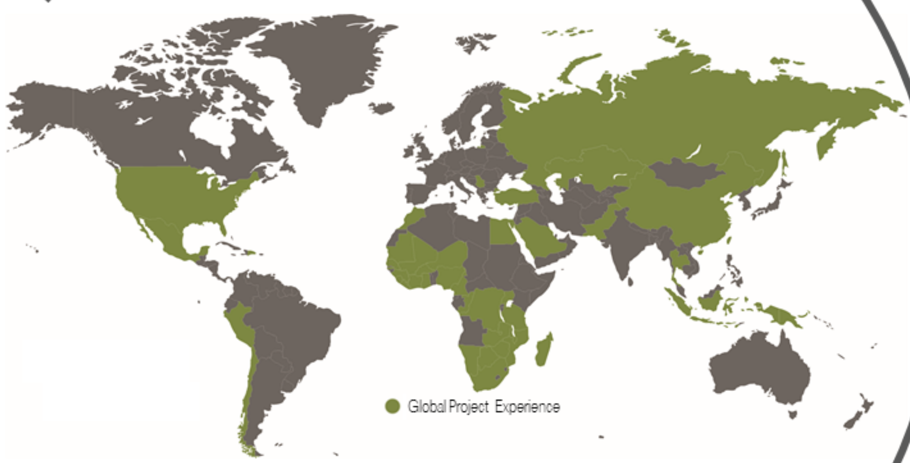

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Environmental Authorisation for Proposed Additional Infrastructure at the Universal Coal Development III (Pty) Ltd Ubuntu Colliery, Mpumalanga Province

Air Quality Impact Assessment

Prepared for:
Universal Coal Development III (Pty) Ltd

Project Number:
UCD6097

31 January 2021

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This document has been prepared by Digby Wells Environmental.

Report Type:	Air Quality Impact Assessment
Project Name:	Environmental Authorisation for Proposed Additional Infrastructure at the Universal Coal Development III (Pty) Ltd Ubuntu Colliery, Mpumalanga Province
Project Code:	UCD6097

Name	**Responsibility**	**Signature**	**Date**
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Barbara Wessels	Reviewer	BWessels	January 2021

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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.

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Experience (years):	16 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.

[signature]	*January 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

Universal Coal Development III (Pty) Ltd (hereinafter Universal Coal) holds a Mining Right (MR), and Environmental Authorisation (EA) for the Ubuntu Colliery. Universal Coal has subsequently reconsidered the infrastructure necessary to undertake the approved mining activities. As such, Universal Coal intends to amend the existing approvals to include additional infrastructure (the Project).

The proposed additional infrastructure triggers activities listed in the Environmental Impact Assessment (EIA) Regulations, 2014 (GN R 982 of 4 December 2014 as amended by GN R 326 of 7 April 2017) promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). To this end, Universal Coal appointed Digby Wells Environmental (hereinafter Digby Wells) as the independent Environmental Assessment Practitioner (EAP) to complete a suite of specialist studies during the EIA process in support of the EA application.

This Air Quality Impact Assessment (AQIA) forms part of the suite of specialist studies required. The planned life-of-mine (LOM) is one year for the construction phase, followed by an eight-year operational (production) phase, with crushing and screening now taking place on-site in the approved pit area as opposed to the original plan of utilising Kangala Colliery for further processing of ore (including crushing, screening, and washing).

This AQIA was set out to establish the future perturbation of ambient air quality from the proposed Project's operational phase and associated cumulative impacts. Although this assessment focused on the additional infrastructure, it will be biased, if they are assessed in isolation without considering the full suite of activities associated with the use of the crushing and screening circuit, coupled with the use of the haul road for transporting of ore and overburden. For this AQIA, a holistic approach was adopted by considering all air emissions sources associated with the extraction of coal, with the focus on the worst-case scenario (i.e. without mitigation measures in place). The latter may have resulted in the model over-predicting future potential impacts.

Findings from the baseline assessment have confirmed that the meteorology is influenced by dominant winds from the north and north northwest respectively. Secondary contributions are from the northwest and north northeast. The average wind speed was observed to be ~3.2 m/s, with winds greater than 5.4 m/s occurring for 8.9% of the time.

Historical dustfall records from seven months of monitoring at ten sites were used to evaluate the background air quality scenario. With all the sites classified as "Residential". The sites that were non-complaint with the residential limit were DB9 (experienced exceedances in three sequential months) and DB11 (experienced exceedances in two sequential months). In general, 90th percentile of the dustfall rates measured were below the residential limit value.

Potential emissions anticipated from the operational phase of the Project were assessed. Model simulations of Ground Level Concentration (GLC) of criteria pollutants were generated, and for different averaging periods as recommended by the regulatory authorities. The GLC were then compared with the South African standards to ascertain compliance.

A summary of the predicted GLC is given below:

- The areas where the 24-hour standard (40 µg/m³) will be exceedanced are within the MR boundaryy. The GLC predicted at the nearby sensitive receptors (DB3, DB7, DB8, and DB9) will be lower than the standard. The annual GLC of $PM_{2.5}$ predicted will not exceed the regulatory standard, as the GLC predicted were very low, below 1 µg/m³ at the selected receptors.
- The predicted GLC of PM_{10} over a 24-hour averaging period returned simulation isopleths shown in (PM_{10} daily) and (PM_{10} annual). The area where the South African 24-hour standard of 75 µg/m³ will be exceeded, extends outside the MR boundaryy in the northern direction (some 1,7 km from the edge of the MR boundaryy). The GLC at the nearest sensitive receptors DB3, DB7, DB8, and DB9 were lower than the standard. The predicted annual isopleth showed that areas, where exceedance will occur, are confined to within the MR boundaryy during operation.
- The predicted dustfall simulation was conducted with mitigation and without mitigation. The predicted dustfall rates confirmed that both the residential and the non-residential limit of 1,200 mg/m^2/d will be exceeded within the MR boundaryy, and will extend outward to a distance of 2 km from the edge of the northern boundary. With mitigation in place, the predicted dustfall rates at the selected receptors were lowered significantly.

The impacts of the proposed Project were evaluated using a risk matrix that considers the nature, significance, extent, duration, and probability of impacts occurring. Based on this rating system, impacts on the surrounding receptors from the operational phase are deemed “major negative” without mitigation. However, with mitigation, the impacts were reduced to “negligible negative”. Since anticipated emissions from the operational phase activities are likely to influence receptors outside the Project boundary, mitigation and management intervention measures are crucial.

Some of the possible mitigation measures and management intervention measures recommended 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, rehabilitation of overburden stockpiles to prevent wind erosion, and enclosure of crushers; and
- Operation of ambient air quality monitoring network for particulates and gases to provide valuable data needed to assess the effectiveness of mitigation measures put in place during operation.

Once the mine implements the recommended mitigation measures outlined in this report, associated emissions can be contained to below standards, ensuring compliance with regulatory requirements.

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Appendix A: Impact Assessment Ranking

LIST OF ACRONYMS, ABBREVIATIONS AND DEFINITION

AERMOD	American Meteorological Society/United States Environmental Protection Agency Regulatory Model
AQIA	Air Quality Impact Assessment
DEA	Department of Environmental Affairs
EMPr	Environmental Management Plan Report
EIA	Environmental Impact Assessment
GLC	Ground Level Concentrations
LOM	Life of Mine
MM5	Mesoscale model - Fifth generation
NDCR	National Dust Control Regulations
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
ROM	Run of Mine
SAAELIP	South African Atmospheric Emission Licensing & Inventory Portal
tpa	Tonnes per annum
TSP	Total Suspended Particulates
USEPA	The United States Environmental Protection Agency
WBG	World Bank Group
WHO	World Health Organisation

CONTENT OF THIS REPORT IN ACCORDANCE WITH THE REGULATION GNR982 OF 2014, APPENDIX 6 (AS AMENDED)

Legal Requirement		Section in Report
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of- (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	 iii, iv Section 3
(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 2
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
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 6
(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;	N/A
(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 4

Legal Requirement		Section in Report
(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, Section 13
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9, Section 13
(n)	a reasoned opinion (Environmental Impact Statement) -	Section 14
	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	Section 12
(q)	any other information requested by the competent authority.	N/A

1. Introduction

Universal Coal Development III (Pty) Ltd (hereinafter Universal Coal) holds a Mining Right (MR) and Environmental Authorisation (EA) for the Ubuntu Colliery. Universal Coal has subsequently reconsidered the infrastructure necessary to undertake the approved mining activities. As such, Universal Coal intends to amend the existing approvals to include additional infrastructure (the Project).

The proposed additional infrastructure triggers activities listed in the Environmental Impact Assessment (EIA) Regulations, 2014 (GN R 982 of 4 December 2014 as amended by GN R 326 of 7 April 2017) promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). To this end, Universal Coal appointed Digby Wells Environmental (hereinafter Digby Wells) as the independent Environmental Assessment Practitioner (EAP) to complete the EIA in support of the EA application.

The EIA process includes a suite of specialist studies including an Air Quality Impact Assessment (AQIA) in support of the EIA process.

1.1. Project Background and Description

Universal Coal Development III (Pty) Ltd (hereafter Universal Coal) secured a Mining Right (MP30/5/1/1/2/10027 MR) for the formerly known Brakfontein Colliery in 2017. The Environmental Management Plan (EMP) was also approved simultaneously. Subsequently, the Colliery name was amended in January 2019 to reflect the name change of the mine to Ubuntu Colliery. Universal Coal currently holds the following approvals, which are applicable to the Ubuntu Colliery:

- A Mining Right and an EMP issued by the Mpumalanga Department of Mineral Resources and Energy with reference number MP 30/5/1/1/2/10027 MR;
- The name change of the colliery from Brakfontein Colliery to Ubuntu Colliery on 29 January 2019; and
- A Water Use License (WUL) issued by the Department of Water and Sanitation on 22 February 2019 with license number 03/B20E/ABCGIJ/4751.

The Ubuntu Colliery is located on Portions 6, 8, 9, 10, 20, 26, 30 and the Remaining Extent of the Farm Brakfontein 264 IR. This application focuses on the inclusion of additional infrastructure not previously considered in the original applications (i.e. Current EMP). The proposed infrastructure triggers Listed Activities contemplated under the Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) and thus the need for prior Environmental Authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). Other ancillary infrastructure included in this report are present on site but do not trigger NEMA Listed Activities.

1.2. Mining

The colliery is located on Portions 6, 8, 9, 10, 20, 26, 30 and the Remaining Extent of the Farm Brakfontein 264 IR.

The Ubuntu Colliery MR area consists of four seams for open pit mining. This EA application is to authorize additional infrastructure required to support mining processes. This is described in Section 1.3.2 below. The planned Life-of-Mine (LOM) is eight years.

1.3. Infrastructure

1.3.1. Approved Infrastructure

The authorised infrastructure (as per the approved Environmental Management Plan (EMP)) includes the following:

- Parking and offices;
- Weighbridge;
- Run of Mine (ROM) pads and Pollution Control Dams (PCD's);
- Mine equipment workshop and stores; and
- Wash bay facility.

