DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENTAL MANAGEMENT PROGRAMME:

APPLICATION FOR MINING RIGHT FOR THE PROPOSED DUNBAR OPENCAST COAL MINE, MPUMALANGA PROVINCE

FOR LISTED ACTIVITIES ASSOCIATED WITH A MINING RIGHT

SUBMITTED FOR ENVIRONMENTAL AUTHORISATION IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (ACT 107 OF 1998) AND THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT (ACT 59 OF 2008) IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED BY AN APPLICATION IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT (ACT 28 OF 2002) (AS AMENDED)

NAME OF APPLICANT: **VANDABYTE (PTY) LTD**

TEL NO: **+27 (12) 771 4411**

FAX NO: **+27 (86) 604 5100**

POSTAL ADDRESS: **PO Box 68727, Highveld, 0169**

PHYSICAL ADDRESS: **2nd Floor, Tugela House, Riverside Office Park, 1303 Heuwel Ave, Centurion 0157**

FILE REFERENCE NUMBER SAMRAD: **MP 30/5/1/2/2/10237 MR/ MP 30/5/1/2/3/2/1 10237 EM**

OCTOBER 2019

Prepared by: Enviro-Insight CC

www.enviro-insight.co.za

IMPORTANT NOTICE

In terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 as amended), the Minister must grant a prospecting or mining right if among others the mining "will not result in unacceptable pollution, ecological degradation or damage to the environment".

Unless an Environmental Authorization can be granted following the evaluation of an Environmental Impact Assessment and an Environmental Management Programme report in terms of the National Environmental Management Act, Act 107 of 1998) (NEMA), it cannot be concluded that the said activities will not result in unacceptable pollution, ecological degradation or damage to the environment.

In terms of section 16(3)(b) of the EIA Regulations 2014, any report submitted as part of an application must be prepared in a format that may be determined by the Competent Authority and in terms of section 17(1)(c) the competent authority must check whether the application has taken into account any minimum requirements applicable or instructions or guidance provided by the competent authority to the submission of applications.

It is therefore an instruction that the prescribed reports required in terms of applications for an environmental authorisation for listed activities triggered by an application for a right or permit are submitted in the exact format, and provide all the information required in terms of this template. Furthermore, please be advised that failure to submit the information required in the format provided in this template will be regarded as a failure to meet the requirements of the Regulation and will lead to the Environmental Authorisation being refused.

It is furthermore an instruction that the Environmental Assessment Practitioner must process and interpret his/her research and analysis and use the findings thereof to compile the information required herein. Unprocessed supporting information may be attached as appendices. The EAP must ensure that the information required is placed correctly in the relevant sections of the Report, in the order, and under the provided headings as set out below, and ensure that the report is not cluttered with un-interpreted information and that it unambiguously represents the interpretation of the applicant.

OBJECTIVES OF THE SCOPING PROCESS

The objective of the scoping process is to, through a consultative process –

(a) Identify the relevant polices and legislation relevant to the activity;

(b) Motivate the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;

(c) Identify and confirm the preferred activity and technology alternatives through an impact and risk assessment and ranking process;

(d) Identify and confirm the preferred site, through a detailed site selection process, which includes an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified alternatives focusing on the geographical, physical, biological, social, economic, and cultural aspects of the environment;

(e) Identify the key issues to be addressed in the assessment phase;

(f) Agree on the key issues addressed in the assessment phase; including the methodology to be applied, the expertise required as well as the extend of further consultation to be undertaken to determine the impacts and risks the activity will impose on the preferred site through the life of the activity, including the nature, significance, consequence, extent, duration and probability of the impacts to inform the location of the development footprint within the preferred site; and

(g) Identify suitable measures to avoid, manage, or mitigate identified impacts and to determine the extent of the residual risks that need to be managed and monitored.

EXECUTIVE SUMMARY

Introduction and Background

Vandabyte (Pty) Ltd (hereafter the applicant) has appointed Enviro-Insight CC to undertake environmental authorisations associated with the proposed Dunbar Coal Mine. The applicant has obtained a Prospecting Right (reference number MP 30/5/1/1/2/10737 PR) on 22 May 2014 from the Mpumalanga Department of Mineral Resources to prospect for coal in an area of 1797 ha on a Portion of Portion 1, Portion 2 and the remaining extent of the Farm Dunbar 189 IS, Portion 1 of the Farm Middelkraal 50 IS and Portion 6 of the Farm Halfgewonnen 190 IS located in Mpumalanga Province. The Mining Right (MR) application and environmental authorisation (EA) application was lodged on 9 May 2019 to the DMR (reference number MP30/5/1/2/2/10237MR) and includes the abovementioned properties and extent.

The application for mining right was accepted on 23 May 2019, and the acknowledgement letter for the EA application was signed on 12 June 2019. The Scoping Report (SR) and Plan of Study (PoS) was submitted on 3 July 2019 to the DMR, and the approval letter was received on 21 August 2019 (Appendix J). As per the acceptance letter, the EIA phase of the process may continue and the final EIA report and EMPr should be submitted within 106 days from the date of approving the SR and PoS. This draft EIA report and EMPr will be submitted for public and stakeholder review for a period of 30 days in terms of the National Environmental Management Act (1998) and the National Environmental Management Waste Act (2008) in respect of listed activities that have been triggered by applications in terms of these legislation and the Mineral and Petroleum Resources Development Act, 2002 (MPRDA) (as amended). The Final EIA report and EMPr will be submitted on or before 29 November 2019.

The Integrated Environmental Authorisation (IEA) application includes the above-mentioned properties where the proposed two mining blocks identified with an estimated life of mine (LoM) of approximately ten years and associated infrastructure is located on Portion 2 of the Farm Dunbar 189 IS. Further invasive drilling and exploration activities on the remainder of the proposed mining right is still required and based on new geological information becoming available will likely result in the mining layouts to be updated to ensure optimal mining and utilisation of the available coal resources throughout the mining right area.

For the Dunbar project, the resources for a specific area were estimated as described in detail in the Mining Work Programme (MWP) (Appendix I). This area was chosen for its potential for surface mining and distance from environmentally sensitive areas. Sufficient data was available for the western section of the proposed MR to make an initial assessment of its potential. Both Seams 4 and 2 occur on the PR area with Seam 4 reaching a maximum thickness of 5.89 m and Seam 2 a maximum of 9.95 m. In the shallowest parts, Seam 4 starts at a depth of 2.45 m and goes as deep as 100.9 m with Seam 2 at depths from 29.80 to 122.70 m. Seam 5 is thin and not regarded as economical. There is a persistent dolerite sill in the western part and another in the north-east that caused large areas of the coal to be burnt or devolatilised. From the MWP, a low-quality thermal coal will be produced from the different coal seams that will be mined if approved.

In order for the proposed mine to operate, the applicant is required to submit an application for a MR with the DMR. In support of the application to obtain the MR, the applicant is required to conduct a Scoping and Environmental Impact Assessment (S&EIA) process that need to be submitted to the DMR for adjudication, which includes activities triggered under the Environmental Impact Assessment (EIA) Regulations of 2014 (as amended) promulgated under the National Environmental Management Act, 1998 (Act 107 of 1998) and activities triggered under the National Environmental Management: Waste Act, 2008 (NEM:WA) (Act 59 of 2008). In addition, an integrated water use licence application will be submitted to the Department of Water and Sanitation.

