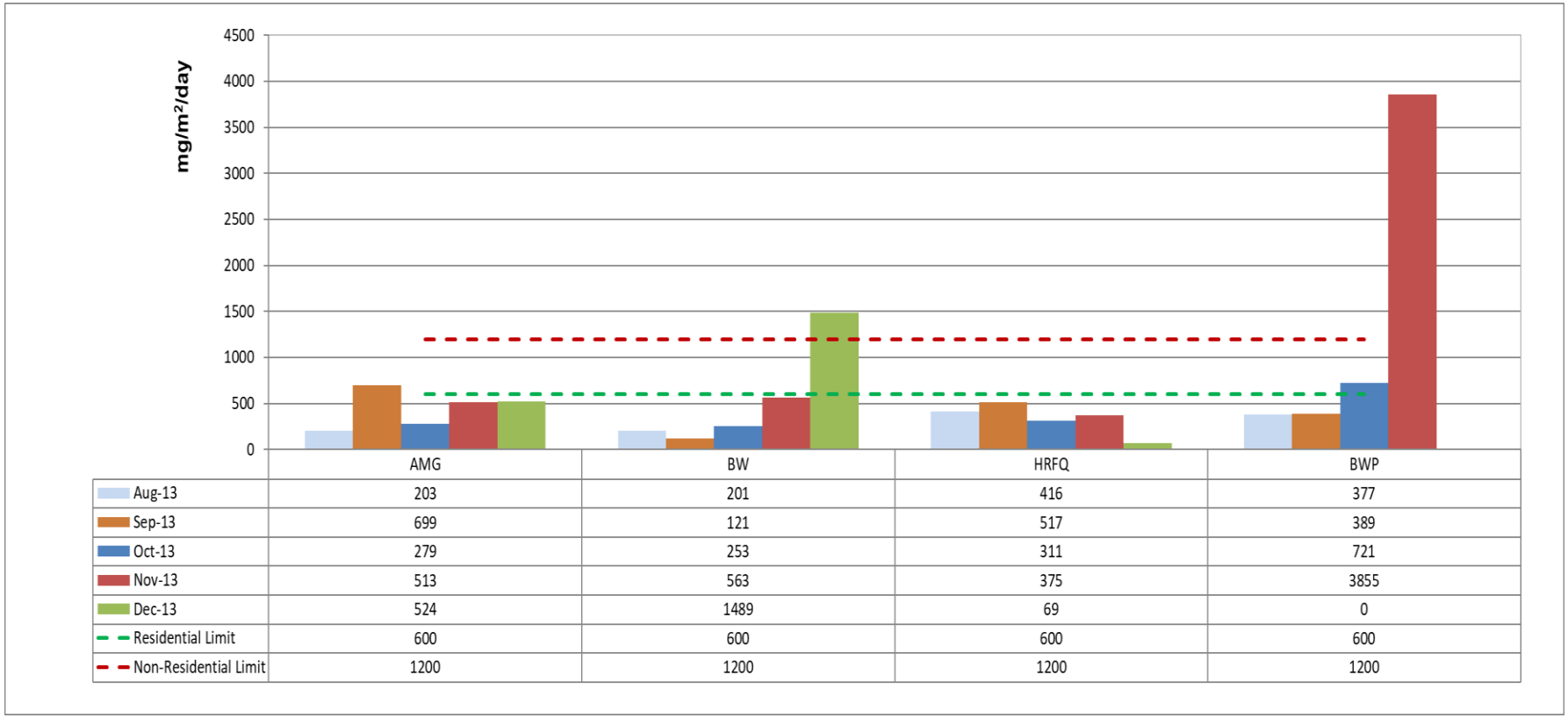
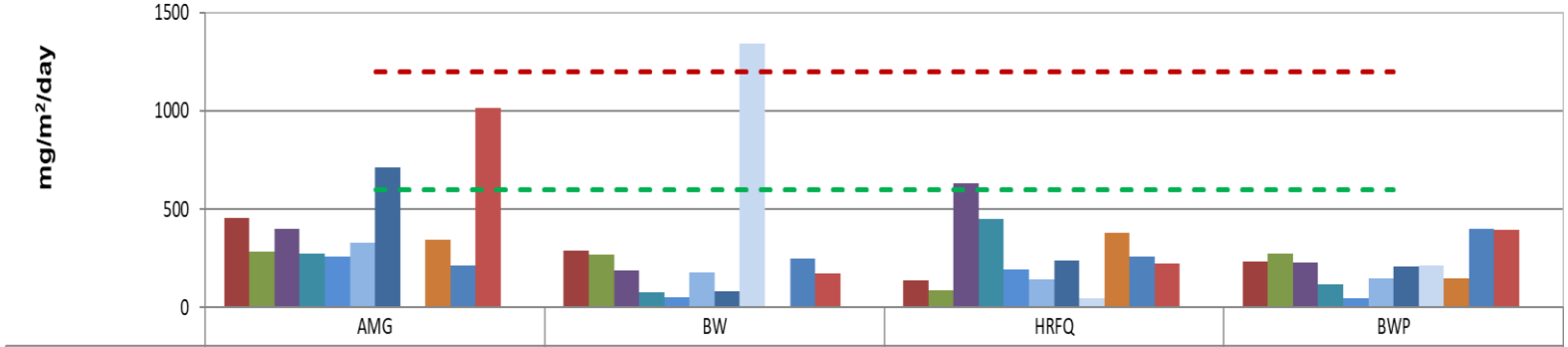


Figure 6-6: Local Setting Showing Nearby Sources of Air Pollution and Dust Monitoring Locations



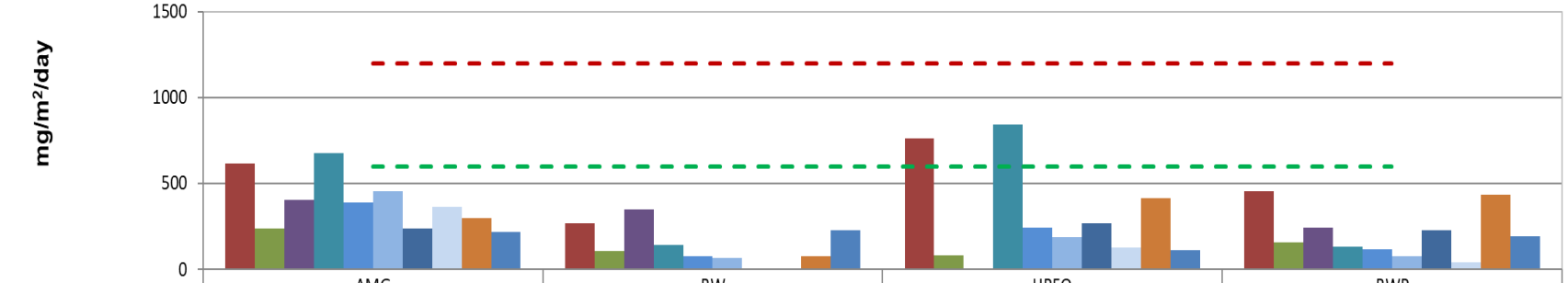
	AMG	BW	HRFQ	BWP
Aug-13	203	201	416	377
Sep-13	699	121	517	389
Oct-13	279	253	311	721
Nov-13	513	563	375	3855
Dec-13	524	1489	69	0
Residential Limit	600	600	600	600
Non-Residential Limit	1200	1200	1200	1200

Figure 6-7: Copper Sunset Dustfall Data (2013)



	AMG	BW	HRFQ	BWP
Jan-14	457	288	140	232
Feb-14	283	272	86	274
Mar-14	403	187	630	228
Apr-14	276	76	451	117
May-14	259	55	194	50
Jun-14	329	180	143	149
Jul-14	712	84	240	210
Aug-14	0	1342	46	212
Sep-14	347	0	380	151
Oct-14	216	251	260	399
Nov-14	1018	176	226	395
Dec-14	1			
Residential Limit	600	600	600	600
Non-Residential Limit	1200	1200	1200	1200

Figure 6-8: Copper Sunset Dustfall Data (2014)



	AMG	BW	HRFQ	BWP
Jan-15	617	268	764	455
Feb-15	239	105	80	159
Mar-15	406	350	0	244
Apr-15	675	143	840	131
May-15	388	74	241	118
Jun-15	455	66	186	76
Jul-15	236	0	266	228
Aug-15	363	0	125	41
Sep-15	297	77	415	432
Oct-15	218	226	113	190
Residential Limit	600	600	600	600
Non-Residential Limit	1200	1200	1200	1200

Figure 6-9: Copper Sunset Dustfall Data (2015)

6.3. Air Quality Impact Assessment

The NEM:AQA regulation regarding Air Dispersion Modelling (GN R 533 of 11 July 2014) informed the assessment approach. A Level 3 assessment was used, which required detailed meteorological geophysical and source input data.

6.3.1. Impact Assessment Approach

The approach used to determine the impacts associated with the sand mining on the ambient air quality of the area is provided in Figure 6-10.