The original proposals did not involve any processing infrastructure on-site but to transfer the coal to Kangala Colliery for further processing (including crushing, screening, and washing). This has subsequently proven to not be a practical solution and crushing and screening are now planned to take place in the approved pit area with a mobile crusher and screening plant.

1.3.2. Additional Infrastructure (The Project)

Further to on-site crushing and screening, the following additional infrastructure is required to be included in the EMP. Based on Digby Wells knowledge, all the below listed infrastructure has been established on site, except for the road diversion:

- Guard house and access control gate
- Control room
- Toilet facilities
- Haulage truck queueing area
- Hard park area
- Brake test ramp area
- Diesel depot area
- Product stockpile
- LDV and main access road
- Heavy duty truck access road
- Storm water diversion berm/trench
- Access control and boom gate
- Topsoil safety berm
- Lab office
- Sewage Treatment Plant (STP)
- Contractors camp site

- Perimeter fencing
- Crushing facilities and stockpile area
- Diversion of D2546 District road
- Water Treatment Plant (WTP)
- 45 000 litre silo tank

The following should be further noted pertaining to the above infrastructure:

- The additional infrastructure, except for the road diversion, has been established and does not trigger NEMA Listed Activities;
- The WTP will treat borehole water sourced from areas in the project footprint. The treated water will be for domestic use. The daily throughput of the WTP will be $12m^3$ p/day;
- The additional infrastructure, including the road, will be relocated in 2023; and
- The specific designs for the diversion of district road D2546 will be confirmed. It is proposed to have a reserve of 30 m and length of 2,5 km.

The Project list of activities for the construction, operation, and decommissioning phases are depicted in Table 1-1 below.

The table below details the list of project activities that will be used for impact assessment.

Table 1-1: Project activities

Phase	Activity
Construction	Site preparation: Surface preparation for infrastructure
	Construction of surface infrastructure
Operational	Operation and maintenance of infrastructure
	Use and maintenance of haul roads (incl. transportation of coal to offsite
Decommissioning	Demolition and removal of all infrastructure (incl. transportation off-site)
	Rehabilitation (spreading of soil, re-vegetation, and profiling/contouring)

2. Scope of Work

The aim of the AQIA is to to complete an air dispersion modelling assessment to predict the future implications of mining on the ambient air quality and exposure scenarios for nearby sensitive receptors.

Based on the above mentioned, the air quality Scope of Work (SoW) encompasses the following:

- Establishment of the site meteorology and existing background air quality using existing historical data;
- Assessment of the future air quality impacts of the proposed Project coupled with the additional infrastructure and comparison of results against the regulatory standards for compliance;
- Recommendation of management measures, including mitigation and monitoring requirements; and
- The SoW excludes baseline data collection and client meetings.

3. Details of the Specialist

Dr Matthew Ojelede is an air quality specialist at Digby Wells & Associates (Pty) Ltd and the Manager at the Department of Atmospheric Sciences and Noise. He holds a BSc in Geology (Hons), an MSc in Environmental Science, and a Ph.D. in Environmental Management. He is a member of the South African Council for Natural Scientific Professions (SACNASP), and the National Association for Clean Air (NACA). Matthew has authored and co-authored research articles and conference papers in both local and international peer-reviewed journals.

He has attended specialised courses in atmospheric dispersion modeling (AERMOD and CALPUFF).

4. Assumptions, Limitations and Exclusions

Assumptions, limitations, and exclusions pertaining to this Project are discussed in Table 4-1.

Table 4-1:Assumptions, Limitations and Exclusions

Assumption, Limitation, or Exclusion	Consequence
The uncertainty associated with dispersion models	Since mining activities were selected to demonstrate the worst-case scenario, the predicted model may have resulted in an overestimation

5. Relevant Legislation, Standards, and Guidelines

The legislation, regulation, and guidelines considered in this air quality report are tabulated and discussed briefly in Table 5-1. The applicable standards in terms of compliance are discussed in Section 5.1 below.

Table 5-1: 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.
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,	The purpose of these Regulations is to prescribe general measures for the control of dust in all areas.

Legislation, Regulation, Guideline, or By-Law	Applicability
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.	

5.1. 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 to 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).

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 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 5-2 below.

Table 5-2: 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

The DEA has established National Ambient Air Quality Standards for particulate matter with an aerodynamic diameter less than 10 microns (PM_{10}) in Table 5-3 and particulate matter with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$) since June 2012 (GN R 486 of 29 June 2012) as in Table 5-4.

Table 5-3: National Ambient Air Quality Standards for Particulate Matter (PM_{10}) (2009)

National Ambient Air Quality Standard for Particulate Matter (PM_{10})			
Averaging Period	**Limit Value (µg/m^3)**	**Frequency of Exceedance**	**Compliance Date**
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.			

Table 5-4: 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/m^3)**	**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.			

6. 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 Project area prior to the development i.e. in the context of this report, the land use and ambient air quality (may involve gathering and evaluating information from existing sources and collecting new field data). The second component involves the use of a computational air dispersion model to predict potential emissions from a source "the Project" and the degree of impact on the receiving environment

6.1. Baseline Assessment

The baseline assessment examines the site and immediate surroundings, the sensitive receptors likely to be impacted, and the background air quality of the Project area.

6.2. Project Area

Ubuntu Colliery is located within the Western margins of the Witbank Coalfields, in the jurisdiction of the Victor Khanye Local and Nkangala District Municipalities in the Mpumalanga Province. The site is located approximately 17 km east southeast of the town of Delmas, 14 km and 17 km north of Devon and Leandra respectively. For the purposes of this report, the Project area is defined as the "MR boundary".

The area is dominated by mechanised crop farming (i.e. maize), livestock farming and mining activities as the predominant land use types, all within a 10 km radius from the MR boundary. As a result, widely scattered farmsteads can be observed on Google Earth Imagery® ofthe area (Google Earth Pro V.7.3 (October 3, 2020)).

The mine is located in an area where the elevation varies between 1530 metres above sea level (masl) and 1591 masl from east to west.

Figure 6-1 shows the Project boundary, surrounding sensitive receptors (selected as the dust monitoring locations), and historical dust monitoring locations. These monitoring points were selected as sensitive receptors. According to the United States Environmental Protection Agency (USEPA), 2016, a sensitive receptor encompasses but is not limited to "*hospitals, schools, daycare facilities, elderly housing, and convalescent facilities. The aforementioned are locations where the occupants are more susceptible to airborne pollutants" if exposed*.

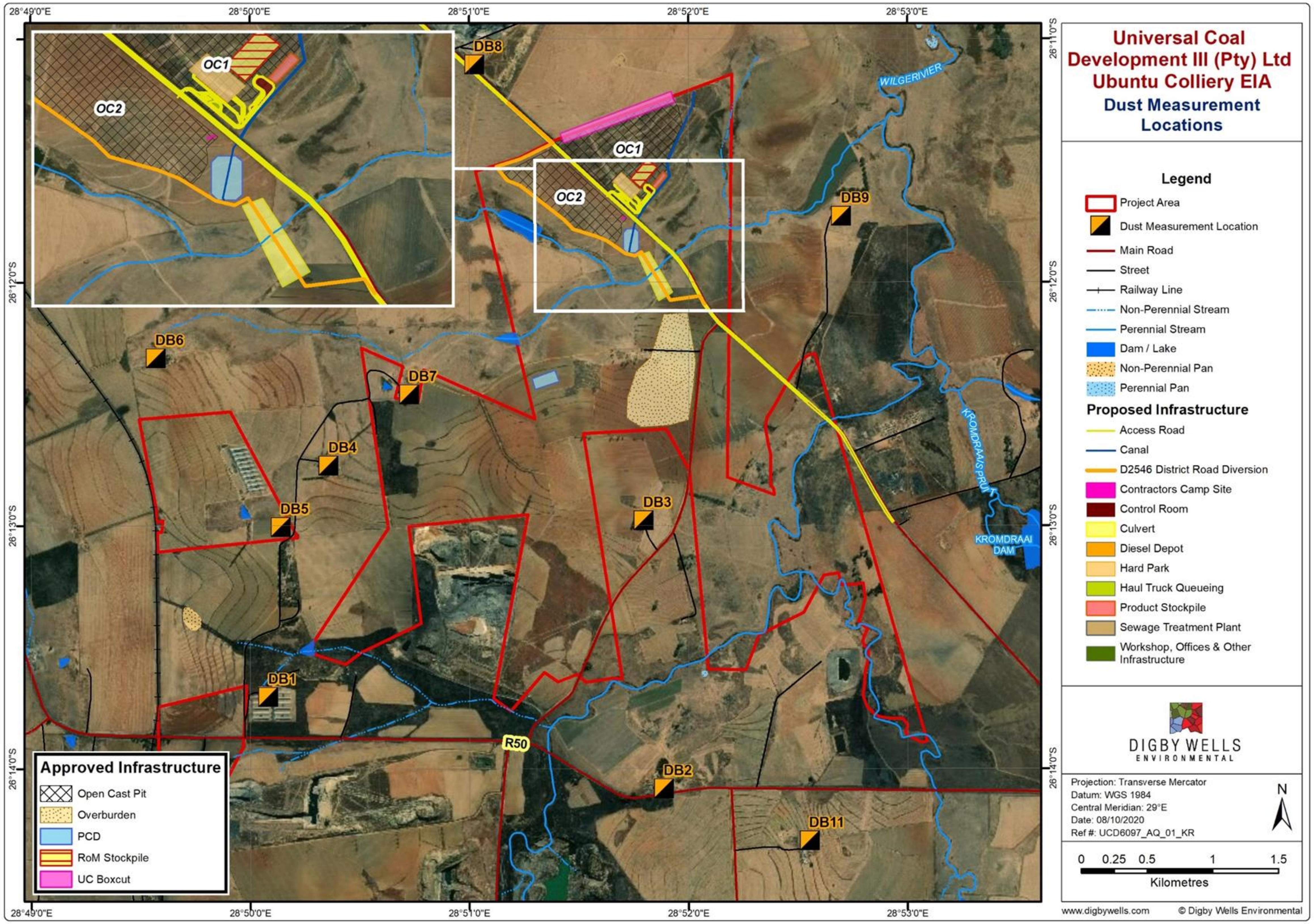


Figure 6-1: Project Boundary Showing Surrounding Receptors and Monitoring Sites

6.3. General Description of Climate in the Project Area

Site-specific MM5 modeled meteorological data set for three years (2017-2019) obtained from Lakes Environmental Software was used to assess the prevailing weather conditions. 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. Meteorological data for a point in the proposed project area 18 km east southeast of Delmas (26.208678 S, 28.861028 E) was obtained. 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 calms conditions (wind speed below 0.5 m/s) occur. The meteorological data assessed encompasses temperature, relative humidity, wind speed, and direction, and are discussed (Table 6-1).

6.3.1.1. *Temperature*

The monthly temperature for the MR boundary (3-year average) is presented in Table 6-1 and Figure 6-3. The data indicate that the monthly temperature average varied between 10°C - 21°C. Ambient temperatures were observed to be higher during the summer months.

6.3.1.2. *Rainfall*

The total monthly rainfall records (3-years average) are provided in Table 6-1 and Figure 6-2. Based on the rainfall data, the summer months (December – February) received much of the rains (i.e. >69%) with January and February being the peak rainfall months (Figure 6-2), followed by Spring with 19% and Autumn with 11%. While winter (June – August), received the least rainfall (less than 1%).