Scoping and Environmental Impact Assessment (S&EIA) process

A S&EIA is conducted in two phases. The first phase is scoping and the second phase is the EIA/EMPr report compilation. The scoping phase will commence once the application has been submitted with the competent authority and the following tasks will be undertaken: identify interested and affected parties (I&APs) and stakeholders, identify relevant policies and legislation; consider the need and desirability of the project; consider alternative technologies and sites; identify the potential environmental issues; determine the level of assessment and public participation process required for the EIA phase; and identify preliminary measures to avoid, mitigate or manage potential impacts. The objectives of the EIA phase will be to assess the potential impacts associated with the preferred project alternatives as per the terms of reference for the assessment that are set out in the scoping report. The EIA/EMPr report will document the assessment findings and will detail the measures required to avoid, mitigate and/or manage the potential impacts.

The requirements for the S&EIA process are specifically contained in Chapter 4 Part 3 of the NEMA Reg No 326 (amended on 7 April 2017). The EIA process can take up to 300 days to complete (87 days for scoping phase, 106 days for EIA phase, and 107 days for competent authority to review). The Final EIA report will be submitted to the DMR for final decision making on or before 29 November 2019.

The particulars for the Project applicant are detailed in the table below:

Contact Person	Bjorn Goosen
Address	2nd Floor, Tugela House, Riverside Office Park, 1303 Heuwel Ave, Centurion 0157 PO Box 68727, Highveld, 0169 South Africa
Telephone	+27 12 771 4411
Email	info@insacoal.co.za
Fax	086 604 5100

Project Location

The study area for the Mining Right application falls in the Steve Tshwete Local Municipality in the Nkangala District Municipality and in the Govan Mbeki Local Municipality located in the Gert Sibande District Municipality, Mpumalanga Province. The Mining Right application will include a Portion of Portion 1, Portion 2 and the remaining extent of the Farm Dunbar 189 IS, Portion 1 of the Farm Middelkraal 50 IS and Portion 6 of the Farm Halfgewonnen 190 IS. The study area is located approximately 4.1 km south of Meerlus, 8.93 km southeast of Komati and 13.76 km west of Hendrina. The R35 is located west, R542 is located north and the R38 is located south-east of the study area.

Project Overview

The proposed project involves the development of two new open pit coal mines and the associated supporting infrastructure. The coal resource will be mined using open pit methods due to the seemly depth of the coal reserve. For this specific project the mining of coal by means of surface mining methods are viable due to the fact that the resource is situated close enough to the surface to make it economically mineable. Typical surface mining methods include: strip mining and open pit mining, as well as dredge, placer and hydraulic mining in riverbeds, terraces and beaches. These activities always disrupt the surface and this, in turn, affects soils, surface water and near-surface ground water, fauna, flora and all alternative types of land-use.

The generally low strip ratios and wide surface area of the project area makes it ideal for the opencast truck and shovel mining method. Also, the mining method applicability is driven by technical applicability, economic viability, safety, equipment and infrastructure.

The proposed mining method and sequence comprised of the following main mining activities for both waste and coal:

- Initial topsoil and soft overburden removal which will be stockpiled to ensure it can be replaced back in the initial box cut;
- The physical mining of the coal seam which includes drilling of hard overburden material, charging and blasting;
- The coal is loaded into trucks and hauled to the crushing and screening facility;
- Discard coal will be extracted and replaced in the bottom of the opencast pit, while the product will be taken to the weighbridge via trucks and then removed off site;
- The overburden is replaced back into the pit as mining progresses leaving a minimum area open at a single time;
- The topsoil which was stripped and stockpiled separately before mining commenced is then replaced. The findings of the land capability study will determine the optimal composition to ensure pre-mining conditions for utilisation.

The proposed mining layout is based on a 100 m x 50 m mining block size. The purpose of a square mining layout is to increase the ease of strategic mine scheduling. The start of the mining block layout was based on the mining boundary. The size and scale of the open-pit mine entails that small and conventional truck and shovel mining equipment is used to mine both waste material and coal.

Key infrastructures include:

- Access & Haul roads (with necessary security) including the upgrading of the access point to the gravel road;

- Contractor's Yard with septic/chemical ablution facilities;
- Offices;
- Weighbridge, workshop and stores (with septic/chemical ablution facilities);
- Rail Siding;
- Diesel facilities and a hardstand;
- Power and Water;
- Boxcut;
- Stockpiles (topsoil, overburden, subsoil/softs, ROM);
- Surface water management measures (stormwater diversion berms and trenches, pollution control dams etc);
- Crushing, screening and wash facility.

The current resource is estimated at 21 Mt for the life of mine (LOM). The LOM for the project is 10 years excluding the anticipated one year construction period and three year decommissioning and rehabilitation phase.

Alternatives

The identification and investigation of alternatives is a key aspect during the EIA process, which was initially investigated during the scoping phase. All reasonable and feasible alternatives must be identified and assessed during the EIA phase to determine the most suitable or preferred development footprint.

There are however some significant constraints that have to be taken into account when identifying alternatives for a project of this scope. The preferred option is to be highlighted and presented to the authorities.

Alternatives can typically be identified or categorised according to:

- Location alternatives – alternative project sites in the same geographic area;
- Process/design alternatives – alternative process/design/equipment/technologies;
- Associated infrastructure location and layout alternatives – consideration of the different options to place project infrastructure;
- Activity alternatives – consideration of different means to achieve the same project objective; and
- No-go alternatives – the proposed project/activity does not proceed, implying that the current situation or status quo remains.

For any alternative to be considered feasible such an alternative must meet the need and purpose of the development proposal without presenting significantly high associated impacts. The alternatives are described and the advantages and disadvantages are presented. It is further indicated which alternatives are considered feasible from a technical as well as environmental perspective.

The study area was considered due to the positive results obtained during the prospecting phase and exploration drilling with regards to the underlying coal. As the applicant already has prospecting rights on the above-mentioned properties, and with the favourable results from the prospecting phase regarding coal deposits, the proposed study area locality is optimal for mining coal. No location alternatives therefore exist, as it is dependent on the underlying coal reserve

Several layout alternatives were considered, and the preferred one indicated in this report. Furthermore, a location alternative for the processing plant has been suggested as the alternative site occurs on an already transformed area.

The No-Go alternative would entail not mining the coal reserve and leaving the area mainly as agricultural land. The current land use is mainly cultivated land (for maize and soya, with some grazing activities). Food security is undoubtedly one of the most important sectors in Mpumalanga, nationally and the world, with agriculture contributing to Mpumalanga's and South Africas GDP. This would mean that all potential negative impacts associated with the proposed mine and its associated infrastructure would not occur. However, by not implementing this project the social and economic impacts in excess of 60 permanent jobs and approximately 150 unskilled jobs will not be created and the coal which could potentially have benefitted the economy would become sterilised. The reality is that South Africa has been slow to transformation regarding renewable energy sources; accordingly coal will still be a necessary and dominant energy source until 2050.