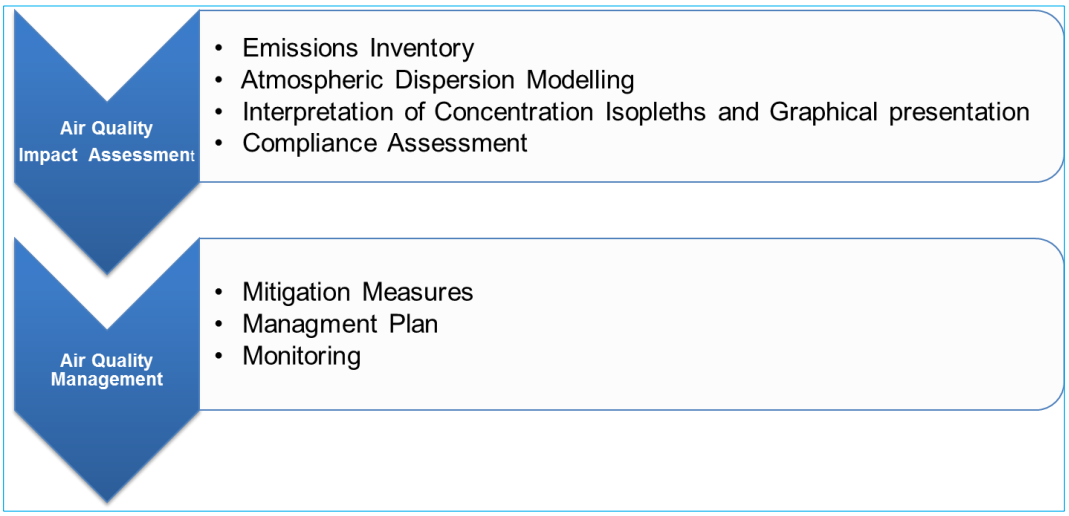


Figure 6-10: Air Quality Impact Assessment Methodology

During the impact assessment, tasks to be completed included the development of an emissions inventory, followed by model simulations to predict Ground Level Concentration (GLC) of criteria pollutants. The model outputs were used to assess compliance with regulatory standards and inform the mitigation and management measures recommended, as well as monitoring requirements to assess the efficiency of the mitigation measures.

6.3.1.1. Emissions Inventory

The development of an emissions inventory forms the basis for any conceptual model. Emission rates are typically obtained using actual sampling equipment at the point of emission or are estimated from mass and energy balances or emission factors that have been established at similar operations. The latter was followed, employing emission factors published by the USEPA in its *AP-42* "Compilation of Air Pollution Emission Factors" (USEPA, 1995; 1998; 2016), Australian National Pollutant Inventory (*NPi*) "Emission Estimation Technique (EET, 2012)" manuals were employed and European Environmental Agency EMEP/EEA Air Pollution Emissions Inventory Guidebook 2019.

Quoting directly from the USEPA AP-42 (2016), …" *air pollutant emission factors are representative values that attempt to relate the quantity of a pollutant released to the ambient air with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of the pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant. Such factors facilitate the estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages*".

The equations and parameters used in the calculations of the emissions expected from various sources within the sand mine during operation are discussed in detail in Table 6-2.

Table 6-2: Emission Factor Equations

Activity	Emission Equation	Source	Information assumed/provided
Materials handling (Excavator)	$EF_{TSP\,(kg/t)} = k_{TSP} \times 0.0016 \times \frac{\left(\frac{U_{(m/s)}}{2.2}\right)^{1.3}}{\left(\frac{M_{(\%)}}{2}\right)^{1.4}}$ Where, E = Emission factor (kg dust / t transferred) U = Mean wind speed (m/s) M = Material moisture content (%) The $PM_{2.5}$, PM_{10} and TSP fraction of the emission factor is 5.3%,0 35% and 0.74% respectively. An average wind speed of 2.8 m/s was used based on the Lakes Environmental data for the period 2017 – 2019.	US-EPA AP42 Section 13.2.4	<u>The moisture content of the materials are as follows:</u> Topsoil Stockpile: 6.9% Hours of operation were given as 24 hrs per day, 7 days per week.
Vehicle entrainment on unpaved surfaces	$EF_{(\frac{KG}{VKT})} = \frac{0.4536}{1.6093} * k * (\frac{s(\%)}{12}) a * (\frac{w(t)}{3}) b$ Where, E = particulate emission factor in grams per vehicle km traveled (g/VKT) k = basic emission factor for particle size range and units of interest s = road surface silt content (%) W = average weight (tonnes) of the vehicles traveling the road = 40 t side truck	US-EPA AP42 Section 13.2.2	Default silt content: Mine Road: 6.9% Hours of operation were assumed as 24 hrs per day, 7 days per week. The capacity of the haul trucks to be used was given as a 40 tonnes truck.

Activity	Emission Equation	Source	Information assumed/provided
	The particle size multiplier (k) is given as 0.15 for $PM_{2.5}$ and 1.5 for PM_{10}, and as 4.9 for TSP The empirical constant (a) is given as 0.9 for $PM_{2.5}$ and PM_{10}, and 4.9 for TSP The empirical constant (b) is given as 0.45 for $PM_{2.5}$, PM_{10}, and TSP		The layout of the haul roads of 10 m wide was used.
Screening	TSP=0.0011 kg/t PM10=0.00037 kg/t PM2.5=0.000025 kg/t	European Environmental Agency EMEP/EEA Air Pollution Emissions Inventory Guidebook 2019	Emissions factor for screening
Bulldozing	$EF_{TSP} = 2.6 \times (s)^{1.2} / (M)^{1.3}$ $EF_{PM_{10}} = 0.34 \times \left((s)^{1.5} / (M)^{1.4} \right)$	NPi, 3.1, 2012	Variable emission
Tipping	$E_{TSP} = 0.74 \times 0.0016 \times \left(\frac{U}{2.2}\right)^{1.3} \times \left(\frac{M}{2}\right)^{-1.4}$ $E_{PM10} = 0.35 \times 0.0016 \times \left(\frac{U}{2.2}\right)^{1.3} \times \left(\frac{M}{2}\right)^{-1.4}$	US-EPA AP42 Section 13.2.4	The silt contents of materials are as follows: Topsoil: 6% (Assumed) U = mean wind speed in m/s M = moisture content in %
Wind Erosion	$EF\left[\frac{kg}{m2}\right] = 1.2 * 10^4 * J * 1.7 * \left(\frac{s}{1.5}\right) * 365 * \left(\frac{365 - P}{235}\right) * \left(\frac{L}{15}\right)$ J = particulate aerodynamic factor with the following values: J(TPM) = 1.0 J(PM10) = 0.5 J(PM2.5) = 0.2	European Environmental Agency EMEP/EEA Air Pollution Emissions Inventory Guidebook 2019	Three conical stockpiles with a radius of 5 m and height of 4 m assumed

Activity	Emission Equation	Source	Information assumed/provided
	s = average silt loading of storage pile in percent (%); P = average number of days during the year with at least 0.254 mm of precipitation; I = percentage of time with unobstructed wind speed >19.3 km/h in percent (%) The exposed area of the conical stockpile A = π x R √(R2 + H2) π = 3.1416 (approximately) R = radius of the stockpile (m) H = height of the stockpile (m) A = exposed surface area of stockpile (m^2)		
Generator	PM_{10}: 0.26 g/kWhr NOx + HC: 4.42 g/kWhr CO: 1.06 g/kWhr	CAT Model D40-6S Diesel Engine	Parameters applied: Exit temperature:571°C Exit Velocity: 0.59 m/s Release height: 5 m Volumetric flow rate: 0.23 m^3/s

6.3.1.2. Air Quality Dispersion Modelling and Data Requirements

6.3.1.2.1. Meteorological Data Requirements

Dispersion models compute ambient concentrations as a function of source configurations, emission rates, and meteorological characteristics, thus providing a useful tool to ascertain the spatial and temporal patterns in GLCs of pollutants arising from the emissions of various sources.

An AERMOD modeling system incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including both surface and elevated sources, and of simple or complex terrain.

The mesoscale model, known as MM5 (Fifth-Generation Penn State/NCAR Mesoscale Model) is a limited-area, non-hydrostatic, terrain-following sigma-coordinate model designed to simulate or predict mesoscale atmospheric circulation. MM5 modeled meteorological data set for the full three calendar years was obtained from Lakes Environmental Software. This dataset consists of surface and upper air meteorological data required to run the dispersion model.

6.3.1.2.2. Modelling Domain

The AERMAP terrain pre-processor requires the user to define a modeling domain. The modeling domain is defined as the area that contains all the receptors and sources being modeled, to accommodate any significant terrain elevations. The influence of the terrain will vary with the source height and position and the local meteorology. Table 6-3 gives an overview of meteorological parameters and basic setup options for the AERMOD model runs.

AERMOD's three models and required model inputs are described below:

- AERMET: calculates boundary layer parameters for input to AERMOD:
  - Model inputs: wind speed; wind direction; cover; ambient temperature; albedo; surface roughness; and Bowen ratio.
- AERMAP: calculates terrain heights and receptor grids for input to AERMOD:
  - Model inputs: Digital elevation model data [x,y,z]; design of receptor grid; and
  - Model outputs for AERMOD: [x,y,z] and hill height scale for each receptor.
- AERMOD: calculates temporally-averaged air pollution concentrations at receptor locations for comparison to the relevant standard:
  - Model inputs: source parameters (from permit application); boundary layer meteorology (from AERMET); and receptor data (from AERMAP).