6.3.1.3. *Relative Humidity*

The relative humidity records (3-year average) ranged between 64% and 73% (Table 6-1 and Figure 6-3). 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*.

[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)	19	21	20	19	16	13	10	10	12	15	17	19	16
Total Mon. Rain (mm)	631	552	255	27	12	0	1	28	59	155	235	356	2310
Rel. Hum. (%)	64	70	66	65	72	70	73	69	68	64	60	61	67

(Source: Lakes Environmental)

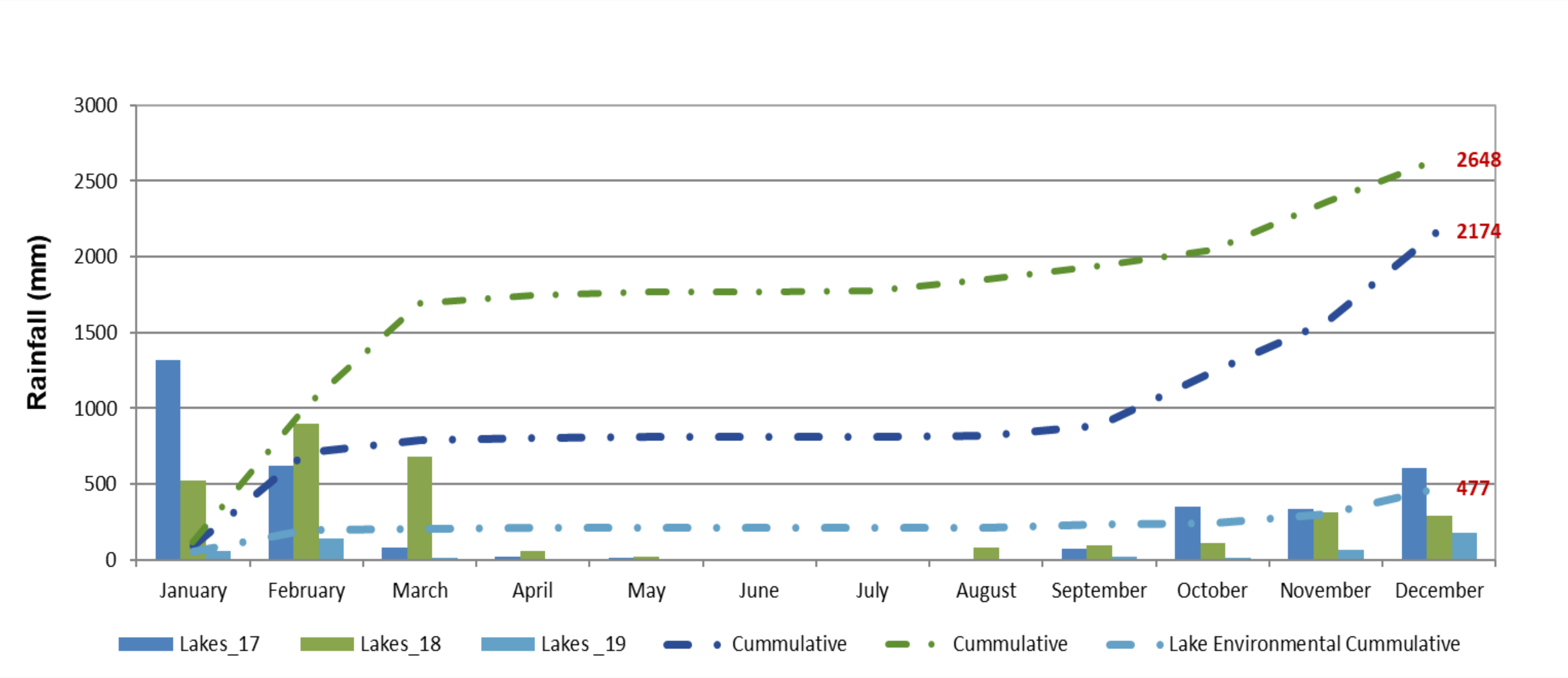


Figure 6-2: Rainfall

(Source: Lakes Environmental)

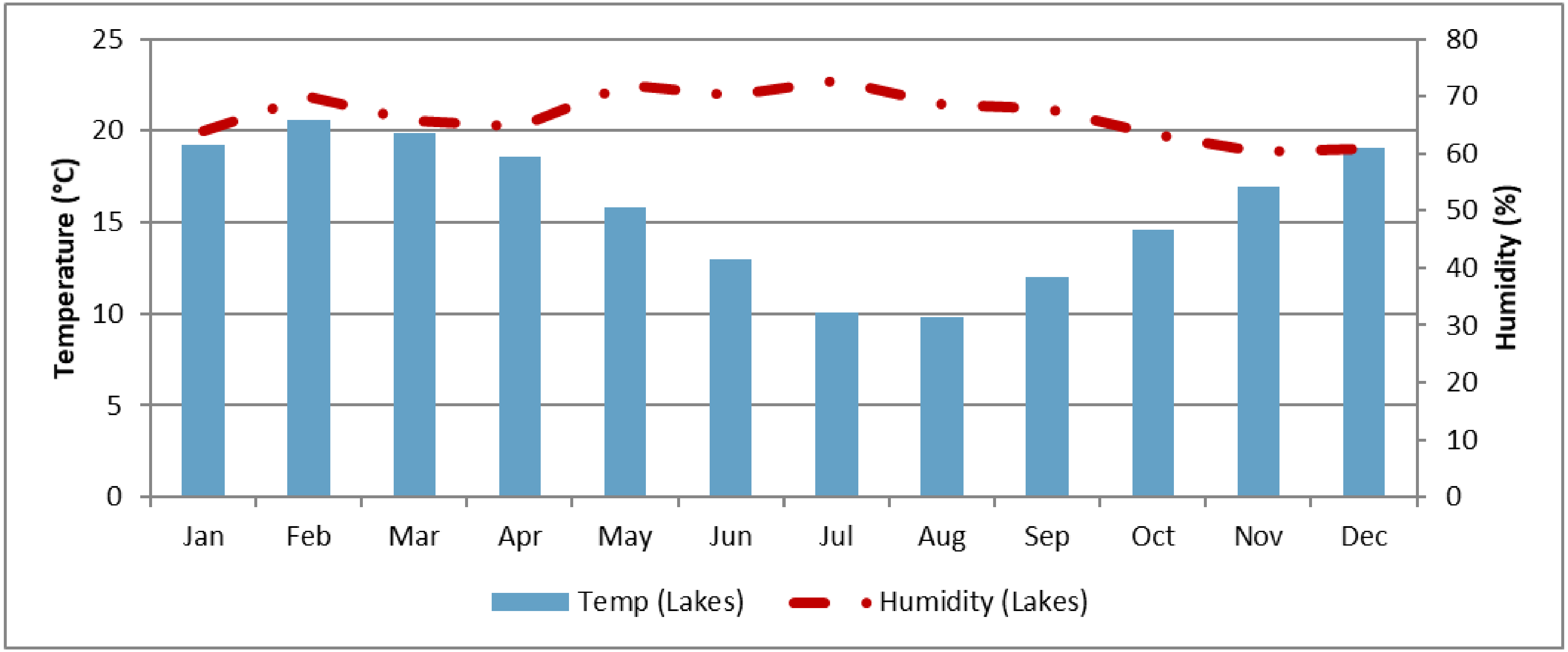


Figure 6-3: Monthly - Temperature and Humidity

(Source: Lakes Environmental)

6.3.1.4. Wind Speed

Hourly meteorological 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 6-4). The prevailing winds are from the north (11%) and north northwest (11%) respectively. Secondary contributions are from the northwest (9%) and north northeast (7%). The seasonal variability in wind speed pattern is shown in Figure 6-5.

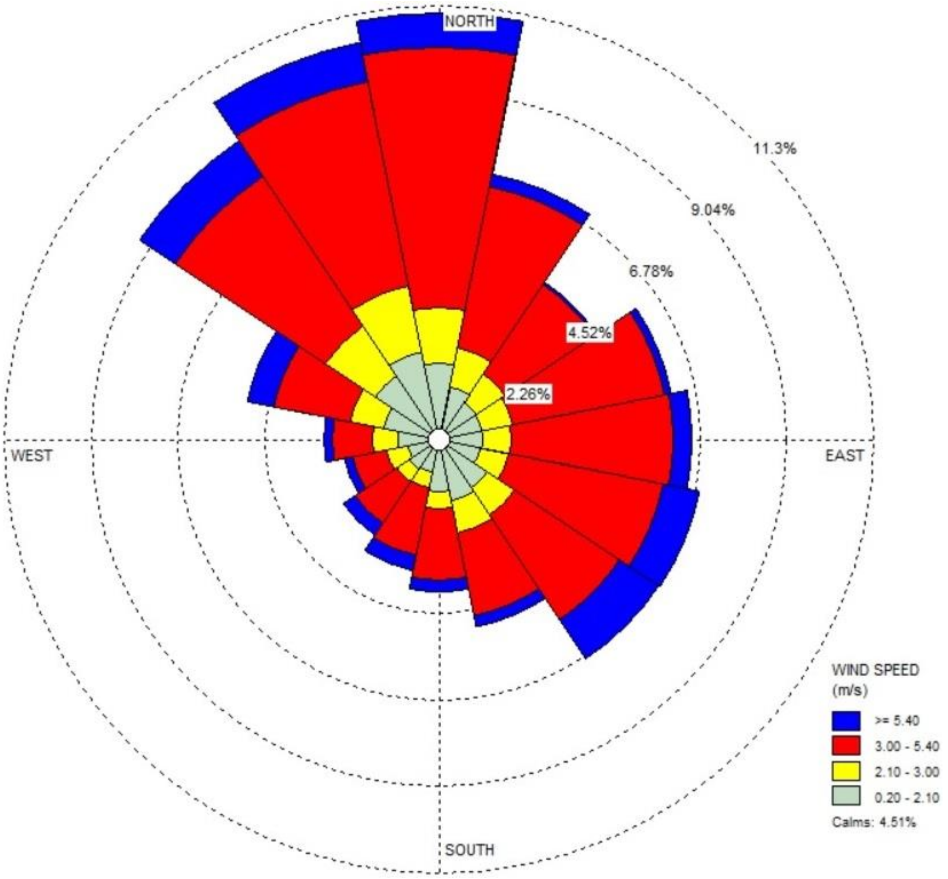


Figure 6-4: Surface Wind Rose

(Source: Lakes Environmental)

The average wind speed at the MR boundary is 3.2 m/s and calm conditions (<0.5 m/s) occurred for some 4.5% of the time. Wind speed capable of causing wind erosion i.e. ≥5.4 m/s occurred for about 8.9% of the time (Figure 6-6). This equates to about 32 days of high wind speed each year. Based on the statistics, 13 days in spring experience wind speed greater than 5.4 m/s, 10 days in winter, six days in summer, and three days in autumn. The frequency of winds from a particular direction can be seen in Figure 6-5