Need and desirability of the project

The Integrated Environmental Management Guideline Series 9: Guideline on Need and Desirability was promulgated in terms of the Environmental Impact Assessment (EIA) Regulations, 2010 in Government Notice 891 of 2014. According to these guidelines, the consideration of "need and desirability" in EIA decision-making requires the consideration of the strategic context of the proposed Project along with the broader public interest and societal needs. The guidelines further state that the development must not exceed ecological limits and the proposed actions must be measured against the short-term and long-term public interest to promote justifiable social and economic development, essentially ensuring the simultaneous achievement of the triple bottom line (i.e. social, economic and environmental aspects).

This section will examine the need and desirability of the proposed Dunbar Coal Mine project as well as the importance of coal as a mineral resource and the desirability of coal mining operations at the proposed study area.

It is recognised that mining activities are an essential component of South Africa's economic development. According to the Chamber of Mines of South Africa's Integrated Annual Review (2017) the mining sector accounted for 6.8% of South Africa's Gross Domestic Product (GDP), contributing R312 billion to GDP. Due to higher mining production, employment is estimated to have increased by 1.6% to 464,667 during 2017. This eventually arrested the rate of job losses which stood at 30,000 jobs between 2014 and 2017.

Mining employment represents 6.1% of private non-agricultural employment and 4.8% of total non-agricultural employment.

The sector contributed R80.9 billion to fixed investment in 2017, which constituted 18.2% of private-sector fixed investment and 10.8% of the country's total fixed investment for the year. The following economical components are applicable to the mining sector:

- Mining employment represents 6.1% of private non-agricultural employment and 4.8% of total non-agricultural employment.
- The sector contributed R80.9 billion to fixed investment in 2017, which constituted 18.2% of private-sector fixed investment and 10.8% of the country's total fixed investment for the year.
- The industry exported R307 billion worth of produce, which is 27% of the country's R1.1 trillion export book.

- In the 2016/2017 fiscal year, the industry paid R5.8 billion in royalties, representing a 56% increase on the previous year. The industry paid R16 billion in taxes over the same period.
- The overall weighted dollar commodity price index (coal, iron ore, gold and platinum) for South Africa hardly moved between 2016 and 2017. In dollar terms, this was due to gold's lacklustre price trend (+0.8%) and the decline in the platinum price (-4%), negating increases in the price movements of coal (+28%) and iron ore (+22%).
- The coal industry employed 81,962 people totalling R 22,415,572 in 2017.
- Coal specifically is a national requirement to meet the demand for electricity supply.

According to the Chamber of Mines (2018)[1] coal provides 82% of the power generated within South Africa. South Africa is home to 3.5% of the world's coal reserves and produces 3.3% of the world's annual coal production. South Africa is a net exporter of coal and exports amount to 6% of total global exports. This ranks South Africa as the 6th largest coal-exporting nation in the world. Eskom operates 16 power stations and is building two more that will come on stream by 2021.

The National Development Plan 2030 (NDP) identifies the sufficient production of energy to support industry and providing access to poor households as an enabling milestone toward the reduction of inequality and elimination of income poverty by the year 2030 (National Planning Commission, 2011). It is therefore essential that sufficient coal resources are available to meet the demand required for electricity generation. The coal that would be produced through the proposed Project would be of suitable quality for use in local markets, thereby assisting with the alleviation of the shortage of supply.

In addition to providing an essential resource for power generation in South Africa, the proposed project will have knock-on benefits. These include tax contributions, an overall improvement of the local socio-economic profile job creation and procurement.

The SLP stipulates that the Applicant will appoint Contractors who will be responsible to appoint employees as per the MPRDA and latest Mining Charter. Skills development to employees will be provided to advance the future employability of these individuals. There are several positive as well as negative social impacts for the proposed project.

Coal, because of its strategic importance, is one of the five minerals selected by the DMR for local beneficiation as it is considered critical to the on-going development of South Africa (Department of Mineral Resources, 2011). The driving force behind the emphasis of the importance of coal, coal mining and local beneficiation is primarily due to concerns voiced by Electricity Supply Commission (Eskom) over the future security of supply in both the medium and long term of the mineral to its coal fired electricity generating power stations, which has economical impacts if not met. This will remain an issue until the decommissioning of all coal-fired Power Stations in the country.

South Africa's energy is predominately coal fuelled, with limited renewable energy alternatives (this will only change within the next 10-20 years). South Africa consumes approximately 175 Mtpa of coal where Eskom consumes approximately 110 Mtpa (Eskom, 2017)[2]. Eskom is a South African electricity public utility, established in 1923 as the Eskom by the government of South Africa in terms of the Electricity Act (1922). The utility is the largest producer of electricity in Africa, is among the top

[1] http://www.mineralscouncil.org.za/component/jdownloads/send/25-downloads/535-coal-strategy-2018
[2] http://www.eskom.co.za/AboutElectricity/FactsFigures/Documents/CO0004AshManagementRev13.pdf

seven utilities in the world in terms of generation capacity and among the top nine in terms of sales. The company is divided into Generation, Transmission and Distribution divisions and together Eskom generates approximately 82% of electricity used in South Africa. Currently, Eskom has 24 power stations in commission, consisting of 13 coal-fired stations (3 of which are in cold reserve storage, 1 nuclear station, 2 gas turbine stations, 6 hydroelectric stations and 2 pumped storage schemes).

Eskom's existing coal fired power stations are critical in terms of electricity production and in meeting the growing energy requirements of South Africa as a whole. Coal and coal supply is consequently seen as critical and its importance is detailed in the Eskom Transmission Ten Year Development Plan 2018 to 2027 (Eskom, 2017)[3]. Without steady, secure supply of the mineral, it is unlikely that Eskom will be able to meet the energy demands of the country. As a result, coal mining, beneficiation and supply is of paramount importance to South Africa for continued electricity generation to meet the rising energy demands of the country in the short, medium and long term until the decommissioning of coal-fired Power Stations in the country.

Coal produced is usually used locally within the municipal region but also exported. Eskom is the largest local buyer while China and India are the major international export buyers.

There are essentially three market segments for coal, these are:

- Eskom - Low Grade Coal (19.0Mj/kg – 23.3Mj/kg)
- Export - High Grade Steam Coal (>5,900Kcl/kg)
- Metallurgical - High Grade Low Phosphate, High Fixed Carbon

Given the size and quality of the reserve for Dunbar, the proposed Colliery will target both domestic and export markets. The applicant has approached Eskom in order to supply coal to the Komati Power Station approximately 8 km away from the proposed study area. Eskom and the applicant are currently in discussion and negotiating the terms of supply, however this is dependent on the outcome of the granting of the mining right.

Public Participation Process (PPP)

Objectives of the Public Participation Process:

- Provides Interested and Affected parties (I&APs) with an opportunity to voice their support, concerns and questions regarding the project, application or decision;
- Provides an opportunity for I&APs, Environmental Assessment Practitioners (EAPs) and the Competent Authority (CA) to obtain clear, accurate and understandable information about the environmental, social and economic impacts of the proposed activity or implications of a decision;
- Provides I&APs with the opportunity of suggesting ways of reducing or mitigating negative impacts of an activity and for enhancing positive impacts
- Enables the applicant to incorporate the needs, preferences and values of affected parties into the application.