Table 6-3: Summary of Meteorological and AERMET Parameters

Number of grids (spacing)	100 m, 200 m, 400 m
Number of grids points	107 x 107
Years of analysis	January 2017 to December 2019
Centre of analysis	Vereeniging (26.765883 S, 27.968611 E)
Meteorological grid domain	20 km (east-west) x 20 km (south-north)
Station Base Elevation	1443 m
Anemometer Height	14 m
Sectors	The surrounding area land use type was cultivated
Albedo	0,33

Surface Roughness	0,27
Bowen Ratio	4,8
Terrain Option	Flat

6.3.1.3. Impact Assessment Ranking

Based on the predicted GLC of various pollutants and the spread across the mining landscape, the impact assessment ranking methodology in Appendix A was applied in rating the potential impacts of the mining operation on the ambient air quality.

7. Findings and Discussion

The findings associated with the air quality baseline and the proposed sand mining operation are presented below. The modeling demonstrates the air quality impacts associated with Copper Sunset's operation and implications for nearby sensitive receptors.

7.1. Baseline Results

The meteorology of the MRA assessed with three-years' worth of data, revealed that the predominant winds are from the north northeast (9.7%), north (9.6%), east (9.2%) and north northwest 8.6%), respectively. The average wind speed at the Project site is 2.8 m/s and calm conditions (<0.5 m/s) occurred for some 6.3% of the time. Wind speed capable of causing wind erosion i.e. ≥5.4 m/s occurred for about 5.5% of the time. This equates to about 20 days in a year.

The background air quality in the area is influenced by several contributing sources in the area, including mining activities and a power station. Data for 27 months, from August 2013 to October 2015 from four sites were obtained and used to assess background. Only three exceedances were measured during the period. These sites are classified as non-residential and are all within the MRA. These sites were compliant with the permissible frequency of exceedance (which is two within a year). Exceedance recorded in sequential months would have meant the site was not compliant with the requirements of the regulation - GN R 827 of 1 November 2013.

7.2. Dispersion Model Simulation Results

The model results consist of graphical isopleths showing the predicted GLC (in a unit of µg/m^3 for PM_{10} and $PM_{2.5}$, and mg/m^2/d for dust deposition rates). The daily averages were calculated as the 4th highest value (99th percentile). Annual averages were shown as the 1st highest value (100th percentile). The model simulations show the worst-case scenario (assuming no mitigation measures were put in place at the mine) for $PM_{2.5}$ and PM_{10} and dustfall. To show the effectiveness of mitigation measures, a model run was conducted for dustfall only.

7.3. Isopleth Plots and Evaluation of Results

The results from the dispersion model simulations are discussed below. The isopleths are depicted in Figure 7-1 to Figure 7-5, and the GLCs at the selected sensitive receptors are depicted in Table 7-1.

7.3.1. Predicted GLC of $PM_{2.5}$

The predicted $PM_{2.5}$ GLC over a 24-hour averaging period for the sand mining operation returned simulation isopleths that are shown in Figure 7-1 ($PM_{2.5}$ daily) and Figure 7-2 ($PM_{2.5}$ annual).

Figure 7-1 shows the predicted daily GLC of $PM_{2.5}$ for the worst-case scenario, i.e. mining happening without any mitigation measures in place. Areas where the daily standard (40 µg/m³) are likely to be exceeded will be confined within the MRA (red in Figure 7-1). The predicted GLC at the selected monitoring locations were below the standard (Table 7-1). The predicted annual GLC of $PM_{2.5}$ will not exceed 20 µg/m³ (annual standard) onsite and at selected sensitive receptors (Figure 7-2).

7.3.2. Predicted GLC of PM_{10}

The predicted daily GLC of PM_{10} over a 24-hour averaging period returned simulation isopleths shown in Figure 7-3 (PM_{10} daily) and Figure 7-4 (PM_{10} annual).

The areas where the 24-hour standard of 75 µg/m³ are likely to be exceeded will be confined within the MRA (red in Figure 7-3). The predicted GLCs at the selected sensitive receptors are depicted in Table 7-1, and the levels will be lower than the daily standard. The predicted annual GLC at these receptors will be lower than the South African standard (Table 7-1).

7.3.3. Predicted Dustfall Rates

The predicted dustfall rates are onsite and at selected sensitive receptors are shown in Figure 7-5 (with simulations for – no-mitigation and with-mitigation). The simulated dustfall rates confirmed that the areas where the residential limit (600 mg/m^2/d) and non-residential limit (1,200 mg/m^2/d) values will be exceeded are likely to be confined within the MRA. The dustfall rates predicted at selected sensitive receptors were lower than both limit values. Also, with mitigation measures in place, the footprint where exceedances are likely to occur shrunk further within the MRA (Table 7-1).

7.3.4. Gases

Gaseous emissions were modelled for a 40kVA generator as the sole source of electricity onsite. Vehicular emissions were considered variable, intermittent, and negligible. Emission factors from a Cat® 40kVA Model D4—6S for NO_X, CO, and PM were utilised. Predicted GLCs were very low and insignificant, hence, not discussed further in this report.

Table 7-1: Predicted Concentrations of PM_{10}, $PM_{2.5}$ and Dust Deposition Rates at Selected Sensitive Receptors

Pollutants	Averaging Period	South Africa Air Quality Standard (µg/m³)	Predicted Ground Level Concentration (µg/m³)			
			AMG	BW	HRFQ	BWP
PM_{10} (No Mitigation)	Daily	75(1)	34	**7**	5	7
	Annual	40(1)	2.5	1.1	0.8	0.9
$PM_{2.5}$ (No Mitigation)	Daily	40(1)	4	2	1.8	2.4
	Annual	20(1)	0.4	0.2	0.2	0.2
Dust Deposition Rates (mg/m²/day)						
Dust (No Mitigation)	Monthly	Residential (600(2)) Non-residential (1200(2))	166	76	87	87
Dust (With Mitigation)			110	37	52	46

* Annual average at a site in bracket

1. South African National Ambient Air Quality Standards, 2009;2012
2. South African National Dust Control Regulation, 2013 (NDCR)

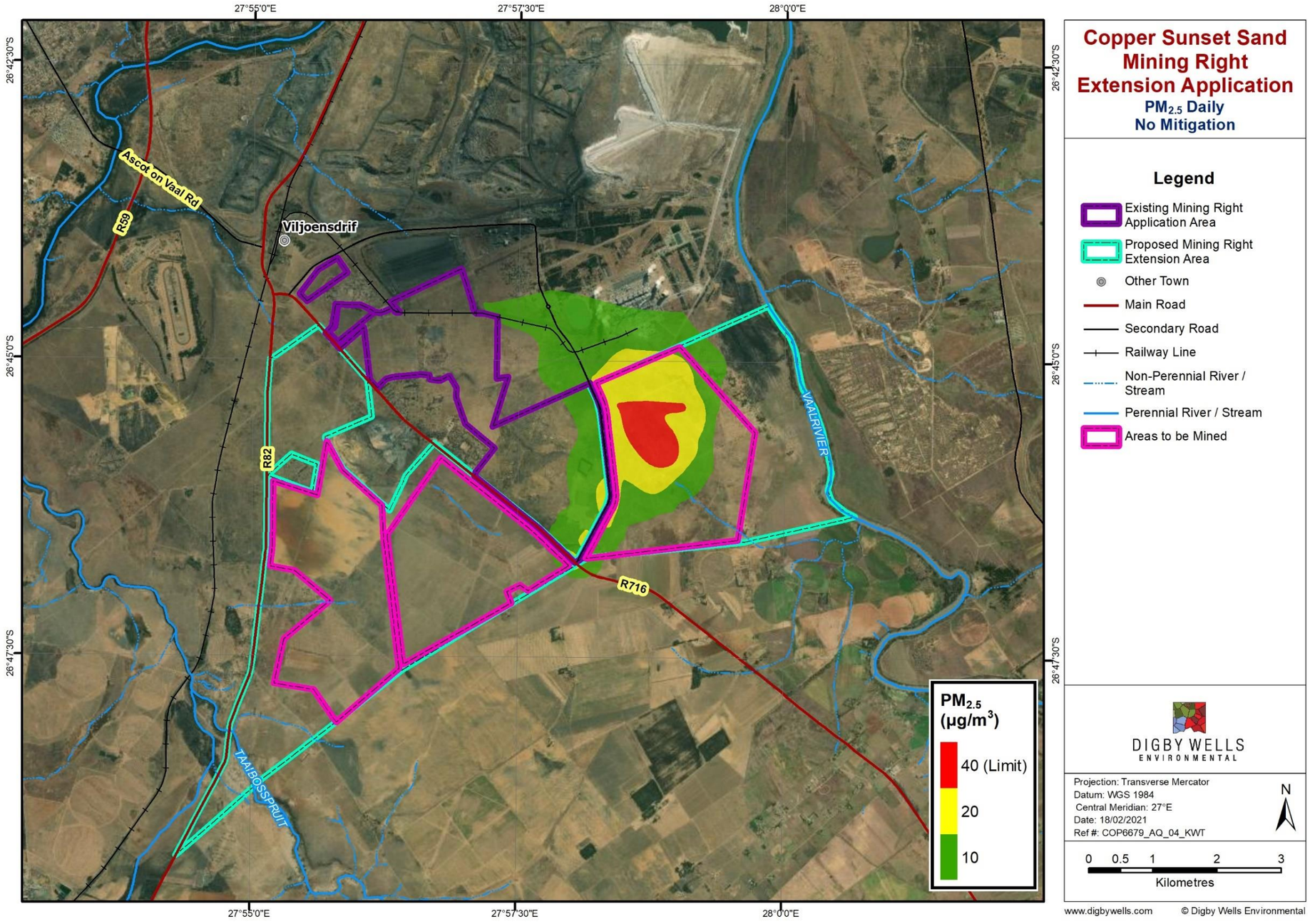


Figure 7-1: Predicted 4th highest (99th percentile) daily $PM_{2.5}$ Concentrations (µg/m³)