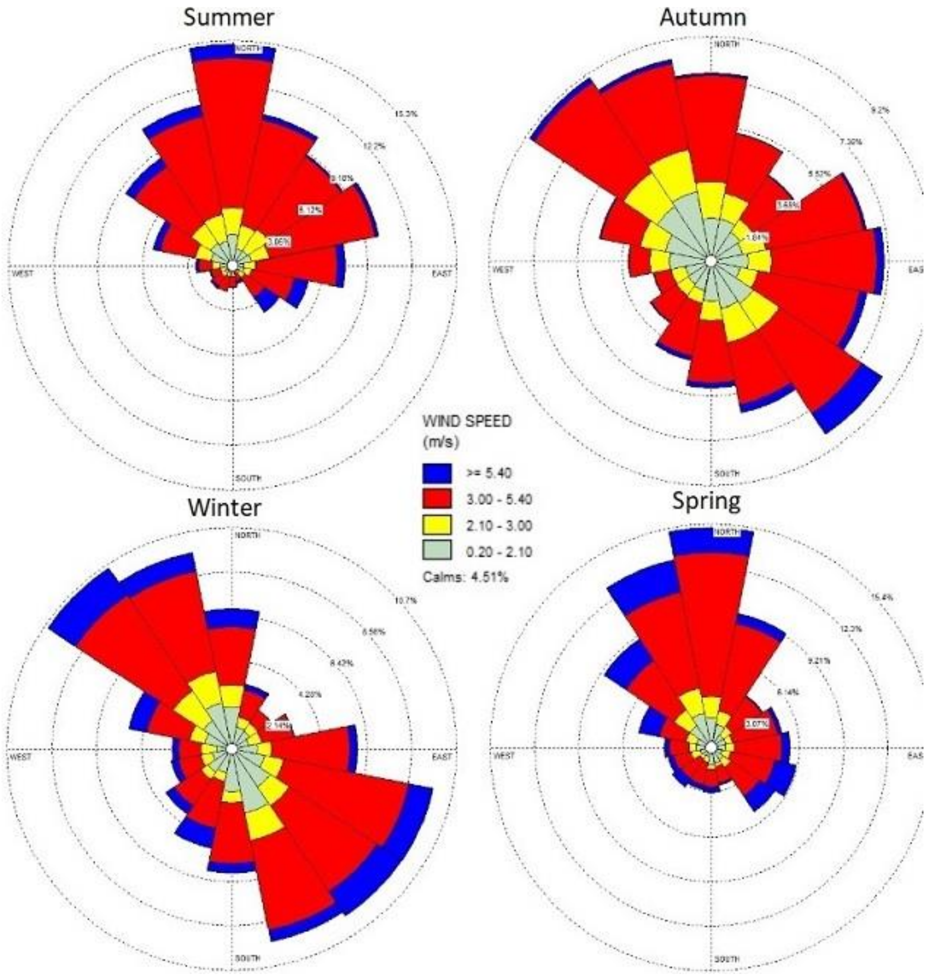


Figure 6-5: Seasonal Wind Roses

(Source: Lakes Environmental)

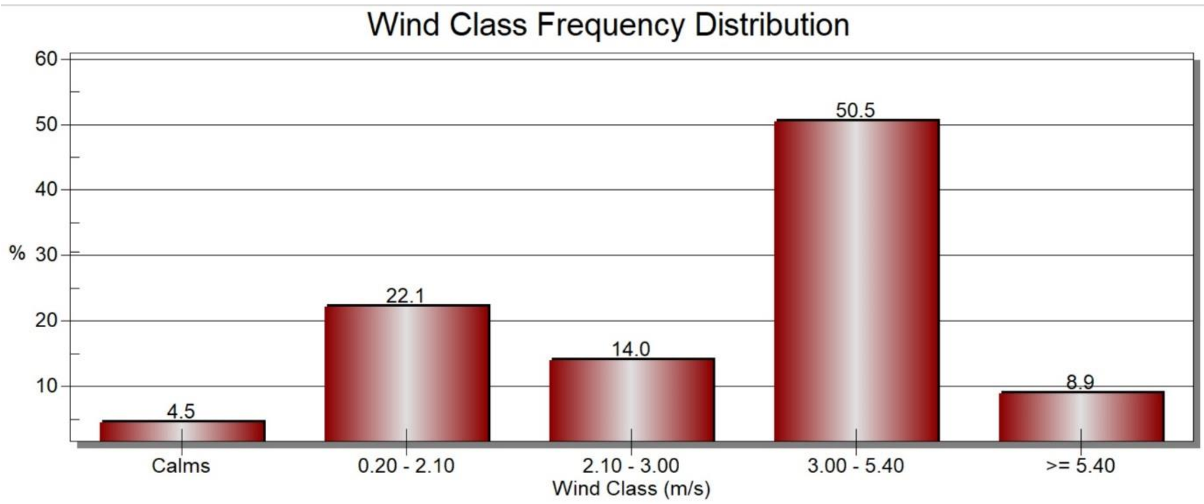


Figure 6-6: Wind Class Frequency

6.3.2. Assessment of Existing Air Quality

6.3.2.1. Dustfall

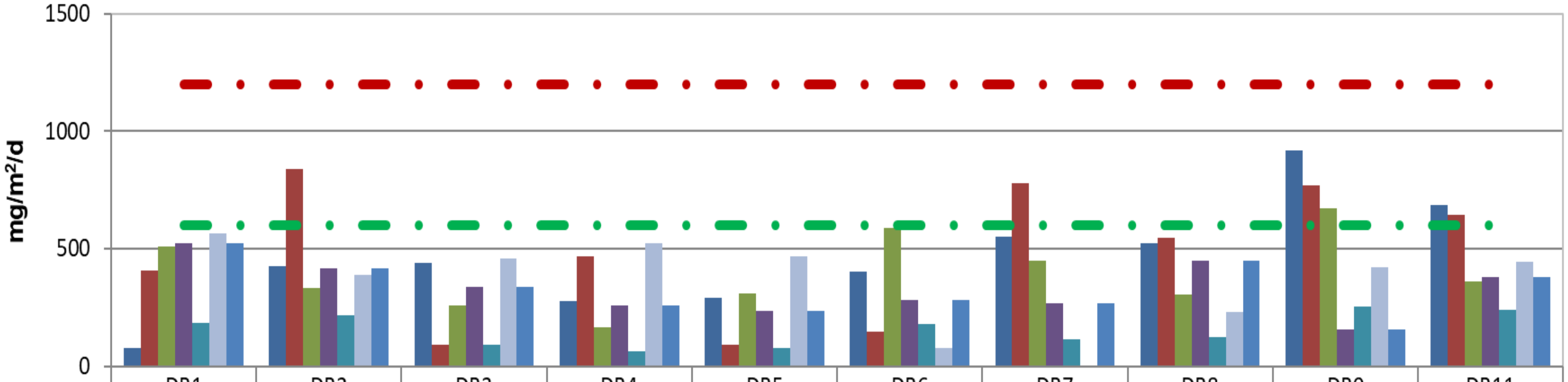
Archived dust deposition data collected using the American Standard Test Method (ASTM D1739) in the Project area was used to assess background air quality. Data for seven months, from July 2012 to January 2013 were obtained from the historical records. The graph showing the results is depicted below (Figure 6-7). Since mining has not commenced, the monitoring sites were categorised as residential. Once mining commences, some of the monitoring locations will have to be re-categorised to non-residential (the reason being they fall within the MR boundary). The dustfall rates were compared with the South African *Dust standards* (GN R 827 of 1 November 2013) for compliance.

Based on the dustfall results, the sites where exceedances of the residential limits were measured and in sequential months (i.e non-compliant) are discussed below in sequential order:

- DB9 (2012): the dustfall rates measured at this site were in exceedance of the residential limit of 600 $mg/m^2/d$ in July (with **920** mg/m^2d), August (with **770** mg/m^2d), and September (with **673** mg/m^2d). Therefore, the site is not compliant. This was likely due to localised farming activities in the vicinity, resulting in particulates being airborne, deposited, and re-suspended; and
- DB11 (2012): the dustfall rates measured at this site were in exceedance of the residential limit of 600 $mg/m^2/d$ in July (with **680** mg/m^2d) and August (with **644** mg/m^2d). Most likely the same reason as mentioned above may have resulted in non-com-laince.

6.3.2.2. Fine Particulate Matter and Gasses

The real-time monitoring of other criteria pollutants, such as particulate matter with an aerodynamic diameter of less than 10 microns (PM_{10}) and less than 2.5 microns ($PM_{2.5}$), and gaseous pollutants such as sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), and ozone (O_3) is yet to commence. As a result, data were not yet available to assess these pollutants.



	DB1	DB2	DB3	DB4	DB5	DB6	DB7	DB8	DB9	DB11
Jul-12	75	426	442	276	290	402	550	525	920	688
Aug-12	409	841	91	469	91	146	779	547	770	644
Sep-12	509	332	259	166	309	588	450	305	673	361
Oct-12	522	416	338	258	233	281	266	451	155	378
Nov-12	185	216	93	62	76	180	116	124	256	241
Dec-12	566	390	459	522	470	75	0	231	422	443
Jan-13	522	416	338	258	233	281	266	451	156	378
Residential Limit	600	600	600	600	600	600	600	600	600	600
Non-Residential Limit	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200

Figure 6-7: Dustfall Results

6.4. Air Quality Impact Assessment

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

6.4.1. Impact Assessment Approach

The approach used to determine the future impacts from the operational phase of the Project and related activities is provided in Figure 6-8.

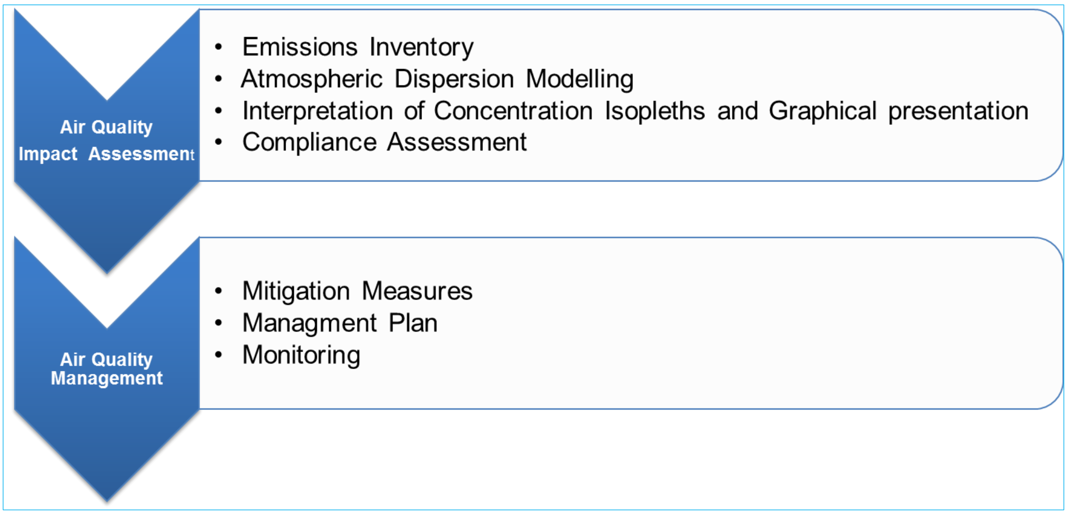


Figure 6-8: Air Quality Impact Assessment Methodology

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.