[3] http://www.eskom.co.za/Whatweredoing/TransmissionDevelopmentPlan/Pages/Transmission_Development_Plans.aspx

A PPP was initiated during the Scoping phase, which is central to the investigation of environmental and socio-economic impacts, as it is important that stakeholders who are affected by the project are given an opportunity to identify concerns and to ensure that local knowledge, needs and values are understood and taken into consideration as part of the impact assessment process. These concerns and comments were addressed in the Scoping Report submitted to the DMR on 3 July 2019. No comments were received after the 30 day review period by the competent authority (DMR) or the following Departments which have received a hard copy of the Draft SR on 30 May 2019: Department of Water and Sanitation (DWS), Govan Mbeki Local Municipality (GMLM), and the Mpumalanga Department of Agriculture, Rural Development, Land & Environmental Affairs (DARDLEA) (Appendix E). The only Department that provided comments on the DSR within the prescribed 30 day period was the Steve Tshwete Local Municipality (STLM) (Appendix K). The STLM had no objection to the proposed Dunbar opencast coal mine.

This draft EIA report will be submitted for public review for a period of 30 days (15 October to 13 November 2019). All comments received will be incorporated into the final EIA report prior to submission to the DMR for final review and decision-making (Appendix E-VI). The draft EIA will be available for review on Enviro-Insight website: http://www.enviro-insight.co.za/download-it/project-downloads/. Electronic copies (CDs) will be made available from Enviro-Insight office on request.

A detailed list of registered Interested and Affected Parties and a detailed Issues and Comments register is attached in Appendix E. All comments received from stakeholders and I&APs have been included in this report (refer to Item 3(g)(iii): Summary of issues raised by I&APs) as well as Appendix E.

Purpose of this report

The purpose of the EIA process is to ensure that potential environmental and socio-economic impacts associated with project are identified, assessed and appropriately managed where possible.

Various specialist studies were undertaken during the Project evaluation to inform the EIA report. These include:

- Soil, Land Capability, and Agricultural Potential Assessment,
- Hydropedology Assessment;
- Hydrogeological (Groundwater) Assessment;
- Terrestrial Ecology Assessment;
- Surface Water Assessment;
- Air Quality Assessment;
- Noise Assessment;
- Visual Assessment;
- Blasting and Vibration Assessment;
- Heritage and Palaeontological Assessment;
- Socio-economic Assessment;

- Traffic Assessment;
- Waste Classification; and
- Rehabilitation, Decommissioning and Closure Assessment.

A summary of impacts identified include:

- Surface and Groundwater Contamination.
- Depletion of Groundwater reserves.
- Wetland degradation and lowering of PES/EIS class.
- Wetland habitat loss and associated habitat for fauna and flora.
- Alteration of hydrological regimes.
- Impact on sensitive heritage features including graves and historical buildings.
- Removal of natural vegetation and fragmentation of habitats.
- Faunal displacement and mortality.
- Loss of species of conservation concern.
- Dust emissions.
- Soil contamination and loss of soil resources.
- Loss of high agricultural potential land.
- Land use conversion (agricultural to mining).
- Noise and vibration nuisance.
- Decant of water and AMD (post-closure).
- Direct and Indirect Job creation.
- Economic stimulation and growth.
- Community based projects which benefits the community.
- Increased traffic volumes.

Conclusions and recommendations

Various specialist studies were undertaken during the EIA Phase of the Project with the objective of identifying and weighing anticipated impacts and risks associated with the activities. The findings of the impact assessment have shown that the Project will have some major adverse impacts on the receiving environment. This mainly pertains to the loss of high agriculture potential land, where the land can only be rehabilitated post-mining to grazing capacity at best. Other significant impacts include increased sedimentation of surface water resources which may also impact aquatic biota, reduction in catchment yields, nuisance noise, dust and visual impacts, and loss of natural vegetation. Where possible, mitigation and management measures, no-go areas by applying applicable buffer zones, as well as further recommendations have been provided by specialists which in reducing the significance of impacts to medium or low significance. Monitoring plans, which should be implemented throughout the Life of Mine, have also been provided to ensure that adverse impacts are realised and continuous improvements are developed.

If the proposed project is authorised some positive social and economic impacts will be realised at local, regional and national level. Nationally, the project will contribute coal requirement to meet the demand for electricity supply as well as knock-on benefits such as tax contributions. At regional and local level, the project has the potential to improve local socio-economic profiles through job creation, development of SMMEs and skills development.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

LIST OF ABBREVIATIONS

ASAPA:	Association of Southern African Professional Archaeologists
AMD:	Acid Mine Drainage
BID:	Background Information Document
C-Plan:	Conservation Plan (specifically for Gauteng)
DEA:	Department of Environmental Affairs
DEM:	Digital Elevation Model
DMR:	Department of Mineral Resources
DoL:	Department of Labour
DWS:	Department of Water and Sanitation

EAP:	Environmental Assessment Practitioner
EIA:	Environmental Impact Assessment
EIS:	Ecological Importance and Sensitivity
EIAR:	Environmental Impact Assessment Report
EMPr:	Environmental Management Programme
GIS:	Geographic Information System
GN:	Government Notice
HDSA:	Historically Disadvantaged South African
HIA:	Heritage Impact Assessment
I&AP(s):	Interested & Affected Party(ies)
IBA:	Important Bird Area
IDP:	Integrated Development Plan
IEA:	Integrated Environmental Authorisation
IWULA:	Integrated Water Use Licence Application
IWWMP:	Integrated Water and Waste Management Plan
LED:	Local Economic Development
LoM:	Life of Mine
MHSA:	Mine Health and Safety Act (Act 29 of 1996) as amended
MPRDA:	Minerals and Petroleum Resources Development Act, 2002
Mtpa:	Million tons per annum
MWP:	Mining Works Programme
NEM: WA:	National Environmental Management: Waste Amendment Act, 2008
NEMA:	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEMBA:	National Environmental Management: Biodiversity Act (Act No. 10 of 2004)
NFEPA:	National Freshwater Ecological Priority Areas
NHRA:	National Heritage Resources Act, 1999 (Act No. 25 of 1999)
NWA:	National Water Act, 1998 (Act No. 36 of 1998)

PCD:	Pollution Control Dam
PES:	Present Ecological State
PoS:	Plan of Study
PPP:	Public Participation Process
RoM:	Run of Mine
SACNASP:	South African Council for Natural Scientific Professions
SAHRA:	South African Heritage Resources Agency
SAMRAD:	South African Mineral Resources Administration System
SANBI:	South African National Biodiversity Institute
SANS:	South African National Standard
SASS5:	South African Scoring System version 5
SCC:	Species of Conservation Concern
SDF:	Spatial Development Framework
SEMA:	Specific Environmental Management Acts
S&EIA:	Scoping and Environmental Impact Assessment
S&LP:	Social and Labour Plan
SMME:	Small, Medium and Micro-sized Enterprises
SOP:	Standard Operating Procedure
SPLUMA:	Spatial Planning and Land Use Management Act (Act No.16 of 2013)
SR:	Scoping Report
Stats SA:	Statistics South Africa
TWI:	Topographic wetness index
WMA:	Water Management Area
WML:	Waste Management License in terms of NEM:WA
WRD:	Waste Rock Deposit

1 INTRODUCTION AND BACKGROUND

Vandabyte (Pty) Ltd (hereafter the applicant) has appointed Enviro-Insight CC to undertake environmental authorisations associated with the proposed Dunbar Coal Mine. The applicant has obtained a Prospecting Right (reference number MP 30/5/1/1/2/10737 PR) on 22 May 2014 from the Mpumalanga Department of Mineral Resources to prospect for coal in an area of 1797 ha on a Portion of Portion 1, Portion 2 and the remaining extent of the Farm Dunbar 189 IS, Portion 1 of the Farm Middelkraal 50 IS and Portion 6 of the Farm Halfgewonnen 190 IS located in Mpumalanga Province. The Mining Right (MR) application and environmental authorisation (EA) application was lodged on 9 May 2019 to the DMR (reference number MP30/5/1/2/2/10237MR) and includes the abovementioned properties and extent.