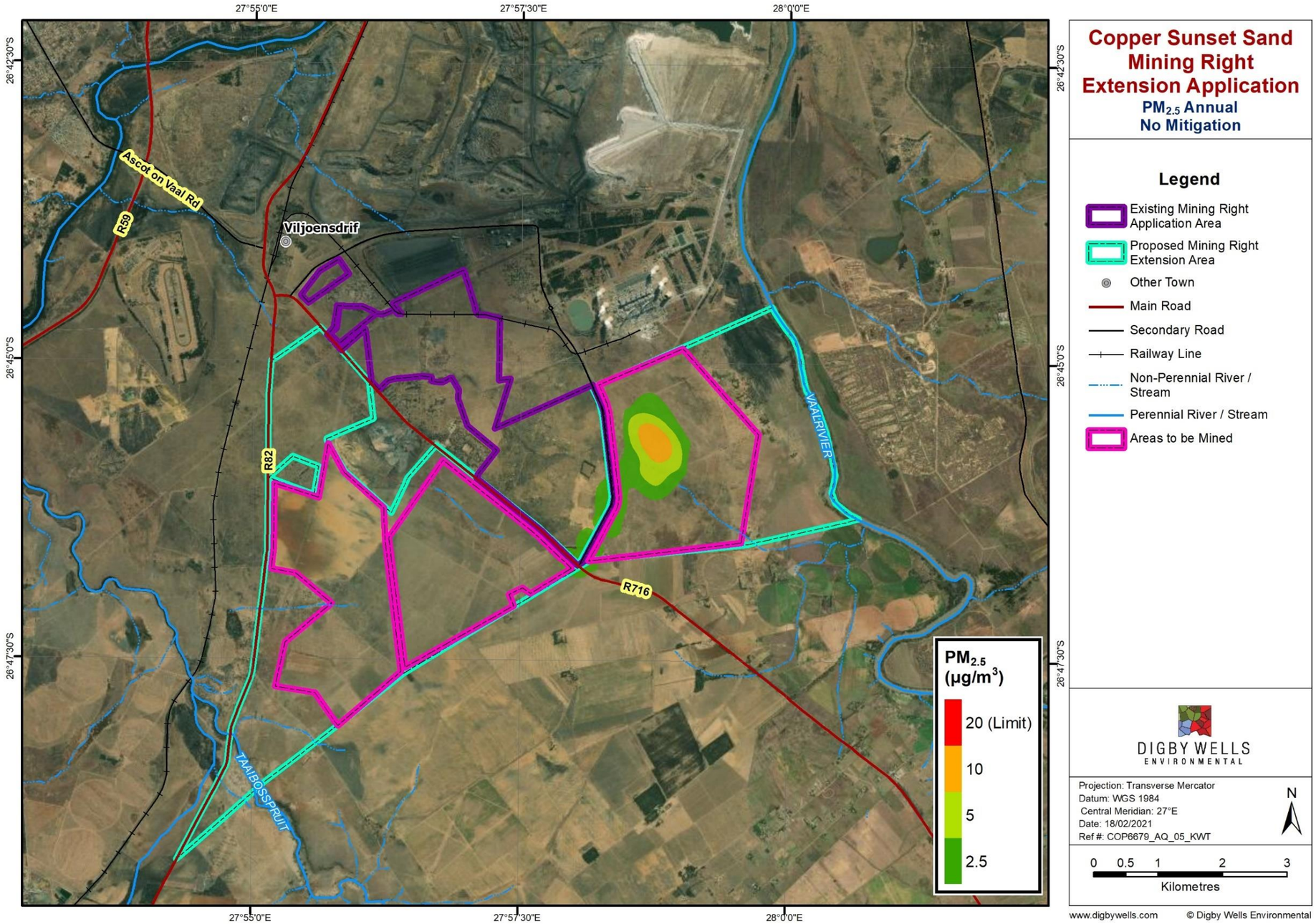


Figure 7-2: Predicted 1st highest (100th percentile) Annual PM2.5 Annual Concentrations (µg/m³)

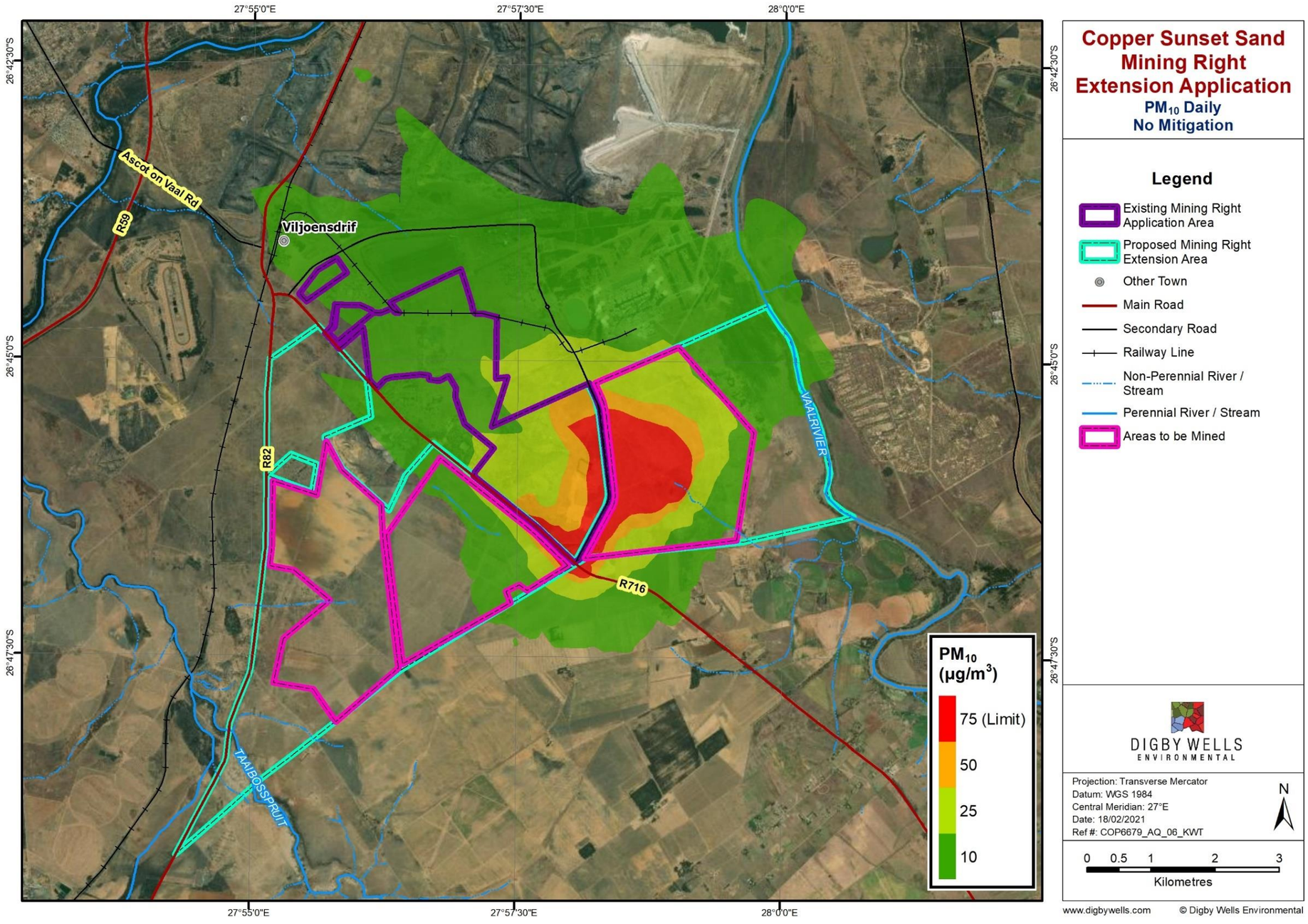


Figure 7-3: Predicted 4th highest (99th percentile) daily PM_{10} Concentrations (µg/m³)