6.4.1.1. 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) and Australian National Pollutant Inventory (*NPi*) “Emission Estimation Technique (EET, 2012)” manuals were employed.

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 anticipated from the various sources within the mine during operation are discussed in Table 6-2.

Table 6-2: Emission Factor Equations

Activity	Emission Equation	Source	Information assumed/provided
Materials handling (including conveying)	$EF_{TSP\,(kg/t)} = k_{TSP} \times 0.0016 \times \frac{\left(\frac{U_{(m/s)}}{2.2}\right)^{1.3}}{\left(\frac{M_{(\%)}}{2}\right)^{1.4}}$ Where, E = Emission factor (kg dust / t transferred) U = Mean wind speed (m/s) M = Material moisture content (%) The KTSP:0.74; KPM10:0.35 respectively. An average wind speed of 3.1 m/s was used based on the Lakes Environmental data for the period 2017 – 2019.	US-EPA AP42 Section 13.2.4	The moisture content of the materials are as follows: Topsoil Stockpile: 6.5% 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 The particle size multiplier (k) is given as 0.15 for PM2.5 and 1.5 for PM10, and as 4.9 for TSP The empirical constant (a) is given as 0.9 for PM2.5 and PM10, and 4.9 for TSP	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 layout of the haul roads was assumed to be 20 m wide.

Activity	Emission Equation	Source	Information assumed/provided
	The empirical constant (b) is given as 0.45 for PM2.5, PM10, and TSP		
Wind Erosion	$E_{TSP} = 1.9 \times \left(\frac{s}{1.5}\right) \times \left(\frac{365-p}{235}\right) \times \left(\frac{f}{15}\right)$	USEPA, 1998	Silt content: 6.9% (Assumed)
Drilling	$0.59 \frac{kg}{hole}$	NPi 1999	
Blasting	$0.000014(A)^{1.5}$	USEPA, 1998	Blasting two times a week (Assumed)
Crusher	Primar High moisture (TSP:0.01; PM10:0.004) Low moisture (TSP:0.2; PM10:0.02) Secondary High moisture (TSP:0.03; PM10:0.012) Low moisture (TSP:0.6; PM10:No data)	NPI EET Manual for Mining (NPI, 2012)	
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: 6.9% (Assumed) U = mean wind speed in m/s M = moisture content in %
Excavator	$EFTSP = 0.580/(M)^{\wedge}1.2$ $EFPM10 = 0.0447/(M)^{\wedge}0.9$	USEPA, 1998	
Bull Dozer	$EFTSP = 35.6 * (s)^{\wedge}1.2/(M)^{\wedge}1.4$ $EFPM10 = 6.33 * (s)^{\wedge}1.5/(M)^{\wedge}1.4$	USEPA, 1998	

6.4.1.2. Air Quality Dispersion Modelling and Data Requirements

6.4.1.2.1. 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.

Three years' worth of MM5 modeled meteorological data were obtained from Lakes. This dataset consists of surface and upper air meteorological data required to run the dispersion model.

6.4.1.2.2. 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 with a buffer, 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)	200 m
Number of grids points	121 x 121
Years of analysis	January 2017 to December 2019
Centre of analysis	Delmas (26.208678 S; 28.681028 E)
Meteorological grid domain	20 km (east-west) x 20 km (south-north)
Station Base Elevation	1579 m
MM5-Processed Grid Cell (Grid Cell Centre)	26.208678 S; 28.681028 E
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

6.4.1.3. *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 impacts of the project on the surrounding air quality.

7. Findings and Discussion

7.1. Baseline Results

The meteorology of the Project assessed with 3-years' worth of data, revealed that the predominant winds are from the north (11%) and north northwest (11%) respectively. Secondary contributions are from the northwest (9%) and north northeast (7%). The average wind speed observed was ~3.1 m/s, while winds greater than 5.4 m/s occurred for 8.9% of the time.

The dustfall rates measured in the proposed Project area was used to understand the air quality scenario. The sites that were non-complaint with the residential limit were DB9 (experienced exceedances in three sequential month) and DB11 (experienced exceedances in two sequential months). In general, 90th percentile of the dustfall rates measured were below the residential limit value.

7.2. Dispersion Model Simulation Results

The model results consist of a graphical presentation of GLC (in a unit of µg/m^3) for the different pollutants, and dust deposition rates (mg/m^2/d). The daily averages were calculated as the 4th highest value (99th percentile). Annual averages were shown as the 1st highest value (100th percentile).

7.3. Isopleth Plots and Evaluation of Results

7.3.1. Predicted GLC of $PM_{2.5}$

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

The model simulations show the worst-case scenario (assuming no mitigation measures were put in place at the mine). The areas where the 24-hour standard (40 µg/m³) will be exceedanced are within the MR boundaryy (Figure 7-1). The GLC predicted at the nearby sensitive receptors (DB3, DB7, DB8, and DB9) will be lower than the standard (Table 7-1). The annual GLC of $PM_{2.5}$ predicted will not exceed the regulatory standard, as the GLC predicted were very low, below 1 µg/m³ at the selected receptors ((Table 7-1).

7.3.2. Predicted GLC of PM_{10}

The predicted 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 area where the South African 24-hour standard of 75 µg/m³ will be exceeded, extends outside the MR boundaryy in the northern direction (some 1,7 km from the edge of the MR boundaryy). This can be seen in Figure 7-3 below. The GLC at the nearest sensitive receptors DB3, DB7, DB8, and DB9 were lower than the standard (Table 7-1). The predicted annual isopleth showed that areas, where exceedance will occur, are confined to within the MR boundaryy during operation (Figure 7-4).

7.3.3. Predicted Dustfall Rates

The predicted dustfall rates are shown in Figure 7-5 (no mitigation and with mitigation). The predicted dustfall rates confirmed that the non-residential limit of 1,200 mg/m²/d will be exceeded within the MR boundaryy, and will extend outward to a distance of 2 km from the edge of the northern boundary. With mitigation in place, the predicted dustfall rates at the selected receptors were lowered significantly.

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)			
			DB8	DB9	DB3	DB7
PM_{10} (No Mitigation)	Daily	75(1)	38	42	30	37
	Annual	40(1)	3	4	2	3
$PM_{2.5}$ (No Mitigation)	Daily	40(1)	7,6	7,2	5,9	7,4
	Annual	20(1)	0,6	0,7	0,4	0,5
Dust Deposition Rates (mg/m²/day)						
Dust (No Mitigation)	Monthly	Residential (600(2)) Non-residential (1200(2))	563	101	171	106
Dust (With Mitigation)			330	49	53	40

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

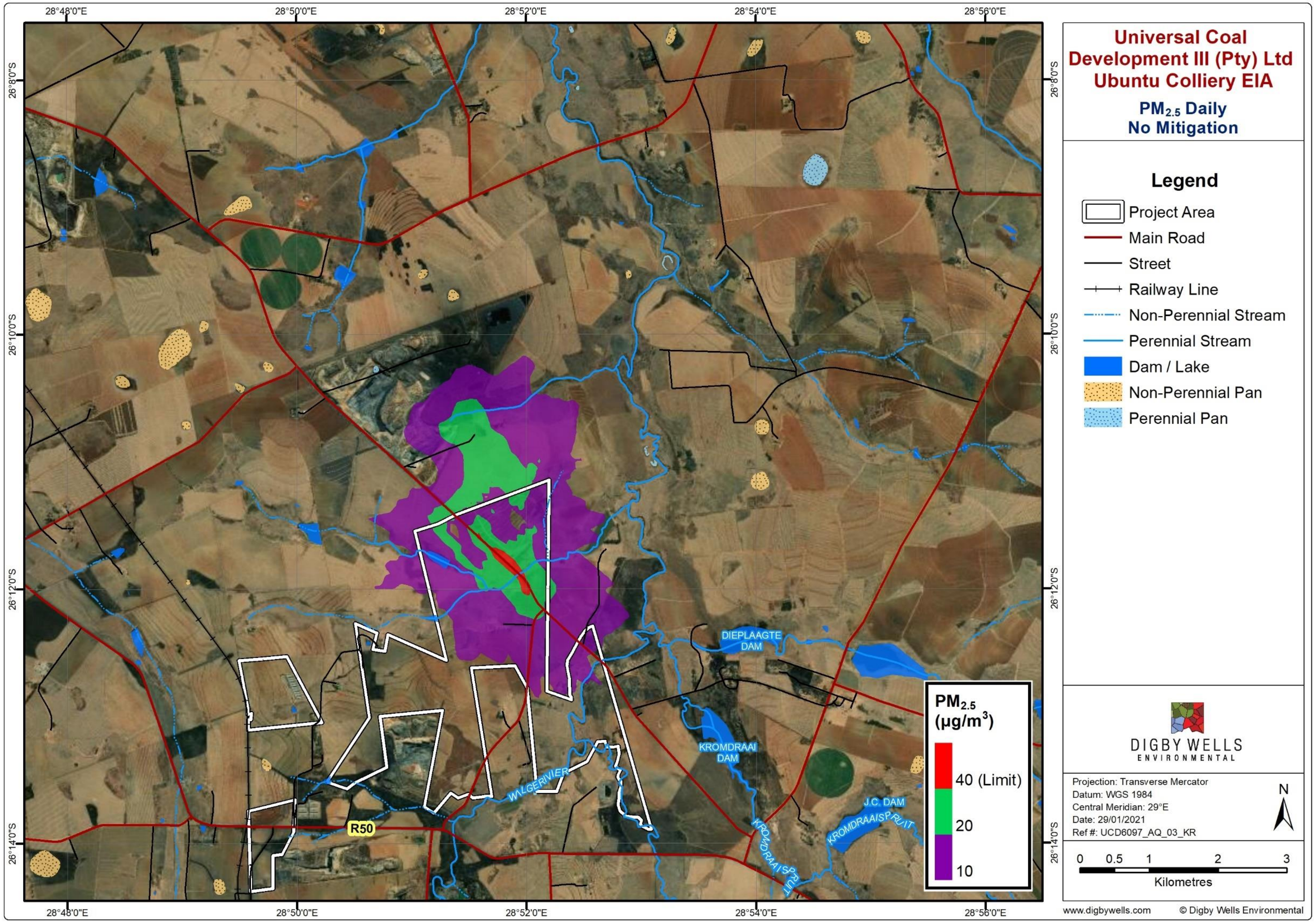


Figure 7-1: Predicted 4th highest (99th percentile) daily $PM_{2.5}$ Concentrations ($\mu g/m^3$)