The application for mining right was accepted on 23 May 2019, and the acknowledgement letter for the EA application was signed on 12 June 2019. The Scoping Report (SR) and Plan of Study (PoS) was submitted on 3 July 2019 to the DMR, and the approval letter was received on 21 August 2019 (Appendix J). As per the acceptance letter, the EIA phase of the process may continue and the final EIA report and EMPr should be submitted within 106 days from the date of approving the SR and PoS. This draft EIA report and EMPr will be submitted for public and stakeholder review for a period of 30 days in terms of the National Environmental Management Act (1998) and the National Environmental Management Waste Act (2008) in respect of listed activities that have been triggered by applications in terms of these legislation and the Mineral and Petroleum Resources Development Act, 2002 (MPRDA) (as amended). The Final EIA report and EMPr will be submitted on or before 29 November 2019.

The Integrated Environmental Authorisation (IEA) application includes the above-mentioned properties where the proposed two mining blocks identified with an estimated life of mine (LoM) of approximately ten years and associated infrastructure is located on Portion 2 of the Farm Dunbar 189 IS. The proposed access road includes both Portion 2 of the Farm Dunbar 189 IS as well as Portion 6 of the Farm Halfgewonnen 190 IS.

For the Dunbar project, the resources for a specific area were estimated as described in detail in the Mining Work Programme (MWP) (Appendix I). This area was chosen for its potential for surface mining and distance from environmentally sensitive areas. Sufficient data was available for the western section of the proposed MR to make an initial assessment of its potential. Both Seams 4 and 2 occur on the PR area with Seam 4 reaching a maximum thickness of 5.89 m and Seam 2 a maximum of 9.95 m. In the shallowest parts, Seam 4 starts at a depth of 2.45 m and goes as deep as 100.9 m with Seam 2 at depths from 29.80 to 122.70 m. Seam 5 is thin and not regarded as economical. There is a persistent dolerite sill in the western part and another in the north-east that caused large areas of the coal to be burnt or devolatilised. From the MWP, a low-quality thermal coal will be produced from the different coal seams that will be mined if approved.

In order for the proposed mine to operate, the applicant is required to submit an application for a MR with the DMR. In support of the application to obtain the MR, the applicant is required to conduct a Scoping and Environmental Impact Assessment (S&EIA) process that need to be submitted to the DMR for adjudication, which includes activities triggered under the Environmental Impact Assessment (EIA) Regulations of 2014 (as amended) promulgated under the National Environmental Management Act, 1998 (Act 107 of 1998) and activities triggered under the National Environmental Management: Waste Act, 2008 (NEM:WA) (Act 59 of 2008). In addition, an integrated water use licence application will be submitted to the Department of Water and Sanitation.

The proposed opencast coal mining operations constitutes various listed activities which have been listed within the scheduled activities in Government Notice Regulation No 324, 325 and 327 (as amended on 7 April 2017) and therefore require a full Scoping and EIA process to be followed. Prior to any listed activity being approved by the DMR, it is required that an environmental process is undertaken and a report is submitted to the relevant environmental authority for consideration.

The purpose of the S&EIA process is to ensure that potential environmental, economic and social impacts associated with operation and closure/ rehabilitation of a project are identified, assessed and appropriately managed. There are two primary phases, namely the scoping phase and the impact assessment phase.

These two phases are discussed in more detail below.

1.1 SCOPING PHASE

The scoping phase is conducted as the precursor to the Environmental Impact Assessment (EIA) process during which:

- Project and baseline environmental information is collated. Baseline information for the scoping report is gathered through visual inspections during field visits of the proposed project area and surroundings, desktop studies which include GIS mapping, and review of existing reports, guidelines and legislation.
- Landowners, adjacent landowners, local authorities, environmental authorities, as well as other stakeholders which may be affected by the project, or that may have an interest in the environmental impacts of the project are identified.
- Interested and affected parties (I&APs) are informed about the proposed project.
- Environmental authorities are consulted to confirm legal and administrative requirements.
- Environmental issues and impacts are identified and described.
- Development alternatives are identified and evaluated, and non-feasible development alternatives are eliminated.
- The nature and extent for further investigations and specialist input required in the EIA phase are identified.
- The draft and final scoping reports are submitted for review by authorities, relevant organs of state and I&APs.
- Key I&AP issues and concerns are collated into an issues and response report for consideration in the EIA phase.

The Scoping Phase has been completed, and the DMR has approved the Scoping Report on 21 August 2019 (Appendix J). Accordingly, approval to continue with the EIA phase has been granted and the 106 day period in which to submit the EIA report and EMPr has commenced.

1.2 EIA PHASE PROCESS

The EIA phase started on 21 August 2019. During this period, consultation with Interested and Affected Parties will continue, including the 30 day review period of the draft EIA report and EMPr during October/November 2019.

The EIA phase of the application includes:

- Specialist investigations are undertaken in accordance with the terms of reference established in the scoping assessment (plan of study for EIA appended to the scoping report). The scope for specialist work is determined accordingly to the nature and scale of the project impacts.

- An evaluation of development alternatives and identification of a proposed option.
- An assessment of existing impacts (no-go development option), environmental impacts that may be associated with the proposed project option, and cumulative impacts using the impact assessment methodology.
- Identification of mitigation measures to address the environmental impacts and development of actions required to achieve the mitigation required.
- Consultation with I&APs.
- Incorporation of public comment received during scoping and the draft EIA into the final EIA report.
- Issuing of the final EIA report for review.
- After the draft EIA report is reviewed, comments received will be incorporated into the final EIA report and final Environmental Management Program (EMPr).

The requirements for the S&EIA process are specifically contained in Chapter 4 Part 3 of the NEMA Reg No 326 (amended on 7 April 2017). The EIA process can take up to 300 days to complete (87 days for scoping phase (completed), 106 days for EIA phase (commenced on 21 August 2019), and 107 days for competent authority to review).

1.3 MINING PROCESS SUMMARY

Mining is conducted via opencast method by employing truck and shovel rollover mining technique. Burden material will be moved back into the pit in order to fill the voids and soils remove from subsequent strips will be used to dress the levelled spoils as part of the rehabilitation programmes. Coal that is removed from the initial pit will be transported via trucks to the conveyors to the washing plant.