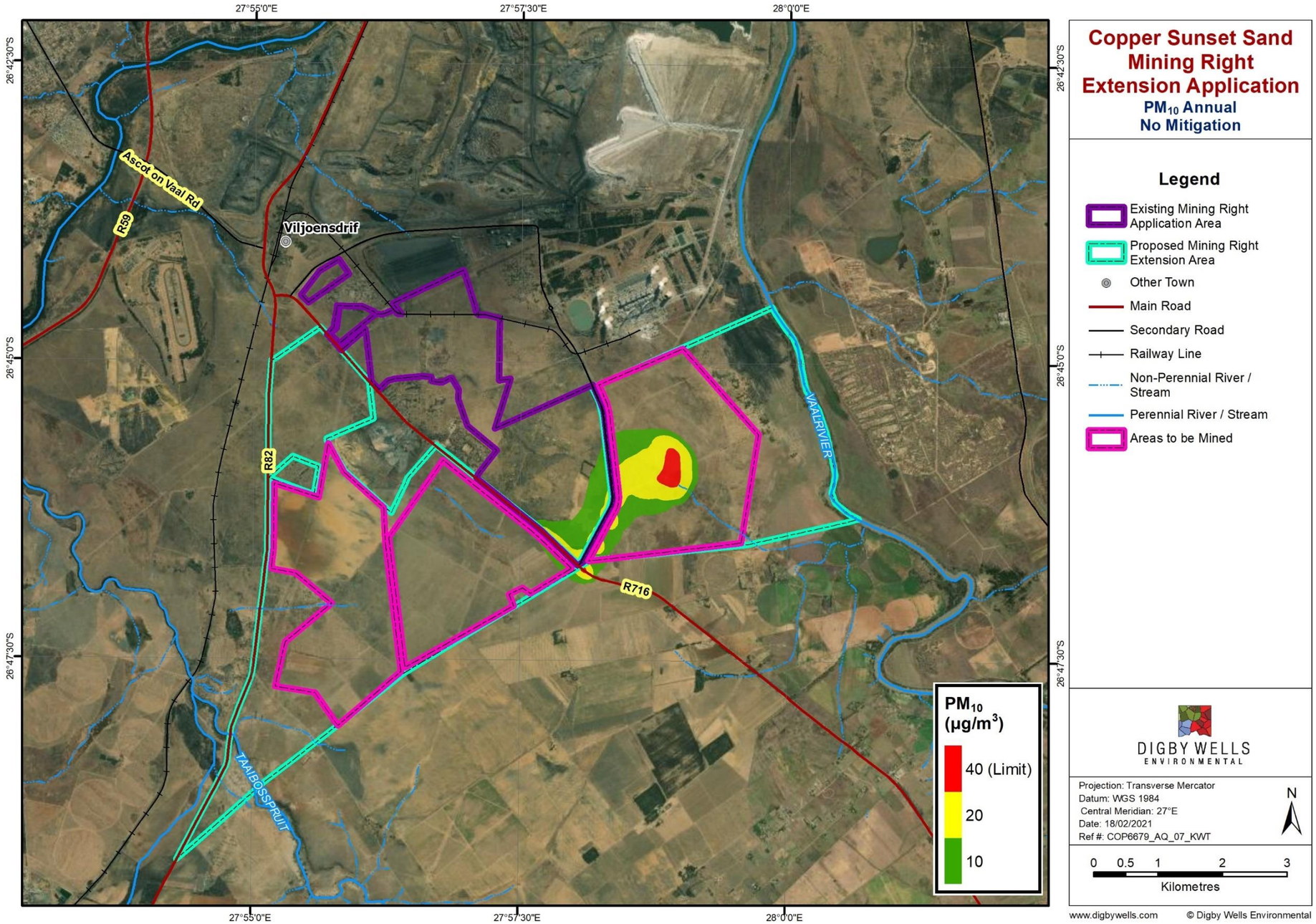


Figure 7-4: Predicted 1st highest (100th percentile) Annual PM_{10} Concentrations (µg/m³)

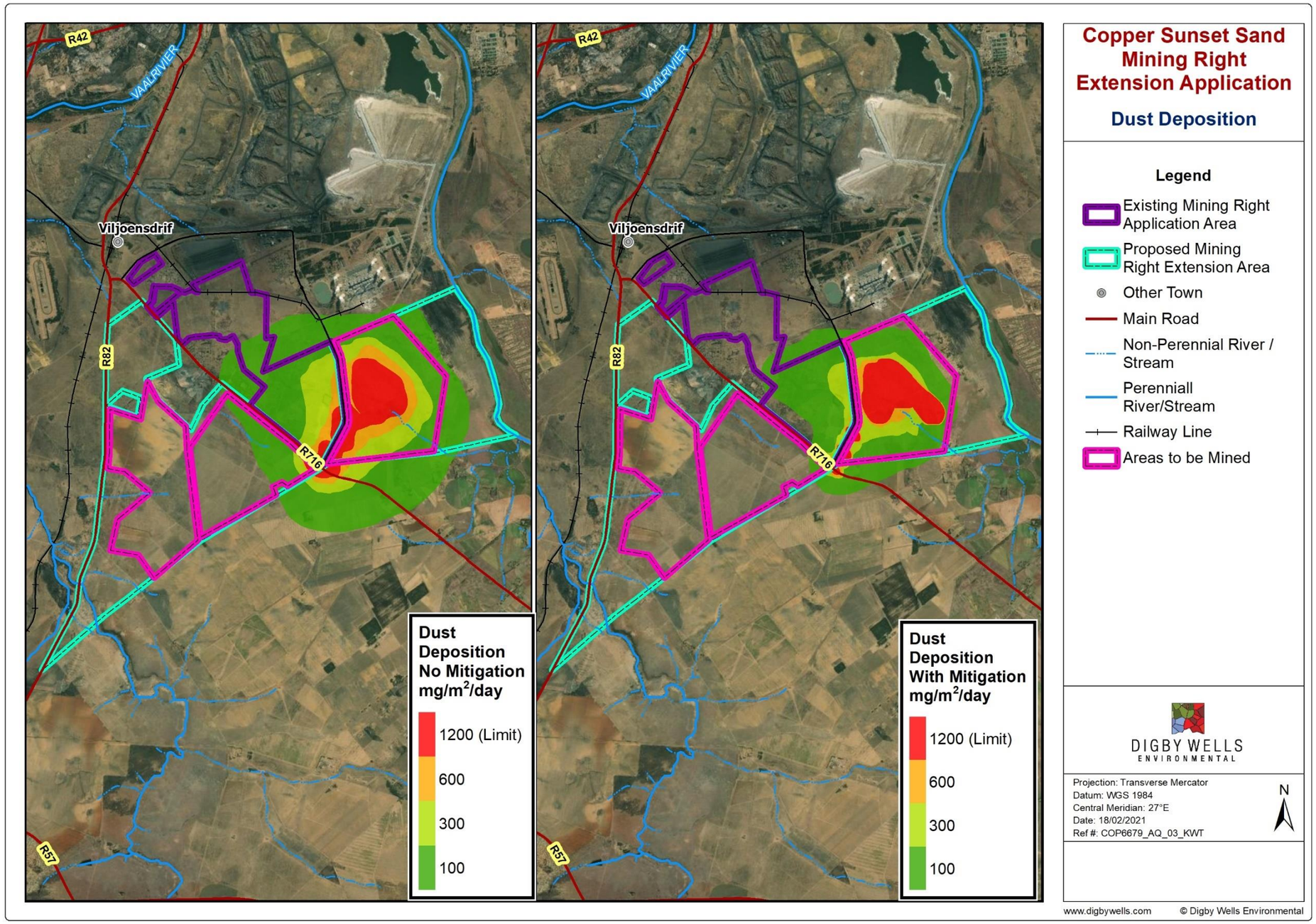


Figure 7-5: Predicted (100th percentile) Monthly TSP Deposition Rates (mg/m²/day) No Mitigation and With Mitigation

8. Findings and Discussions

The predicted impacts of the sand mining operation, that is scheduled to continue into the extension areas were assessed. Findings are discussed below in Section 8.1.

8.1. Findings

The results represent the worst-case scenario, i.e. without mitigation measures factored in the model, except for the simulation of the dust deposition rates. The findings are summarised as follows:

- Areas where the predicted daily GLC of $PM_{2.5}$ will exceed the standard (40 µg/m³) will be confined within the MRA. The predicted GLCs at the selected monitoring locations were below the standard. The predicted annual GLC of $PM_{2.5}$ will not exceed 20 µg/m³ (annual standard) onsite and at the selected sensitive receptors;
- The areas where the PM_{10} 24-hour standard of 75 µg/m³ are likely to be exceeded will be confined within the MRA. Predicted GLCs at the selected sensitive receptors were lower than the daily standard. The predicted annual GLC at these receptors will be lower than the South African standard; and
- The predicted dustfall rates onsite and at selected sensitive receptors (with simulations for no mitigation and with mitigation) have been assessed. The simulated dustfall rates confirmed that the areas where the residential limit (600 mg/m^2/d) and the non-residential limit (1,200 mg/m^2/d) values will be exceeded are likely to be confined within the MRA. The dustfall rates predicted at selected sensitive receptors were lower than both limit values. Also, with mitigation measures in place, the footprint where exceedances are likely to occur shrunk further within the MRA.