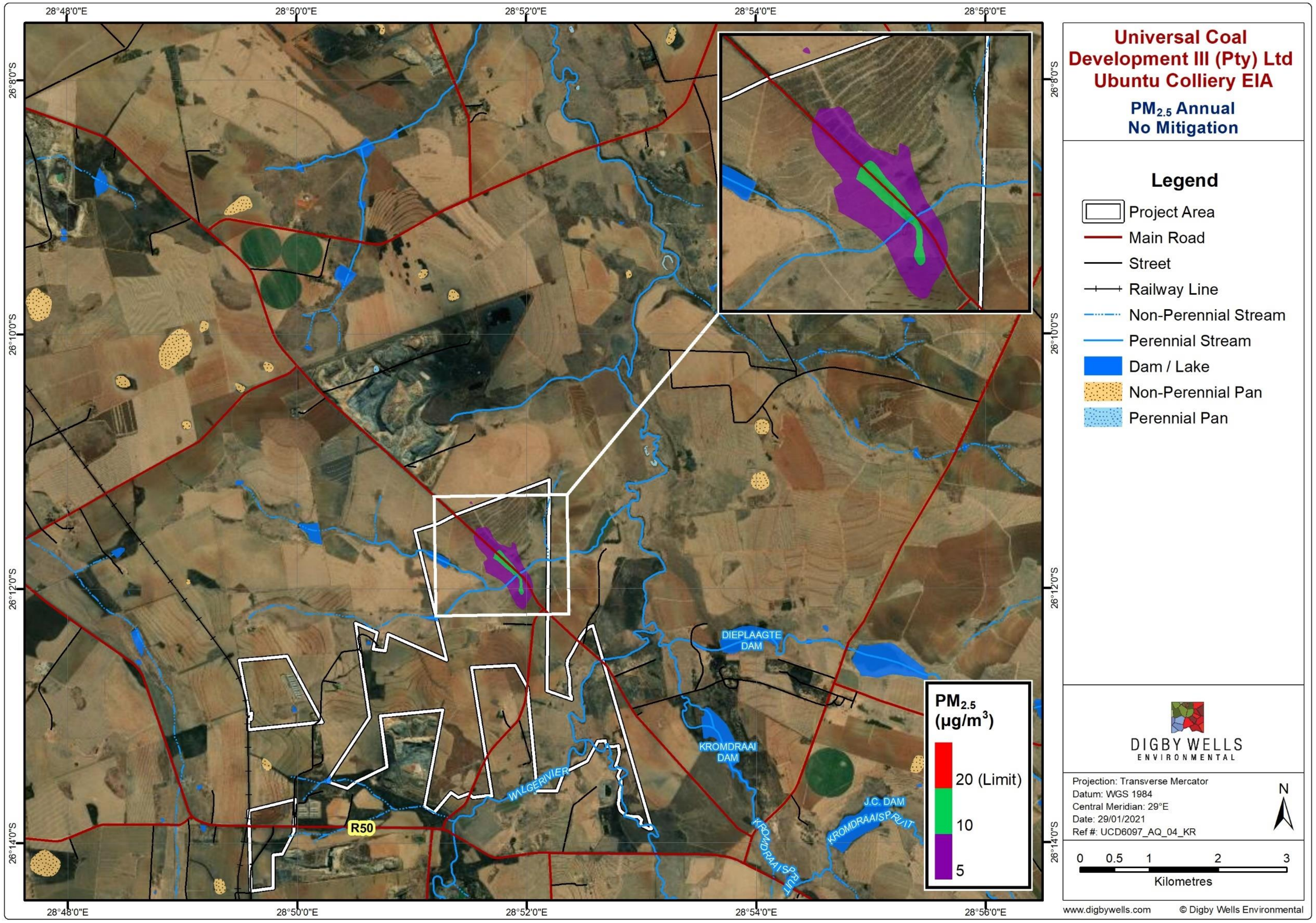


Figure 7-2: Predicted 1st highest (100th percentile) Annual PM2.5 Annual Concentrations (µg/m³)

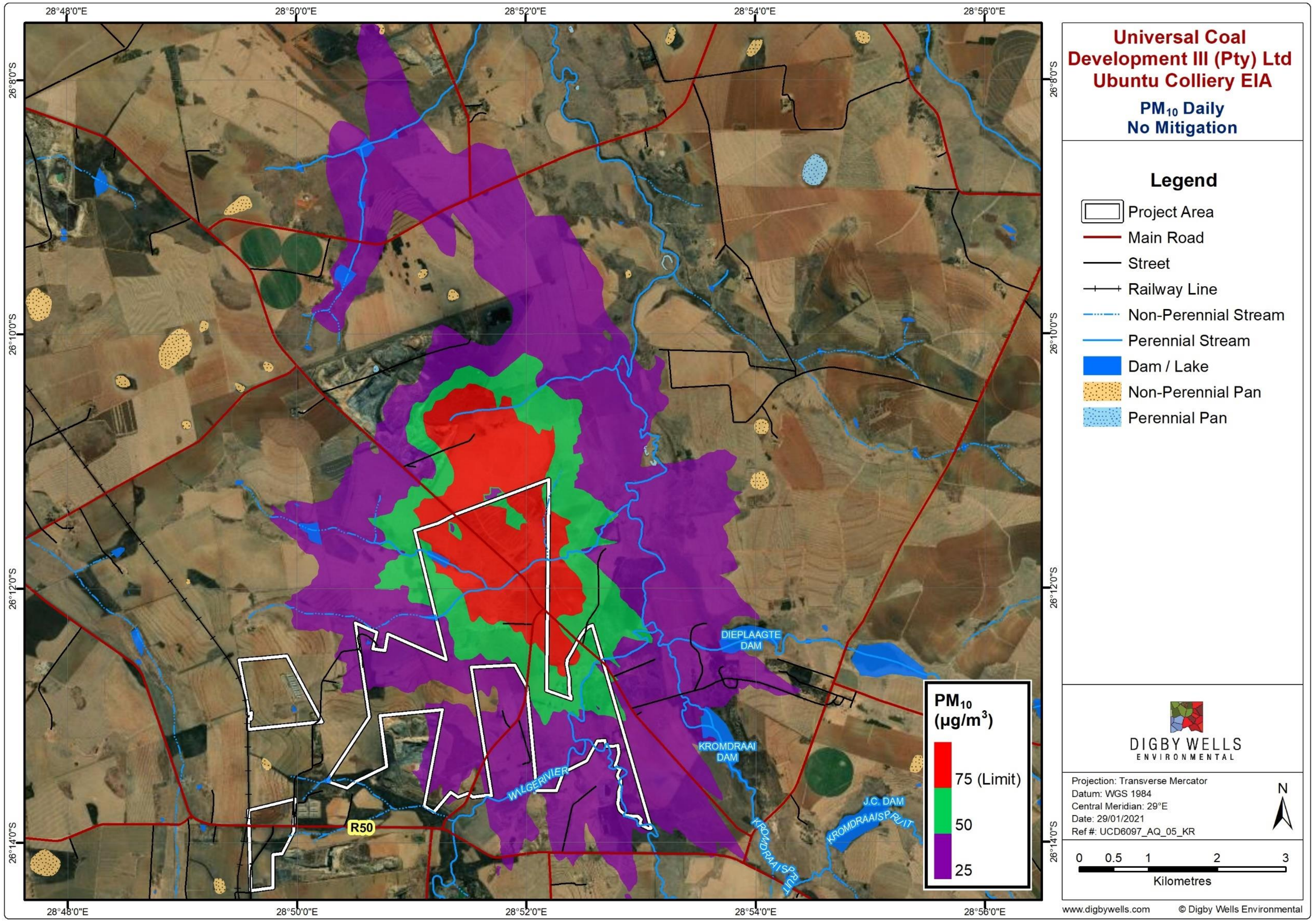


Figure 7-3: Predicted 4th highest (99th percentile) daily PM_{10} Concentrations (µg/m³)

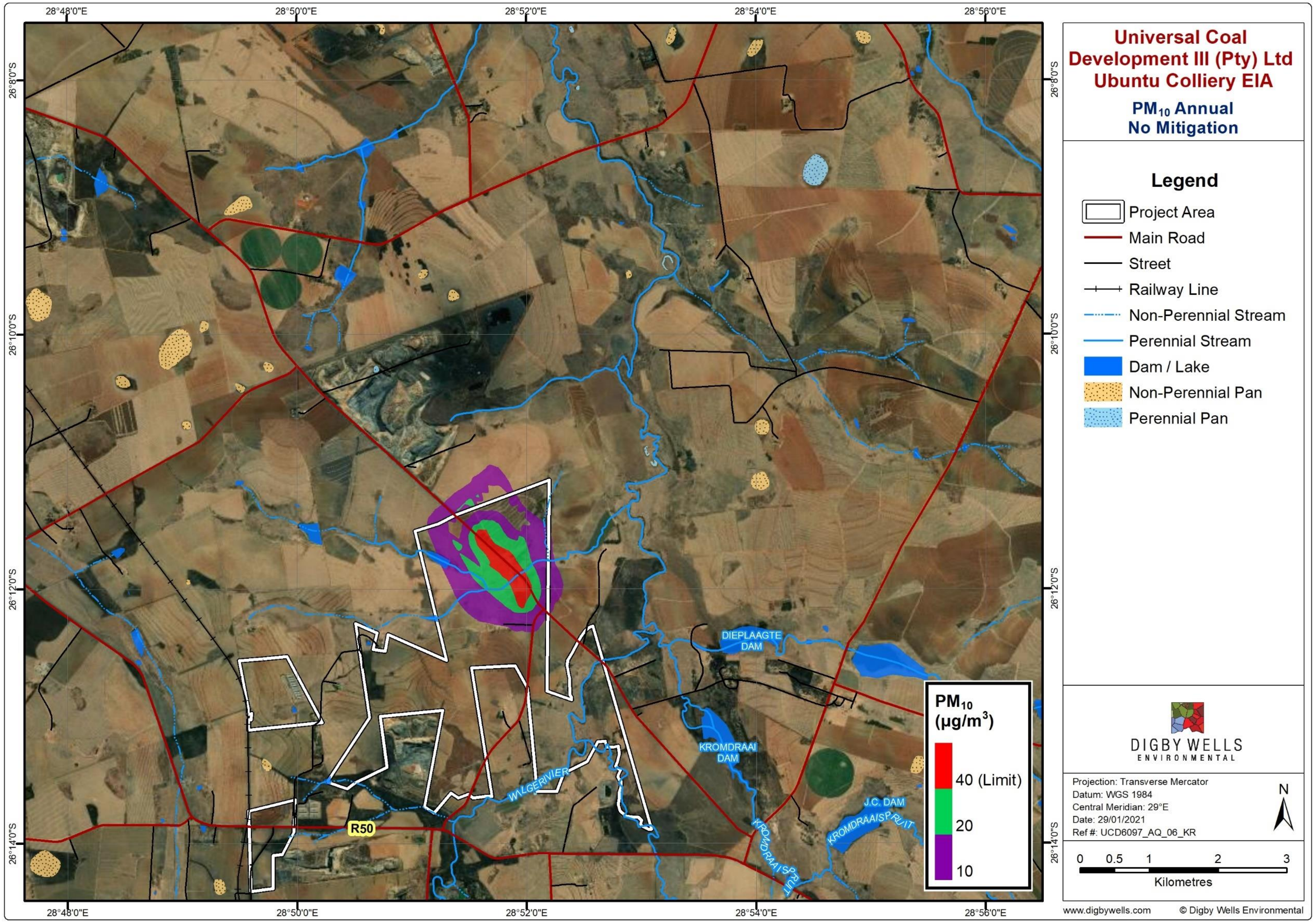


Figure 7-4: Predicted 1st highest (100th percentile) Annual PM_{10} Concentrations (µg/m³)