- **Mineral**: Coal
- **Mining Method**: Opencast “Rollover Method”.
- **Depth of mineral below service:** Depth of the lower coal seams varies from 25 to 75 metres but could be up to 100 metres in isolated areas.
- **Product Market:** Eskom – Komati Power Station / Export market
- **Life of Mine (LoM):** 14 years for operational plus additional time for rehabilitation and decommissioning**.**
- **Life of Mine ROM Tonnage:** 21 Million
- **Coal Transport System: Opencast –** Haul trucks and with conveyor to plant area

2 PROPONENT AND ENVIRONMENTAL ASSESSMENT PRACTITIONER (EAP) DETAILS

2.1 DETAILS OF THE PROPONENT

For purposes of this project, the following person may be contacted:

Figure 2-1: Proponent's contact details

Contact Person	Bjorn Goosen
Address	2nd Floor, Tugela House, Riverside Office Park, 1303 Heuwel Ave, Centurion 0157 PO Box 68727, Highveld, 0169 South Africa
Telephone	+27 12 771 4411
Email	info@insacoal.co.za
Fax	086 604 5100

2.2 ITEM 3(A)(I): DETAILS OF EAP

Vandabyte (Pty) Ltd has appointed Enviro-Insight CC as an independent Environmental Assessment Practitioner (EAP) to undertake a Scoping and Environmental Impact Assessment (S&EIA) process that is required to support the application for a mining right. Enviro-Insight CC has no vested interest in the proposed project and hereby declares its independence as required by the EIA Regulations. For purposes of this S&EIA, the following person may be contacted at Enviro-Insight CC:

Figure 2-2: Enviro-Insight contact details

Company:	Enviro-Insight CC
Contact Person:	Corné Niemandt
Purpose:	Project coordinator and EAP
Address:	Unit 8 Oppidraai Office Park, 862 Wapadrand Road, Wapadrand Security Village, Pretoria, 0081
Telephone:	012 807 0637
Email:	corne@enviro-insight.co.za

2.3 ITEM 3(A)(II): EXPERTISE OF ENVIRONMENTAL ASSESSMENT PRACTITIONER

2.3.1 Qualifications and Memberships (Appendix 1)

Mr. Niemandt holds a *M.Sc*. degree in Plant Science from the University of Pretoria (2015), and is registered as a professional scientist with the South African Council for Natural Scientific Professions (SACNASP). He is also a member of the International Association for Impact Assessment South Africa (IAIAsa) and a member of the South African Association of Botanists (SAAB). He has submitted an application for the professional registration with the newly appointed Environmental Assessment Practitioners Association of South Africa (EAPASA) which becomes affective on 8 February 2020.

2.3.2 Summary of past experience (Appendix 2)

Mr. Niemandt has four years' experience as an environmental consultant, compiling and managing several environmental authorisation reports, including Environmental Management Programmes (EMPr), Strategic Environmental Assessments, rehabilitation plans and environmental auditing. This included fieldwork, data collection, preparation of permits and licensing studies, compliance monitoring and community engagement, and project management involving interdisciplinary teams and contractors. He has also compiled over 40 ecological / flora specialist reports.

2.3.3 Specialist studies

Specialist studies has been undertaken to address the impacts associated with the mining activities. The specialist studies involve the gathering of data relevant to identifying and assessing impacts that may occur as a result of the proposed project. The specialists will also recommend appropriate mitigation / control or optimisation measures to minimise potential negative impacts or enhance potential benefits, respectively. The mitigation measures and recommendations made by the specialists are included in the EMPr, which will serve as the guide during the construction, operational and decommissioning phases (including rehabilitation) of the project. Refer to section 7: Item 3(g)(iv): The Environmental Attributes associated with the development footprint for a list of specialist studies and their associated Appendix.

2.4 ITEM 3(B): DESCRIPTION OF THE PROPERTY

Property description details for the proposed Dunbar Coal mine are provided in Figure 2-3. All farm names applicable to this S&EIA is listed below, although the current mining blocks and associated infrastructure are located on Portion 2 of the Farm Dunbar 189 IS. The proposed access road includes both Portion 2 of the Farm Dunbar 189 IS as well as Portion 6 of the Farm Halfgewonnen 190 IS. It should be noted that Portion 8 of the Farm Dunbar 189 IS is not included in the property description as this belongs to Transnet and is accordingly a railway servitude.

Figure 2-3: Property descriptions of the proposed Dunbar Coal Mine

Farm Name:	• Portion of Portion 1, Portion 2 and the remaining extent of the Farm Dunbar 189 IS • Portion 1 of the Farm Middelkraal 50 IS • Portion 6 of the Farm Halfgewonnen 190 IS
Application area (ha):	1797 ha for the mining right of which approximately 200 ha identified for current mining operations
Magisterial district:	Nkangala District Municipality Steve Tshwete Local Municipality Gert Sibande District Municipality Govan Mbeki Local Municipality
Distance and Direction from nearest town:	4.1 km south of Meerlus 8.93 km southeast of Komati 13.76 km west of Hendrina

21 Digit Surveyor General Code for each farm portion:	T0IS00000000018900000 T0IS00000000018900001 T0IS00000000018900002 T0IS00000000005000001 T0IS00000000019000006

2.4.1 Landowners

The mining right is applicable for Portion of Portion 1, Portion 2 and the remaining extent of the Farm Dunbar 189 IS, Portion 1 of the Farm Middelkraal 50 IS and Portion 6 of the Farm Halfgewonnen 190 IS. This environmental authorisation process for the Dunbar Coal Mine project study area covers the above properties which belong to the following landowners (Figure 2-4):

Figure 2-4: Landowners of the affected properties (Surface right owners)

Landowner	**Property description**
Beestepan Boerdery Peter Kane Berman	Portion 2 of the Farm Dunbar 189 IS
W A DE KLERK FAMILIE TRUST WA de Klerk	The remaining extent of the Farm Dunbar 189 IS
UMCEBO PROP PTY LTD Hugo Grobler	Portion 1 of the Farm Middelkraal 50 IS
ANTON PELSER EIENDOMS TRUST Anton Pelser	A Portion of Portion 1 of the Farm Dunbar 189 IS Portion 6 of the Farm Halfgewonnen 190 IS[4]

2.5 ITEM 3(C): LOCALITY MAP

The study area falls in the Steve Tshwete Local Municipality located in the Nkangala District Municipality and in the Govan Mbeki Local Municipality located in the Gert Sibande District Municipality, Mpumalanga Province. The mining right application will include a Portion of Portion 1, 2 and the remaining extent of the Farm Dunbar 189 IS, Portion 1 of the Farm Middelkraal 50 IS and Portion 6 of the Farm Halfgewonnen 190 IS. The study area is located approximately 4.1 km south of Meerlus, 8.93 km southeast of Komati and 13.76 km west of Hendrina. The R35 is located west, R542 is located north and the R38 is located south-east of the study area (Figure 2-5, Figure 2-6).

Refer to Appendix 3 for enlarged maps in A3 format.