9. Impact Assessment

This section rates the significance of the potential impacts of pre-mitigation and post-mitigation. The impacts below are a result of both the environment in which the activity takes place, as well as the activity itself. The impacts associated with the proposed project include the NEMA EIA Regulations, 2014 (as amended) Listed Activities, as well as the mining and associated activities to take place at the Project area. The methodology utilised to assess the significance of the potential impacts is described in Appendix 1. The following activities will be assessed as discussed in Table 9-1.

Table 9-1: Summary of Project Activities

Activity No.	Activity
Establishment Phase	• Site clearance and vegetation removal; • Placement of the Offices and associated mining equipment; • Construction of the hydrocarbon storage tank and refueling area; • Establishment of a haul road/tracks; and • Stockpiling of topsoil.
Operational Phase	• Mining of sand resources including screening; • Transportation of sand; • Refueling of machineries within the mining area or at the mobile offices; • Handling of general and hazardous waste; and • Concurrent rehabilitation (topsoil cover, ripping, and vegetation establishment) and monitoring of vegetation establishment.
Closure and Rehabilitation Phase	• Backfilling of the mined excavations with topsoil and waste from the screening plants; • Dismantling and removal of infrastructure; • Concurrent rehabilitation (topsoil cover, ripping, and vegetation establishment) and monitoring of vegetation establishment.; and • Post-closure monitoring.

9.1. Establishment Phase

Activities during the Establishment Phase that may have potential implications on the ambient air quality in the MRA and surroundings i.e. increasing pollutant levels in the atmosphere are indicated in Table 9-2.

Table 9-2: Interactions and Impacts of Activity

Interaction	Impact
Site clearance and vegetation removal	• Generation of dust; • Increased particulate matter load in the atmosphere leading to poor air quality; and • Soiling of surfaces due to dustfall
Placement of the Offices and associated mining equipment	
Construction of the hydrocarbon storage tank and refueling area	
Establishment of a haul road/tracks	
Stockpiling of topsoil	

9.1.1. Impact Description

Establishment of project infrastructure will occur in phases and will be short-term in nature. Therefore, the anticipated impacts will be negligible.

Activities associated with site clearing and vegetation removal, establishment activities onsite, including the haul roads, erosion of open areas, and topsoil stockpiling will result in the generation of fugitive dust comprising of TSP, $PM_{10,}$ and $PM_{2.5}$. Also, excavation, loading, and tipping of establishment material will lead to dust generation. These activities will occur in phases, will be short-term and localised in nature, and will have low impacts on the ambient air quality.

9.1.1.1. Management Objectives

The management objective is to ensure that emissions on-site and at off-site locations are not in exceedance of the regulatory limits for the protection of the environment, human health, and wellbeing. Mitigation measures will be implemented to ensure that emissions remain below limit values and in compliance with the relevant standards.

9.1.1.2. Management Actions

- Ensure mitigation measures are factored into the daily operation at the mine; and
- Implement particulate monitoring onsite, and at upwind and downwind sensitive receptor locations to assess the effectiveness of the mitigation measures and ensure compliance.

9.1.1.3. Impact Ratings

The establishment phase activities will require similar mitigation measures to contain emissions from the different activities, hence the impact rating of these activities are grouped for ranking (Table 9-3).

Table 9-3: Significance Ratings for Site Clearing, Construction of Haul Road, Surface Infrastructure, and Topsoil Stockpiling

Activity and Interaction: Site Clearing, Construction of Surface Infrastructure and Topsoil Stockpiling			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Reduction in ambient air quality			
Prior to mitigation/ management			
Duration	Short term (1)	Dust will be generated for the duration of each activity in the establishment phase	Negligible (negative) – 30
Extent	Limited (2)	Limited to the Project area and immediate surroundings.	

Activity and Interaction: Site Clearing, Construction of Surface Infrastructure and Topsoil Stockpiling			
Dimension	**Rating**	**Motivation**	**Significance**
Intensity	Minor (2)	Minor implications on the surrounding area are anticipated	
Probability	Almost certain (6)	There is a possibility that generated dust will impact ambient air quality.	
Nature	Negative		
Mitigation/ Management actions			
• Application of dust suppressant on the haul roads and exposed areas; • Limit activity to non-windy days (wind speed less than 5.4 m/s); • Set maximum speed limits on haul roads and have these limits enforced; • The area of disturbance must be kept to a minimum at all times and no unnecessary clearing, digging, or scraping must occur, especially on windy days; and • The drop heights when loading onto trucks and at tipping points should be minimised.			
Post- mitigation			
Duration	Short term (1)	Dust will be generated for the duration of each activity in the establishment phase	Negligible (negative) – 12
Extent	Very Limited (1)	After mitigation measures are implemented, It is expected that the dust generated will be limited to isolated parts of the site.	
Intensity	Minimal (1)	Generated dust will have negligible impacts on the ambient air quality after mitigation	
Probability	Probable (4)	Probable that the impact on ambient air quality will occur.	
Nature	Negative		

9.2. Operational Phase

Activities during the Operational Phase with implications on the ambient air quality of the MRA and surroundings i.e. increasing emission to the ambient atmosphere are indicated in Table 9-4.

Table 9-4: Interactions and Impacts of Activity

Interaction	Impact
Mining of sand resources including screening	• Generation of dust; • Increased particulate matter load in the atmosphere leading to poor air quality; and • Soiling of surfaces due to airborne dust
Transportation of sand	
Concurrent rehabilitation (topsoil cover, ripping, and vegetation establishment) and monitoring of vegetation establishment	
• Handling of general and hazardous waste; and	• Release of volatiles to the ambient atmosphere
• Refueling of machineries within the mining	

9.2.1. Impact Description

The establishment of the pit, excavation of material, and stockpiling, coupled with the tipping and operation of the screening plant will result in airborne particulate matter, such as TSP, $PM_{10,}$ and $PM_{2.5}$. Also, the handling of hazardous materials and storage and refueling system will result in the release of volatiles.

9.2.1.1. Management Objectives

The management objective is to ensure that emissions on-site and at off-site locations are kept below the regulatory limits for the protection of the environment, human health, and wellbeing. Management will ensure mitigation measures are in place and that emissions remain below limit values and in compliance with the standards.

9.2.1.2. Management Actions

- Ensure mitigation measures are factored into the daily operation at the mine; and
- Implement particulate monitoring onsite, and at upwind and downwind sensitive receptor locations to assess the effectiveness of the mitigation measures and ensure compliance.

9.2.1.3. Impact Ratings

The operational phase activities will require mitigation measures in place to contain emissions from certain activities to the atmosphere. The mitigation measures are similar, hence, the impacts are grouped and rated together (Table 9-5), and storage and handling of hazardous material are rated differently (Table 9-8).

Table 9-5: Significance Ratings for Excavation, Tipping, Screening, Stockpiling, and Material handling

Activity and Interaction: Tipping, Screening, Stockpiling, and Material handling			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Dust generation and poor ambient air quality			
Before mitigation/ management			
Duration	Project life (5)	Dust will be generated for the project life	Negligible (negative) – 72
Extent	Limited (2)	Airborne dust will be limited to the site and its immediate surroundings	
Intensity	Very Serious (5)	Very serious impact on ambient air quality	
Probability	Almost certain (6)	It is almost certain that the impact will occur.	
Nature	Negative		
Mitigation/ Management actions			
• Application of dust suppressant on the haul roads and exposed areas; • Conduct mining activities judiciously on non-windy days (wind speed less than 5.4 m/s); • Set maximum speed limits on haul roads and have these limits enforced; • The area in the mining schedule for each year should be opened up in phases and no unnecessary clearing, digging or scraping must occur, especially on windy days; • The drop heights when tipping and loading should be minimised; and • Implement ambient air quality monitoring Dustfall rates and PM_{10} to assess the effectiveness of the mitigation measures in place.			
Post- mitigation			
Duration	Project life (5)	Dust will be generated for the project life	Negligible (negative) – 36
Extent	Limited (2)	Airborne dust will be limited to the project site and its immediate surrounding after mitigation.	
Intensity	Minor (2)	Minor impacts anticipated after mitigation	
Probability	Probable (4)	Probable that impact will occur after mitigation.	
Nature	Negative		

Table 9-6: Significance Ratings for Storage and Handling of Hazardous material (including Fuel)

Activity and Interaction: Hazardous Materials and Diesel Storage			
Impact Description: Release of Volatiles Resulting in Poor Air Quality			
Prior to mitigation/ management			
Duration	Project life (5)	Vapourisation and oil leaks from storage tanks will occur and hazardous materials will be stored and used for the duration of the operational phase	Minor (negative) – 36
Extent	Limited (2)	Vapour and oil leaks released will be limited to the site and immediate surroundings	
Intensity	Minor (2)	Airborne vapour and oil leak will have a minor impact on ambient air quality during the operational phase	
Probability	Probable (4)	It is unlikely that released vapour and oil leaks will impact ambient air quality.	
Nature	Negative		
Mitigation/ Management actions			
• Strict adherence to products and waste management plan; • Handle, store, and dispose hazardous substances in accordance with the local regulations; • Store hazardous substances in clearly labeled containers and demarcated area; • Deal with emergencies promptly i.e. spills; and • Ensure secondary containment for all fuel storage tank leaks in accordance with good engineering practice.			
Post management			
Duration	Project life (5)	Vapourisation and oil leaks from storage tanks will occur and explosive will be stored and used for the duration of the operational phase	Negligible (negative) – 21
Extent	Very Limited (1)	After mitigation measures are implemented, it is expected escape of vapour or leaks will be limited to isolated areas on site	
Intensity	Minimal (1)	Minimal impact on ambient air quality after mitigation	
Probability	Unlikely (3)	Probable that an impact on ambient air quality will occur.	
Nature	Negative		

9.3. Decommissioning Phase

The management of the mine will be conducting concurrent rehabilitation of the mined-out areas. Hence, the final Decommissioning Phase activities will have minimal impacts (Table 9-7) on the ambient air quality of the MRA and surroundings.