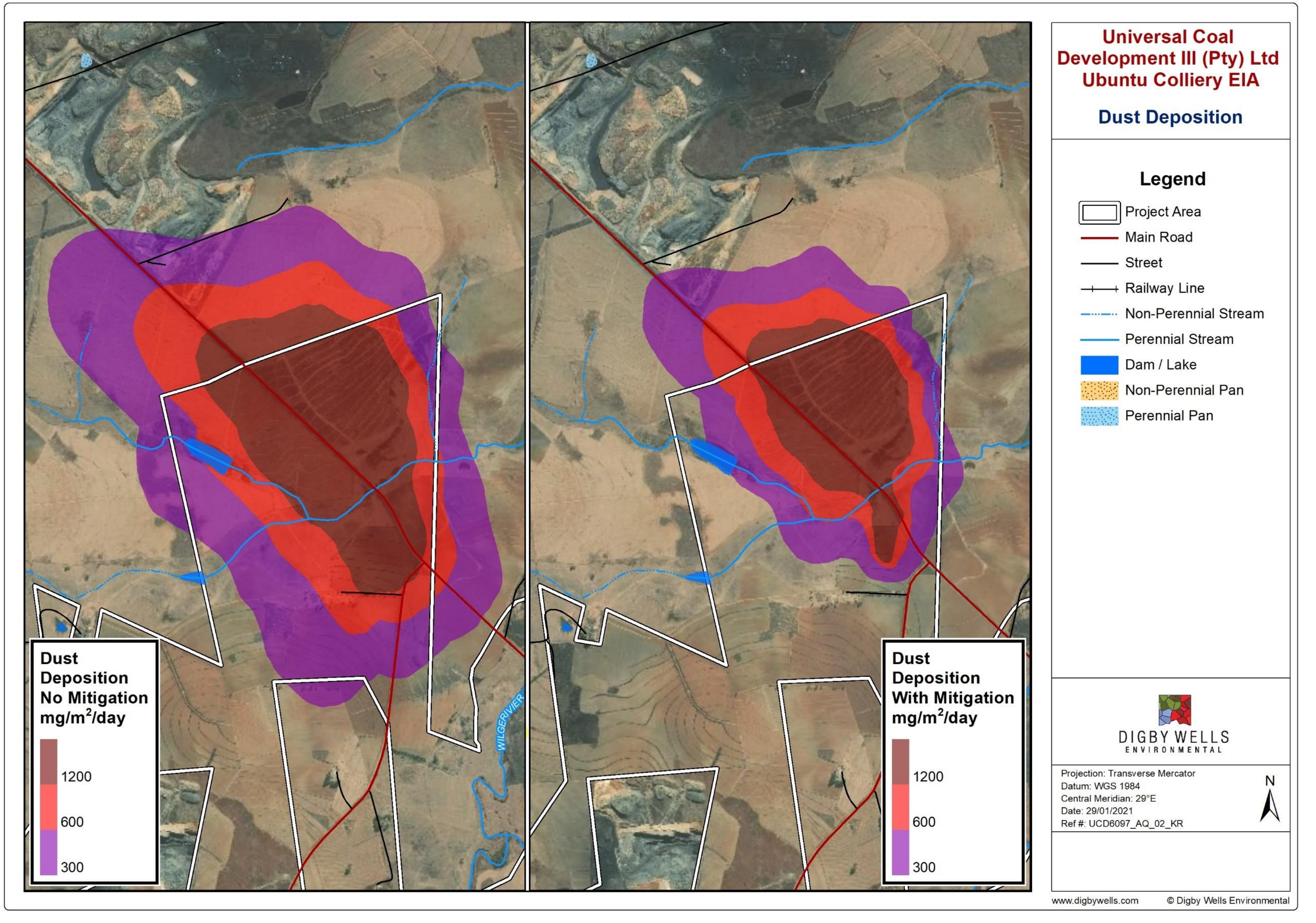


Figure 7-5: Predicted (100th percentile) Monthly TSP Deposition Rates (mg/m²/day) No Mitigation

8. Discussions

The GLC predicted for the operational phase and associated Project risks have been appraised.

8.1. Findings

The findings presented represent the worst-case scenario, i.e. without mitigation measures factored in the model runs, except for the dustfall rates. The findings of this air quality study are summarised as follows:

- The areas where the 24-hour standard (40 µg/m³) will be exceedances are within the MR boundaryy. The GLC predicted at the nearby sensitive receptors (DB3, DB7, DB8, and DB9) will be lower than the standard. The annual GLC of $PM_{2.5}$ predicted will not exceed the regulatory standard, as the GLC predicted were very low, below 1 µg/m³ at the selected receptors ((Table 7-1).
- The predicted GLC of PM_{10} over a 24-hour averaging period returned simulation isopleths shown in (PM_{10} daily) and (PM_{10} annual). The area where the South African 24-hour standard of 75 µg/m³ will be exceeded, extends outside the MR boundaryy in the northern direction (some 1.7 km from the edge of the MR boundaryy). The GLC at the nearest sensitive receptors DB3, DB7, DB8, and DB9 were lower than the standard. The predicted annual isopleth showed that areas, where exceedance will occur, are confined to within the MR boundaryy during operation.
- The predicted dustfall simulation was conducted with mitigation and without mitigation. The predicted dustfall rates confirmed that both the residential and the non-residential limit of 1,200 mg/m²/d will be exceeded within the MR boundaryy, and will extend outward to a distance of 2 km from the edge of the northern boundary. With mitigation in place, the predicted dustfall rates at the selected receptors were lowered significantly.

9. Impact Assessment Ranking

The impact assessment ranking methodology in Appendix A was applied in rating the implications of the different phases of the Project on the ambient air quality of the area.

9.1. Construction Phase

Activities during the Construction Phase that may have potential implications on the ambient air quality in the Project area and surroundings i.e. increasing pollutant levels in the atmosphere are indicated in Table 9-1.

Table 9-1: Interactions and Impacts of Activity

Interaction	Impact
Site/vegetation clearance	Generation of dust Increased particulate matter load in the atmosphere leading to poor air quality Soiling of surfaces due to dustfall
Access and haul road construction	
Infrastructure construction	
Topsoil stockpiling	
Diesel storage and explosives magazine	Release of volatiles to the ambient atmosphere

9.1.1. Impact Description

Construction 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 will result in the generation of fugitive dust comprising of TSP, $PM_{10,}$ and $PM_{2.5}$, especially from construction and use of the haul roads and erosion of open surfaces, construction of infrastructural and topsoil stockpiling. Also, excavation, loading, and tipping of construction 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

- Particulate monitoring at upwind and downwind locations and at sensitive receptors; and
- Application of dust suppressants e.g. Dust-A-Side on haul roads and exposed areas to ensure compliance.

9.1.1.3. Impact Ratings

The construction phase activities will require similar mitigation measures to contain emissions to the atmosphere, hence in the impact rating, these activities are grouped for ranking (Table 9-2).

Table 9-2: Significance Ratings for Site Clearing, Construction of Haul Road and Surface Infrastructure

<table>
<tr><th colspan="4">Activity and Interaction: Site Clearing, Construction of Surface Infrastructure and Topsoil Stockpiling</th></tr>
<tr><th>Dimension</th><th>Rating</th><th>Motivation</th><th>Significance</th></tr>
<tr><td colspan="4">Impact Description: Reduction in ambient air quality</td></tr>
<tr><td colspan="4">Prior to mitigation/ management</td></tr>
<tr><td>Duration</td><td>Short term (1)</td><td>Dust will be generated for the duration of each activity in the construction phase</td><td rowspan="5">Negligible (negative) – 30</td></tr>
<tr><td>Extent</td><td>Limited (2)</td><td>Limited to the project area and immediate surroundings.</td></tr>
<tr><td>Intensity</td><td>Minor (2)</td><td>Minor implications on the surrounding area are anticipated</td></tr>
<tr><td>Probability</td><td>Almost certain (6)</td><td>There is a possibility that generated dust will impact ambient air quality.</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
<tr><td colspan="4">Mitigation/ Management actions</td></tr>
<tr><td colspan="4">Application of a 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;
The drop heights when loading onto trucks and at tipping points should be minimised;
The enclosure of crushers; and
Application of fogging system at the crusher.</td></tr>
<tr><td colspan="4">Post- mitigation</td></tr>
<tr><td>Duration</td><td>Short term (1)</td><td>Dust will be generated for the duration of each activity in the construction phase</td><td rowspan="5">Negligible (negative) – 12</td></tr>
<tr><td>Extent</td><td>Very Limited (1)</td><td>After mitigation measures are implemented, It is expected that the dust generated will be limited to isolated parts of the site.</td></tr>
<tr><td>Intensity</td><td>Minimal (1)</td><td>Generated dust will have negligible impacts on the ambient air quality after mitigation</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td>Probable that the impact on ambient air quality will occur.</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
</table>

9.2. Operational Phase

Activities that will be conducted during the Operational Phase that may have implications on the ambient air quality of the Project and surroundings i.e. increasing emission to the ambient atmosphere are indicated in Table 9-3.

Table 9-3: Interactions and Impacts of Activity

Interaction	Impact
Open-pit establishment	Generation of dust Increased particulate matter load in the atmosphere leading to poor air quality Soiling of surfaces due to dustfall
Removal of rock (blasting)	
Stockpiling (rock dumps, soils, ROM, overburden) establishment and operation	
Operating crushing and screening plant	

9.2.1. Impact Description

The establishment of the pit, drilling and blasting, removal and transportation of topsoil, ROM, and overburden material using haul roads, and stockpiling, coupled with the operation of the screening and crusher circuit and transportation of ore offsite will result in the emission of particulate matter. These emissions will encompass TSP, PM_{10}, and $PM_{2.5}$.

9.2.1.1. *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.

9.2.1.2. *Management Actions*

- Air quality monitoring to ensure compliance at upwind and downwind locations.
- Application of dust suppressants e.g. Dust-A-Side on haul roads and exposed areas to ensure compliance.

9.2.1.3. *Impact Ratings*

The operational phase activities will require similar mitigation measures to contains emissions from certain sources to the atmosphere, hence the rating of grouped some activities (Table 9-4).

Table 9-4: Significance Ratings for Establishment of Open Pit, Removal of Material, Stockpiling, Operation of the Plant

Activity and Interaction: Establishment of Open Pit, Removal of Material, Stockpiling, Operation of the Plant and Construction of Surface Infrastructure			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Dust generation and reduction in ambient air quality			
Prior to mitigation/ management			
Duration	Project life (5)	Dust will be generated for the project life	Major (negative) – 78
Extent	Local (3)	Airborne dust will extend across the development site area and beyond.	
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 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; • Enclosure of the crusher and screening circuit, fitted with dust suppresion spays; and • The drop heights when loading onto trucks and at tipping points should be minimised.			
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 MR boundary 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		

9.3. Decommissioning Phase

Activities during the Decommissioning Phase that may have potential impacts on the ambient air quality in the Project area and surroundings are indicated in Table 9-5.

Table 9-5: Interactions and Impacts of Activity

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

9.3.1. Impact Description

The dismantling of mine infrastructure and rehabilitation activities which will include spreading of subsoil and topsoil, profiling, and re-vegetation of the Project area will involve the use of heavy machinery and vehicles similar to those used in the construction phase. This will result in the release of fugitive emissions, such as TSP, PM_{10}, and $PM_{2.5}$. During this phase, hazardous products must be handled following operational protocol to avoid spills and evaporation from sources.

9.3.1.1. 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.

9.3.1.2. Management Actions

- Particulate monitoring at upwind and downwind locations.
- Application of dust suppressants e.g. Dust-A-Side on haul roads and exposed areas to ensure compliance.

9.3.1.3. Impact Ratings

The decommissioning phase activities will require similar mitigation measures to those employed during the construction phase. The impact rating for this phase is discussed in Table 9-6.

Table 9-6: Significance Ratings for Demolition and Removal of Infrastructure and Rehabilitation of the Project area

Activity and Interaction: Demolition and Removal of Infrastructure and Rehabilitation			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Dust generation and reduction in 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) – 42
Extent	Limited (2)	Limited to the project area and immediate surroundings.	
Intensity	Minor (2)	Minor effect on surrounding air quality is anticipated	
Probability	Almost certain (6)	Almost certain that generated dust will impact ambient air quality.	
Nature	Negative		
Mitigation/ Management actions			
• Application 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; • The drop heights when loading onto trucks and at tipping points should be minimised • Rehabilitation of disturbed land to allow for vegetation growth.			
Post- mitigation			
Duration	Medium-term (3)	Dust will be generated in the medium term for the duration of each activity in the decommissioning phase	Negligible (negative) – 20
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	Probable (4)	Probable that an impact on ambient air quality will occur.	
Nature	Negative		

9.4. Cumulative Impacts

Historical dustfall records for the proposed Project area are available for sensitive receptor sites DB3, DB7, and DB8, and were used to evaluate cumulative impacts. The averages over the seven months at DB3 (289 mg/m^2/d) and DB7 (347 mg/m^2/d), DB8 (376 mg/m^2/d) and DB9 (479 mg/m^2/d) were taken as the background to which the model predicted GLC for the same locations were added (**model prediction + the background**). The final cumulative values were then compared with the standards for compliance. The final cumulative levels were below the limit value for residential receptors, except at DB8 where it exceeds the limit of 600 mg/m^2/d (Table 9-7).

Table 9-7: Comparison of Modelled to Baseline Data

Pollutants	Averaging Period	Location	Regulatory Limit	Dust Deposition Rates (mg/m^2/d)		
				Model	Background	Total
Dustfall	Monthly	DB3	600 mg/m^2/d (Res. Limit)	171	289	460
		DB7		106	347	453
		DB8		563	376	**939**
		DB9		101	479	580

9.5. Unplanned and Low Risk Events

Table 9-8 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 9-8: Unplanned Events and Associated Mitigation Measures

Unplanned Risk	Mitigation Measures
Extreme wind erosion event	Adequate cover and care for storage facilities which will serve as protection during an unplanned event Exposed areas prone to erosions should be avoided or minimised at all times

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 Environmental Management Plan (EMP) are specified.

Table 10-1: Environmental Management Plan

Activity	Potential Impacts	Aspects Affected	Phase	Mitigation Measures	Mitigation Type	Time period for implementation
• Site clearing; • Access and haul road construction; • Construction of surface infrastructure.	Poor air quality due to the generation of dust	Air Quality	Construction	• Apply wetting agents, dust suppressants, and binders on exposed areas; • Limit activity 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; • Construct surfaces of all access roads from lateritic soils and avoid fine/colloidal (e.g. clays and silts) materials; • Minimise the drop heights when loading onto trucks and at tipping points; and • Set maximum speed limits and have these limits enforced.	• Control through the implementation of an air quality management plan; • Dust control measures; and • Ambient air quality monitoring	On commencement of the construction phase and for the duration of the phase
• Drilling and blasting of ROM ore and overburden • Loading, handling, and stockpiling of ROM ore and overburden • Operation of the open pit workings; • Stockpiling (rock dumps, soils, ROM, discard dump) establishment and operation • Operation of the screening and crusher circuit.	Poor air quality due to the generation of dust	Air Quality	Operation	• Apply wetting agents, dust suppressants, and binders on exposed areas and haul roads; • Conduct mining activities judiciously on 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; • Enclosure of the crusher and screening circuit, fitted with dust suppresion spays; and • Set maximum speed limits and have these limits enforced.	• Control through the implementation of an air quality management plan; • Dust control measure; and • Ambient air quality monitoring.	Measurements must commence before the start of the operation phase and for the life of mine.
• Dismantling and removal of infrastructure • Rehabilitation of the Project area • Post-closure monitoring and rehabilitation	Poor air quality due to the generation of dust	Air Quality	Decommissioning	• Apply wetting agents, dust suppressants, and binders on exposed areas; • Conduct mining activities judiciously on 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; • The dismantling of infrastructure must occur in phases; and • The rehabilitated landscape should be vegetated.	• Control through the implementation of an air quality management plan; • Dust control measure; 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 historic dustfall monitoring network be revived, and maintained from the construction phase through the LOM. In addition to the aforementioned, it is recommended that a continuous real-time monitoring station with the ability to measure both particulates and gases be commissioned before the commencement of the construction phase activities. The frequency of monitoring will ensure that diurnal, seasonal, annual, and inter-annual records are available to inform management decision making. Table 11-1 shows the pollutants to be measured and the frequency of monitoring.

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	• Monthly dustfall monitoring; • Continuous PM_{10}, $PM_{2.5}$ monitoring; • Continuous monitoring of gases: SO_2, NO_2, and CO	Particulate pollutants from the ongoing 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

In terms of comments related to the potential impacts from the Project on air quality, nothing has been received from Interested and Affected Parties (I&AP). If in future concerns are raised, the concerns will be documented in linewith the regulatory requirements and the EA application will be updated.

13. Recommendations

Based on the results presented in this report, the following recommendations should be applied once operation commences:

- Revive the dustfall monitoring network and maintain the programme for the LOM;
- Set up a continuous real-time air quality monitoring station to measure criteria particulate and gaseous pollutants;
- Designate a qualified person to act as the EO to oversee implementation of mitigation measures and assess efficiency regularly;

- Ensure air quality information is incorporated into the environmental management information system and submit annual reports to the South African Atmospheric Emission Licensing & Inventory Portal (SAAELIP), as required by law;
- Establish codes of practice for good housekeeping concerning dust management and mitigation, including regular cleaning of spillages, spraying of stockpiles, open areas and roads, appropriate restrictions on vehicle movements and speeds;
- Enclosure of the crushing and screening circuit, fitted with dust suppresion spays to contain emissions; and
- Monitor the air quality management measures and information to ensure that adopted mitigation measures are sufficient to achieve current air quality standards at the Project area and nearby receptors.

14. Reasoned Opinion Whether Project Should Proceed

The dustfall rates measured in the proposed Project area was used to understand the air quality scenario. The sites that were non-complaint with the residential limit were DB9 (experienced exceedances in three sequential month) and DB11 (experienced exceedances in two sequential months). In general, 90th percentile of the dustfall rates measured were below the residential limit value.

Based on the model predictions, areas north of the MR boundaryy are likely to experience GLC above the standard as a result of the proposed mining. However, the model assumed the worst-case scenario, without mitigation measures in place. As depicted with the dust deposition isopleths, which considered mitigation, the impact can be reduced significantly once mitigation measures are factored into the daily operations during mining.

Overall, assuming the dustfall status quo established with historical records has not been altered significantly, the model results show cumulative impacts will be minimal since most of the areas where the standards are expected to exceed, are going to be confined with the MR boundaryy. With appropriate mitigation measures and management measures in place, it is anticipated that the mine will operate within compliance. The air quality specialist will recommend that the EA Application be approved, provided the suggested mitigation measures are implemented.

15. Conclusion

The findings from the baseline assessment have confirmed that the meteorology is influenced by dominant winds from north and north northwest respectively. Secondary contributions are from the northwest and north northeast. The average wind speed was observed to be ~3.2 m/s, with winds greater than 5.4 m/s occurring for 8.9% of the time.

Historical dustfall records from seven months of monitoring at ten sites were used to evaluate the background air quality. Measured dustfall rates were below the residential limit of

600 mg/m^2/day for 90th percentile of the time, with only two records of non-compliance at DB9 and DB11.

Potential emissions from the operational phase of the Project were assessed. Model simulations of GLC of criteria pollutants were generated, for different averaging periods as recommended by the regulatory authorities and compared with the South African standards to ascertain compliance.

A summary of the predicted GLC is given below:

- The areas where the 24-hour standard (40 µg/m^3) will be exceedances are within the MR boundaryy. The GLC predicted at the nearby sensitive receptors (DB3, DB7, DB8, and DB9) will be lower than the standard. The annual GLC of $PM_{2.5}$ predicted will not exceed the regulatory standard, as the GLC predicted were very low, below 1 µg/m^3 at the selected receptors.
- The predicted GLC of PM_{10} over a 24-hour averaging period returned simulation isopleths shown in (PM_{10} daily) and (PM_{10} annual). The area where the South African 24-hour standard of 75 µg/m^3 will be exceeded, extends outside the MR boundaryy in the northern direction (some 1.7 km from the edge of the MR boundaryy). The GLC at the nearest sensitive receptors DB3, DB7, DB8, and DB9 were lower than the standard. The predicted annual isopleth showed that areas, where exceedance will occur, are confined to within the MR boundary during operation.
- The predicted dustfall simulation was conducted with mitigation and without mitigation. The predicted dustfall rates confirmed that both the residential and the non-residential limit of 1,200 mg/m^2/d will be exceeded within the MR boundary, and will extend outward to a distance of 2 km from the edge of the northern boundary. With mitigation in place, the predicted dustfall rates at the selected receptors were lowered significantly.

The impacts of the proposed Project were evaluated using a risk matrix that considers the nature, significance, extent, duration, and probability of impacts occurring. Based on this rating system, impacts on the surrounding receptors from the operational phase are deemed “major negative” without mitigation. However, with mitigation, the impacts were reduced to “negligible negative”. Since anticipated emissions from the operational phase activities are likely to influence receptors outside the Project boundary, mitigation and management intervention measures are crucial.

Some of the possible mitigation measures and management intervention measures recommended 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, rehabilitation of overburden stockpiles to prevent wind erosion, and enclosure of crushers; and

- Operation of ambient air quality monitoring network for particulates and gases to provide valuable data needed to assess the effectiveness of mitigation measures put in place during operation.

Once the mine implements the recommended mitigation measures outlined in this report, associated emissions can be contained to below standards, ensuring compliance with regulatory requirements.

16. References

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Appendix A: Impact Assessment Ranking

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 16-1. 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 16-2, which is extracted from Table 16-1. The description of the significance ratings is discussed in Table 16-3.

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 16-1: 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.

RATING	INTENSITY/REPLACABILITY		EXTENT	DURATION/REVERSIBILITY	PROBABILITY
	Negative impacts	**Positive impacts**			
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 16-2: Probability/Consequence Matrix

	Significance																																					
Probability 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 16-3: 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)