Table 9-7: Interactions and Impacts of Activity

Interaction	Impact
Rehabilitation (spreading of the preserved subsoil and topsoil, profiling of the land and natural re-vegetation)	• Generation of dust; • Increased particulate matter load in the atmosphere leading to poor air quality; and • Soiling of surfaces due to dustfall
Post-closure monitoring and rehabilitation	

9.3.1. Impact Description

The rehabilitation activities which will be concurrent with the sand mining operation include the spreading of subsoil and topsoil, profiling, and natural re-vegetation of the MRA. This will involve the use of heavy machineries similar to those used in the establishment phase for future rehabilitation onsite and will result in the release of fugitive emissions, such as TSP, $PM_{10,}$ and $PM_{2.5}$.

9.3.1.1. Management Objectives

The management objective is to ensure that emissions on-site and at off-site locations are kept below the regulatory limits for the protection of the environment, human health, and wellbeing. Management will ensure mitigation measures are in place that emissions remain below limit values and in compliance with the standards.

9.3.1.2. Management Actions

- Ensure mitigation measures are factored into the daily operation at the mine; and
- Implement particulate monitoring onsite, and at upwind and downwind sensitive receptor locations to assess the effectiveness of the mitigation measures and ensure compliance.

9.3.1.3. Impact Ratings

The decommissioning phase activities will require similar mitigation measures to those employed during the operational phase. The impact rating for this phase is discussed in Table 9-8.

Table 9-8: Significance Ratings for Rehabilitation of the MRA

Activity and Interaction: Rehabilitation of the MRA			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Poor ambient air quality			
Prior to mitigation/ management			
Duration	Medium-term (3)	Dust will be generated in the medium term for the duration of each activity in the decommissioning phase	Major (negative) – 20
Extent	Very Limited (1)	Limited to specific isolated parts of the site	
Intensity	Minimal (1)	Minimal effect on surrounding air quality is anticipated	
Probability	Probable (4)	Probable that an impact on ambient air quality will occur.	
Nature	Negative		
Mitigation/ Management actions			
• Application of dust suppressant on exposed areas prior to vegetation establishment; • Conducting rehabilitation activities judiciously by avoiding windy days (days with wind speed greater than 5.4 m/s); • Set maximum speed limits onsite and have these limits enforced; • The area of disturbance must be kept to a minimum at all times, especially on windy days; • The drop heights when loading or tipping should be minimised; and • Undertake post-closure monitoring to assess the effectiveness of the rehabilitation i.e regular assessment of vegetaion growth and dustfall monitoring.			
Post- mitigation			
Duration	Medium-term (3)	Dust will be generated in the medium term for the duration of the rehabilitation process during the decommissioning phase	Negligible (negative) – 15
Extent	Very Limited (1)	After mitigation measures are implemented, It is expected that the dust generated will be limited to isolated parts of the site.	
Intensity	Minimal (1)	Generated dust will have minimal impacts on the ambient air quality after mitigation	
Probability	Unlikely(3)	Unlikely that impact on ambient air quality will occur after mitigation.	
Nature	Negative		

9.4. Cumulative Impacts

Copper Sunset is already in operation and mining of sand is ongoing. The tonnage and the machineries used will remain the same, the only change will be mining activities moving from the current footprint to the expanded areas to extend the LOM.

Since mining will continue at the scale and pace, and based on the aforementioned, it is difficult to calculate the cumulative impacts. The current sand mining is already contributing to the background and this will not change once mining commences in the extension areas.

9.5. Unplanned and Low Risk Events

Table 9-9 highlights some likely unplanned events related to this Project. This was based on expert knowledge drawn from the related industry. Data on the type of incidents and frequency will assist in establishing the nature, risk type, geographic spread, and appropriate mitigation measures to curtail impacts in the event of an occurrence.

Table 9-9: Unplanned Events and Associated Mitigation Measures

Unplanned Risk	Mitigation Measures
Extreme wind erosion event	• Minimise exposed areas prone to erosions to avoided source(s) during such episode. • Conduct mining and concurrent rehabilitation in phases.
Hydrocarbon spillage	• Service machineries at designated service bays. • Hydrocarbon spill kits must be available on-site at all locations where hydrocarbon spills could take place.

10. Environmental Management Plan

Table 10-1 provides a summary of the proposed project activities, environmental aspects, and impacts on the receiving environment. Information on the mitigation measures, mitigation type, timing of implementation of the EMP are specified.

Table 10-1: Environmental Management Plan

Activity	Potential Impacts	Aspects Affected	Phase	Mitigation Measures	Mitigation Type	Time period for implementation
• Site clearance and vegetation removal; • Placement of the Offices and associated mining equipment; • Construction of the hydrocarbon storage tank and refueling area; • Establishment of a haul road/tracks; and • Stockpiling of topsoil.	Poor air quality due to the generation of dust	Air Quality	Establishment	• Apply dust suppressants or binders on exposed areas and haul roads; • Conduct activities judiciously and limit operation to non-windy days (with wind speed ≤ 5.4 m/s); • Keep the area of disturbance to a minimum and avoid any unnecessary clearing, digging, or scraping, especially on windy days; • Minimise the drop heights when loading onto trucks and at tipping points; • Set maximum speed limits and have these limits enforced; and • Conduct ambient air quality monitoring.	• Control through the implementation of mitigation measures in the air quality management plan; and • Ambient air quality monitoring.	Establishment phase and for the life of mine.
• Mining of sand resources including screening; • Transportation of sand; • Refueling of machineries within the mining area or at the mobile offices; • Handling of general and hazardous waste; and • Concurrent rehabilitation (topsoil cover, ripping, and vegetation establishment) and monitoring of vegetation establishment.	Poor air quality due to the generation of dust	Air Quality	Operation	• Apply dust suppressants or binders on exposed areas and haul roads; • Conduct activities judiciously and limit operation to non-windy days (with wind speed ≤ 5.4 m/s); • Keep the area of disturbance to a minimum and avoid any unnecessary clearing, digging, or scraping, especially on windy days; • Minimise the drop heights when loading onto trucks and at tipping points; • Set maximum speed limits and have these limits enforced; and • Monitor the air quality management measures and information to ensure that adopted mitigation measures are sufficient and efficient to achieve current air quality standards at the MRA boundary and the closest receptors.	• Control through the implementation of mitigation measures in the air quality management plan; and • Ambient air quality monitoring.	Operational phase and for the life of mine.
• Rehabilitation of the MRA; and • Post-closure and rehabilitation monitoring.	Poor air quality due to the generation of dust	Air Quality	Decommissioning	• Apply dust suppressants or binders on exposed areas; • Limit rehabilitation activities to non-windy days (with wind speed ≤ 5.4 m/s), if possible; • Keep the area of disturbance to a minimum and avoid any unnecessary clearing, digging, or scraping, especially on windy days (≥ 5.4 m/s); • Minimise the drop heights when loading onto trucks and at tipping points; • Set maximum speed limits and have these limits enforced; • Rehabilitated landscape should be vegetated; and • Undertake ambient air quality monitoring to assess the effectiveness of the mitigation measures in place.	• Control through the implementation of mitigation measures in the air quality management plan; and • Ambient air quality monitoring.	On commencement of the decommissioning phase and for the duration of the phase.

11. Monitoring Programme

It is recommended that the ongoing dust monitoring continues for the LOM. In addition to the aforementioned, it is recommended that a continuous real-time fine particulate monitor with the ability to measure both PM_{10} and $PM_{2.5}$ be commissioned onsite. The frequency of monitoring should ensure diurnal, seasonal, annual, and inter-annual records are captured to inform management decision-making. Table 11-1 shows the pollutants to be measured and the frequency of monitoring as required by law.

Table 11-1: Recommended Monitoring Plan

Method	Frequency	Target	Responsibility
Monitoring in accordance with: • EN14097 for PM2.5; • EN12341 for PM10; and • American Standard Test Method ASTM 1739-98 in SANS1137:2019	• Continuous PM_{10}, $PM_{2.5}$ monitoring; and • Monthly dustfall monitoring on-site and at surrounding receptors.	Particulate pollutants from the mining operation must be kept below the South African standards: • GN R 1210 of 24 December 2009 • GN R 486 of June 2012; and • GN R 827 of 1 November 2013.	A designated Environmental Officer (EO) onsite to collect ambient air quality data and submit it to an independent consultant for interpretation and reporting.

12. Stakeholder Engagement Comments Received

The comments received from Focus Group Meetings that were held with stakeholders have been collated into a Comments and Response Report (CRR) which was appended to the Public Participation Report submitted to the DMRE. Currently, there were no air quality concerns raised in the CRR, to date. However, should there be any in the future, it will be incorporated in the CRR updates.

13. Recommendations

Based on the results presented in this report, a holistic set of recommendations should be applied, some are existing and currently being applied, others are new and should be implemented. The latter will result in minimal impacts on the ambient air quality and ensure compliance with regulatory requirements at the project boundary:

- Review the dustfall monitoring network by adding more sites, preferably in residential areas;
- Apply dust suppressants or binders on exposed areas and haul roads;
- Conduct activities judiciously and limit operation to non-windy days (with wind speed ≤ 5.4 m/s);

- Keep the area of disturbance to a minimum and mine the areas designated in the annual schedule, in phases. Avoid any unnecessary clearing, digging, or scraping, especially on windy days (≥5.4 m/s);
- Minimise the drop heights when loading onto trucks and at tipping points;
- Set maximum speed limits and have these limits enforced on-site;
- Store hazardous substances in clearly labeled containers;
- Emergencies spills must be dealt with promptly;
- Set up a real-time continuous air quality monitoring station to measure criteria particulate; and
- Monitor the air quality management measures and information to ensure that adopted mitigation measures are sufficient and efficient to achieve current air quality standards at the MRA boundary and the closest receptors.

14. Reasoned Opinion Whether Project Should Proceed

Copper Sunset intends to expand its MRA to incorporate adjacent properties to extend the LOM. The intent is to expand the current mining operations to include include additional portions of the Remaining Extent (RE) of the Farm Bankfontein No. 9 and a portion of the RE of the Farm Zandfontein No. 259.N The proposed extension of the MRA amounts to approximately 1642 ha (Bankfontein) and 1153.6 ha (Zandfontein), for the mining of sand.

Copper Sunset is conducting sand mining in the area and the dustfall data for 26 months were provided and used to assess background conditions. For the period, only three exceedances were recorded (two at BW and one at BWP) and not in sequential months. The data is an indication of the impacts the current operation is having on the ambient air quality. This impact is unlikely to change as the tonnage mined annually will remain the same and the number of mine machineries are unlikely to change.

Also, model predictions have shown that exceedances are likely to be confined within the mining right footprint.

The overall impacts based on the aforementioned can be minimised with appropriate mitigation measures and management measures suggested in this report. The air quality specialist will recommend that the extension be approved, provided the suggested mitigation measures are implemented.

15. Conclusion

This study was set out to establish the overall impacts as a result of the sand mining operations planned for the extension areas. For this assessment, the worst-case scenario (i.e. without mitigation measures in place) was adopted [mitigation measures which are currently being implemented on site were not considered] except for dust deposition, which may have resulted in the model over-estimating the predicted GLC and impacts.

Dustfall records representing the current baseline, a total of 108 data sets from four sites (with 10 missing records), covering approximately two years (i.e. 26 months), have confirmed that exceedance of the non-residential limit occurred thrice. Despite the aforementioned, the sites were compliant, as exceedance in sequential months was not observed. Several other sources in the immediate vicinity are likely to influence background air quality. Apart from these exceedances mentioned above, most of the dustfall rates measured per month were below the non-residential limit, because the 92nd percentile of the data collected were below 1,200 mg/m^2/d.

Dispersion model predictions have shown that the areas where exceedances are likely to occur will be confined largely to within the MRA, with the likelihood of being compliant with the South African daily and annual limit values at the MR boundary.

A summary of the predicted GLC is given below:

- Areas where the predicted daily GLC of $PM_{2.5}$ will exceed the standard (40 µg/m^3) will be confined within the MRA. The predicted GLCs at the selected monitoring locations were below the standard. The predicted annual GLC of $PM_{2.5}$ will not exceed 20 µg/m^3 (annual standard) onsite and at the selected sensitive receptors;
- The areas where the PM_{10} 24-hour standard of 75 µg/m^3 are likely to be exceeded will be confined within the MRA. The predicted GLCs at the selected sensitive receptors are lower than the daily standard. The predicted annual GLC at these receptors will be lower than the South African standard; and
- The predicted dustfall rates onsite and at selected sensitive receptors (with simulations for no mitigation and with mitigation) have been assessed. The simulated dustfall rates confirmed that the areas where the residential limit (600 mg/m^2/d) and the non-residential limit (1,200 mg/m^2/d) values will be exceeded are likely to be confined within the MRA. The dustfall rates predicted at selected sensitive receptors were lower than both limit values. Also, with mitigation measures in place, the footprint where exceedances are likely to occur shrank further within the MRA.

The impacts of the proposed sand mining planned for the extension areas were evaluated using a risk matrix that considers the nature, significance, extent, duration, and probability of impacts occurring (Appendix A). Based on this rating system, impacts on the surroundings with mining occurring are deemed “negligible negative” without mitigation.

To curtail emissions from mining operations from impacting receptors outside the MRA, mitigation, and management interventions are crucial. Some of the suggested mitigation measures and management interventions recommended are repeated, and they include:

- Application of dust suppressants/binders on haul roads and exposed areas, setting maximum speed limits on haul roads and to have these limits enforced, and
- Mining judiciously, by opening up areas schedule for excavation in phases.

If mine management implements the recommended mitigation measures outlined in this report, emissions are likely to be curtailed to below standards within the MRA, ensuring compliance with regulatory requirements at nearby receptors.

16. References

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Appendix A: Impact Assessment Methodology

17. Methodology

The potential impacts from the proposed Project have been assessed based on the severity predicted on-site and at sensitive receptor(s). This culminates in a significance rating which identifies the most important impacts that require mitigation and/or management.

Based on international guidelines and South African legislation, the following criteria were considered when examining potentially significant impacts:

- Nature of impacts (direct / indirect, positive / negative);
- Duration (short / medium / long-term, permanent (irreversible) / temporary (reversible), frequent / seldom);
- Extent (geographical area, size of affected population / habitat / species);
- Intensity (minimal, severe, replaceable / irreplaceable);
- Probability (high / medium / low probability); and
- Possibility to mitigate, avoid or offset significant adverse impacts.

Details of the impact assessment methodology used to determine the significance of physical, bio-physical and socio-economic impacts are provided below.

The significance rating process follows the established impact / risk assessment formula:

Significance = Consequence x Probability x Nature

Where

Consequence = Intensity + Extent + Duration

And

Probability = Likelihood of an impact occurring

And

Nature = Positive (+1) or negative (-1) impact

Note: In the formula for calculating consequence, the type of impact is multiplied by +1 for positive impacts and -1 for negative impacts

The matrix calculates the rating out of 147, whereby Intensity, Extent, Duration and Probability are each rated out of seven as indicated in Table 17-1. The weight assigned to the various parameters is then multiplied by +1 for positive and -1 for negative impacts. Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in the

Environmental Management Plan Report (EMPr). The significance of an impact is then determined and categorised into one of eight categories, as indicated in Table 17-2, which is extracted from Table 17-1. The description of the significance ratings is discussed in Table 17-3.

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, i.e. there may already be certain types of mitigation measures included in the design (for example due to legal requirements). If the potential impact is still considered too high, additional mitigation measures are proposed.

Table 17-1: Impact Assessment Parameter Ratings

RATING	INTENSITY/REPLACABILITY		EXTENT	DURATION/REVERSIBILITY	PROBABILITY
	Negative impacts	Positive impacts			
7	Irreplaceable damage to highly valued items of great natural or social significance or complete breakdown of natural and / or social order.	Noticeable, on-going natural and / or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable damage to highly valued items of natural or social significance or breakdown of natural and / or social order.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Almost certain / Highly probable: It is most likely that the impact will occur. <80% probability.
5	Very serious widespread natural and / or social baseline changes. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/ Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.
4	On-going serious natural and / or social issues. Significant changes to structures / items of natural or social significance.	Average to intense natural and / or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.
3	On-going natural and / or social issues. Discernible changes to natural or social baseline.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local extending only as far as the development site area.	Medium term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.
2	Minor natural and / or social impacts which are mostly replaceable. Very little change to the baseline.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited to the site and its immediate surroundings.	Short term: Less than 1 year and is reversible.	Rare / improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.
1	Minimal natural and / or social impacts, low-level replaceable damage with no change to the baseline.	Some low-level natural and / or social benefits felt by a very small percentage of the baseline.	Very limited Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly unlikely / None: Expected never to happen. <1% probability.

Table 17-2: Probability/Consequence Matrix

Probability	Significance																																									
7	-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
6	-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
5	-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
4	-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Consequence

Table 17-3: Significance Rating Description

Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the project. The impact may result in permanent positive change	Substantial (positive)
73 to 108	A beneficial impact which may help to justify the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and / or social) environment	Major (positive)
36 to 72	An positive impact. These impacts will usually result in positive medium to long-term effect on the natural and / or social environment	Minor (positive)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the natural and / or social environment	Negligible (positive)
-3 to -35	An acceptable negative impact for which mitigation is desirable. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the natural and / or social environment	Negligible (negative)
-36 to -72	A minor negative impact requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the natural and / or social environment	Minor (negative)
-73 to -108	A moderate negative impact may prevent the implementation of the project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and / or social) environment and result in severe changes.	Major (negative)
-109 to -147	A major negative impact may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Substantial (negative)