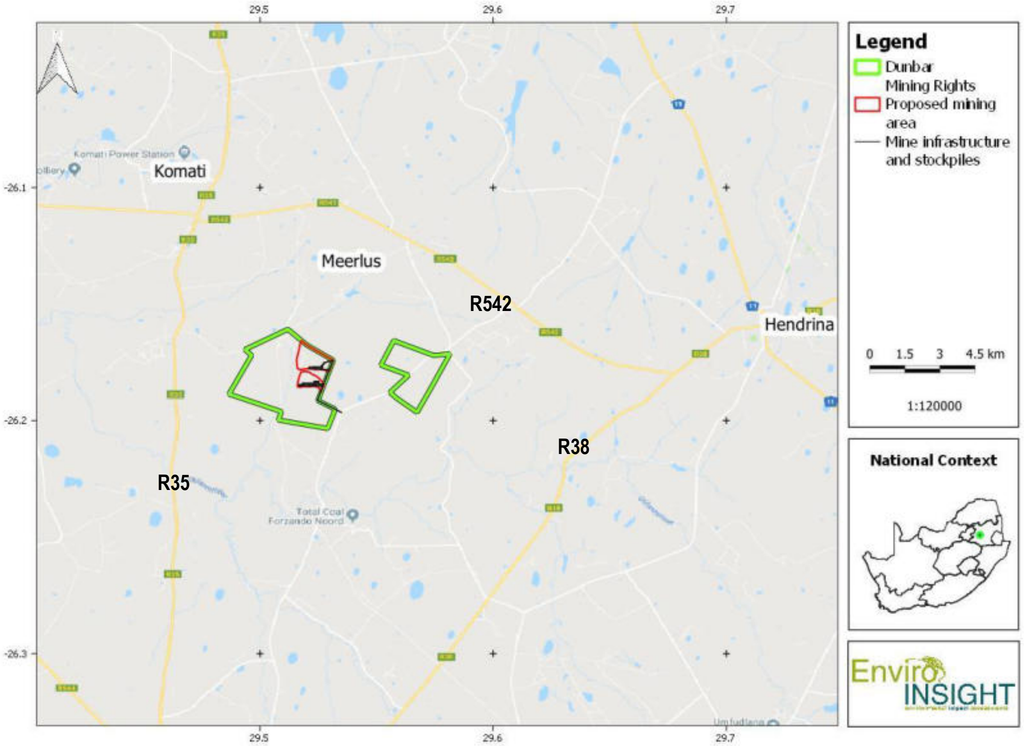


Figure 2-5: Locality map of the proposed coal mine.

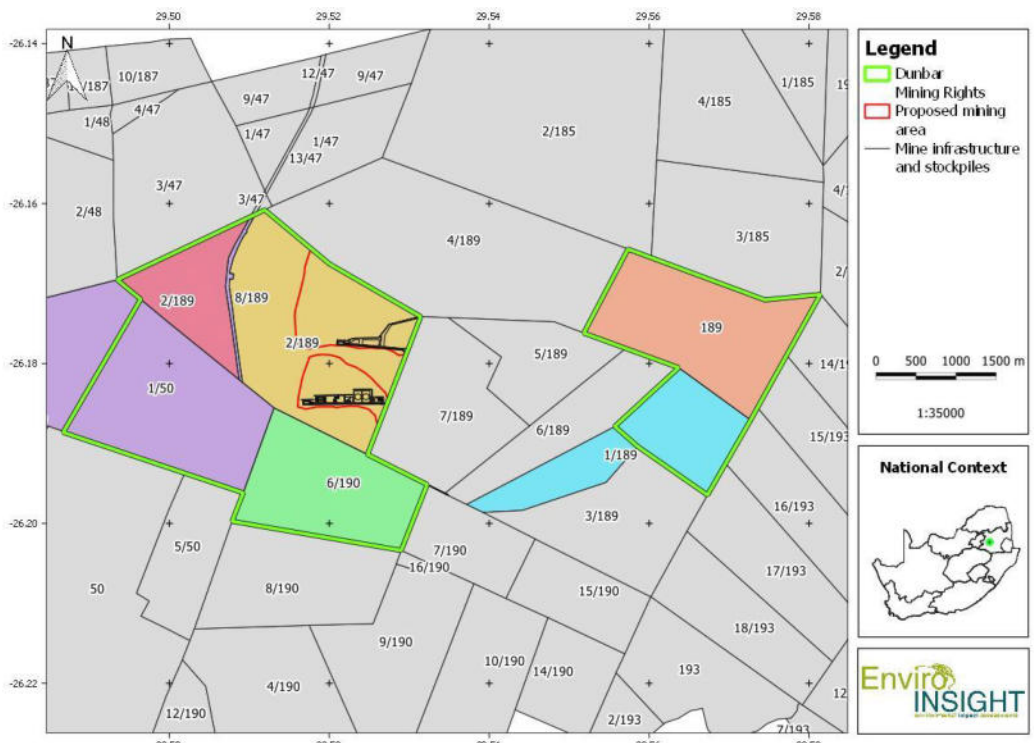


Figure 2-6: Locality map showing the affected farm portions of the mining right area.

3 ITEM 3(D): DESCRIPTION OF THE SCOPE OF THE PROPOSED OVERALL ACTIVITY

3.1 ITEM 3(D)(I): LISTED AND SPECIFIED ACTIVITIES

The applicant has applied for a mining right and environmental authorisation for the development of a mine and supporting infrastructure. The listed activities that require environmental authorisation in terms of the NEMA EIA Regulations GN R.326/324/325/327 amended on 7 April 2017, the Waste Management Activities listed in terms of the NEM: WA GN R. 921 (2013) and GN R. 633 (amended 2015) and the water uses in terms of section 21 of are indicated in Figure 3-1 and Figure 3-2 below, respectively.

Figure 3-1: Listed activities according to NEMA requiring environmental authorisation

Government Notice	Activity Number	Description
Listing Notice 1: R.327 on 7 April 2017	~~12~~	~~The development of—~~ ~~(i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or~~ ~~(ii) infrastructure or structures with a physical footprint of 100 square metres or more;~~ ~~where such development occurs—~~ ~~a) within a watercourse;~~ ~~(b) in front of a development setback; or~~ ~~(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse~~
	This activity is no longer triggered as all infrastructure is located more than 32 meters from a watercourse.	
	14	The development and related operation of facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 cubic metres or more but not exceeding 500 cubic metre
	~~19~~	~~The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse~~
	This activity is no longer triggered as no construction will take place within 32 meters of a watercourse.	

Government Notice	Activity Number	Description
	24	The development of a road— (i) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Government Notice 545 of 2010; or (ii) with a reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 metres
	25	The development and related operation of facilities or infrastructure for the treatment of effluent, wastewater or sewage with a daily throughput capacity of more than 2 000 cubic metres but less than 15 000 cubic metres
	28	Residential, mixed, retail, commercial, **industrial** or institutional developments where such land was used for agriculture, game farming, equestrian purposes or afforestation on or after 01 April 1998 and where such development: (i) will occur inside an urban area, where the total land to be developed is bigger than 5 hectares; or (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare.
	~~31~~	~~The decommissioning of existing facilities, structures or infrastructure for—~~ ~~(i) any development and related operation activity or activities listed in this Notice, Listing Notice 2 of 2014 or Listing Notice 3 of 2014~~
	This activity is no longer triggered as no existing facilities, structures or infrastructure will be influenced by the proposed development.	
	~~56~~	~~The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre—~~ ~~(i) where the existing reserve is wider than 13,5 meters; or~~ ~~(ii) where no reserve exists, where the existing road is wider than 8 metres;~~
	This activity is no longer triggered as no upgrades to existing roads are proposed	
Listing Notice 2: R.325 on 7 April 2017	4	The development and related operation of facilities or infrastructure, for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres.
	6	The development of facilities or infrastructure for any process or activity which requires a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent

Government Notice	Activity Number	Description
	15	The clearance of an area of 20 hectares or more of indigenous vegetation.
	17	Any activity including the operation of that activity which requires a mining right as contemplated in section 22 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including— (a) associated infrastructure, structures and earthworks, directly related to the extraction of a mineral resource; or (b) the primary processing of a mineral resource including winning, extraction, classifying, concentrating, crushing, screening or washing but excluding the secondary processing of a mineral resource, including the smelting, beneficiation, reduction, refining, calcining or gasification of the mineral resource in which case activity 6 in this Notice applies.
	19	The removal and disposal of minerals contemplated in terms of section 20 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including— a) NA; or b) the primary processing of a mineral resource including winning, extraction, classifying, concentrating, crushing, screening or washing
Listing Notice 3: R.327 on 7 April 2017	4	The development of a road wider than 4 metres with a reserve less than 13,5 metres. **f. Mpumalanga** i. Outside urban areas: (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; … (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; …

Government Notice	Activity Number	Description
	10	The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres. **f. Mpumalanga** i. Outside urban areas: (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; … (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; … (hh) Areas within a watercourse or wetland, or within 100 metres of a watercourse or wetland; …
	~~12~~	~~The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.~~ ~~**f. Mpumalanga**~~ ~~ii. Within critical biodiversity areas identified in bioregional plans;~~
	This activity is no longer triggered as the proposed development is not within a CBA	
	~~14~~	~~The development of—~~ ~~(i) dams or weirs, where the dam or weir, including infrastructure and water surface area exceeds 10 square metres; or~~ ~~(ii) infrastructure or structures with a physical footprint of 10 square metres or more;~~ ~~where suc development occurs—~~ ~~(a) within a watercourse~~ ~~(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse;~~ ~~**f. Mpumalanga**~~ ~~i. Outside urban areas:~~ ~~(dd) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;~~ ~~(ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;~~

Government Notice	Activity Number	Description
	This activity is no longer triggered as no development occurs within a watercourse or within 32 meters of a watercourse.	

Figure 3-2: Waste Management listed activities according to NEM: WA requiring environmental authorisation

Government Notice	Activity	Description
R.921 Category B	1	The storage of hazardous waste in lagoons excluding storage of effluent, wastewater or sewage
	10	The construction of a facility for a waste management activity listed in Category B of this Schedule
R.633: Category B	11	The establishment or reclamation of a residue stockpile or residue deposit resulting from activities which require a mining right, exploration right or production right in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No 28 of 2002).

3.2 ITEM 3(D)(II): DESCRIPTION OF THE ACTIVITIES TO BE UNDERTAKEN

MINING METHODOLOGY (as per the MWP)

Mining methods vary widely and depend on the location, type and size of mineral resources. Surface mining methods are most economical in situations where mineral deposits occur close to the surface (e.g. coal, salts and other evaporite deposits or road quarry material) or form part of surface deposits (e.g. alluvial gold and diamonds, and heavy mineral sands). For this specific project the mining of coal by means of surface mining methods are viable due to the fact that the resource is situated close enough to the surface to make it economically mineable. Typical surface mining methods include: strip mining and open pit mining, as well as dredge, placer and hydraulic mining in riverbeds, terraces and beaches. These activities always disrupt the surface and this, in turn, affects soils, surface water and near-surface ground water, fauna, flora and all alternative types of land-use.

The generally low strip ratios and wide surface area of the project area makes it ideal for the opencast truck and shovel mining method. Also, the mining method applicability is driven by technical applicability, economic viability, safety, equipment and infrastructure.

The proposed mining method and sequence comprised of the following main mining activities for both waste and coal:

- Initial topsoil and soft overburden removal which will be stockpiled to ensure it can be replaced back in the initial box cut;

- The physical mining of the coal seam which includes drilling of hard overburden material, charging and blasting;
- The coal is loaded into trucks and hauled to the crushing and screening facility;
- Discard coal will be extracted and replaced in the bottom of the opencast pit, while the product will be taken to the weighbridge via trucks and then removed off site;
- The overburden is replaced back into the pit as mining progresses leaving a minimum area open at a single time;
- The topsoil which was stripped and stockpiled separately before mining commenced is then replaced. The findings of the land capability study will determine the optimal composition to ensure pre-mining conditions for utilisation.

The proposed mining layout is based on a 100 m x 50 m mining block size. The purpose of a square mining layout is to increase the ease of strategic mine scheduling. The start of the mining block layout was based on the mining boundary.

The size and scale of the open-pit mine entails that small and conventional truck and shovel mining equipment is used to mine both waste material and coal. The following equipment is proposed for this:

- 120t Backhoe hydraulic excavators on coal and overburden material
- Articulated dump trucks ("ADT").

Hauler selection is based on the optimal fit and number of passes with excavators and loaders with standardization if appropriate.

To conduct the operational process the planned mining equipment to be utilized is as follows:

- Contractor 1: (mining – equipment per team)
- 2 x CAT Bulldozer
- 3 X Bell Hydraulic Excavators
- 12 X Bell B40 Articulated 6X6 Dump trucks
- 1 X CAT 140 Motor Grader
- 1 X 10 000 litre Water Bowser
- 1 x 4 000 litre Diesel Bowser
- 2 X Mobile Percussion Drill Rig
- 4 X Service Truck
- Support equipment (transport/ material handling – Diesel)
- Contractor 4 (beneficiation/ crushing)

The above equipment will be supplied by the mining contractor and the costing thereof will be included in the contractor's unit rates.

High level description of the processing plant

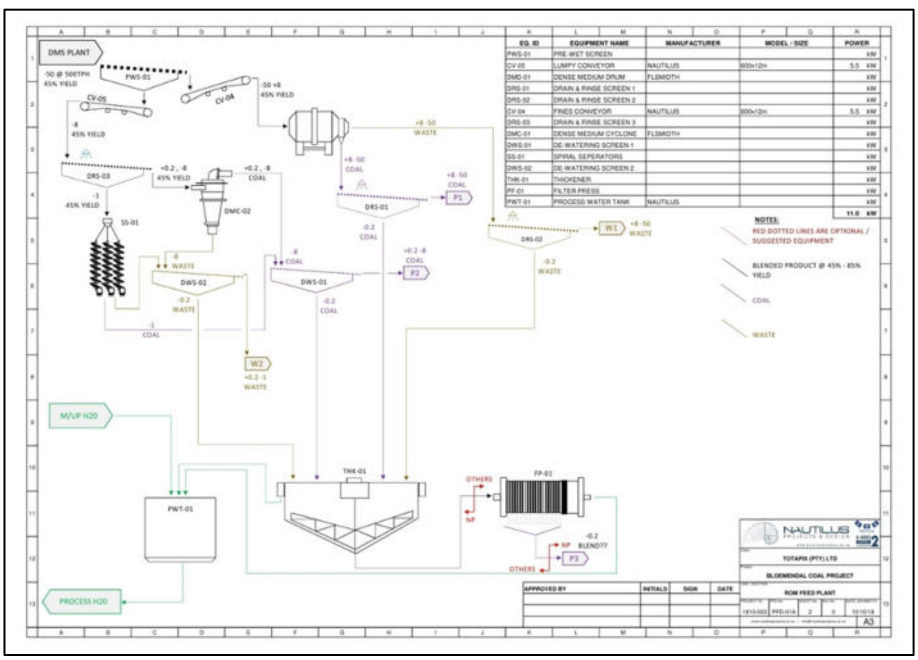
The actual operational time frame is calculated from the date of granting of a mining right. The operational period has been subdivided into a construction and implementation phase and a production phase.

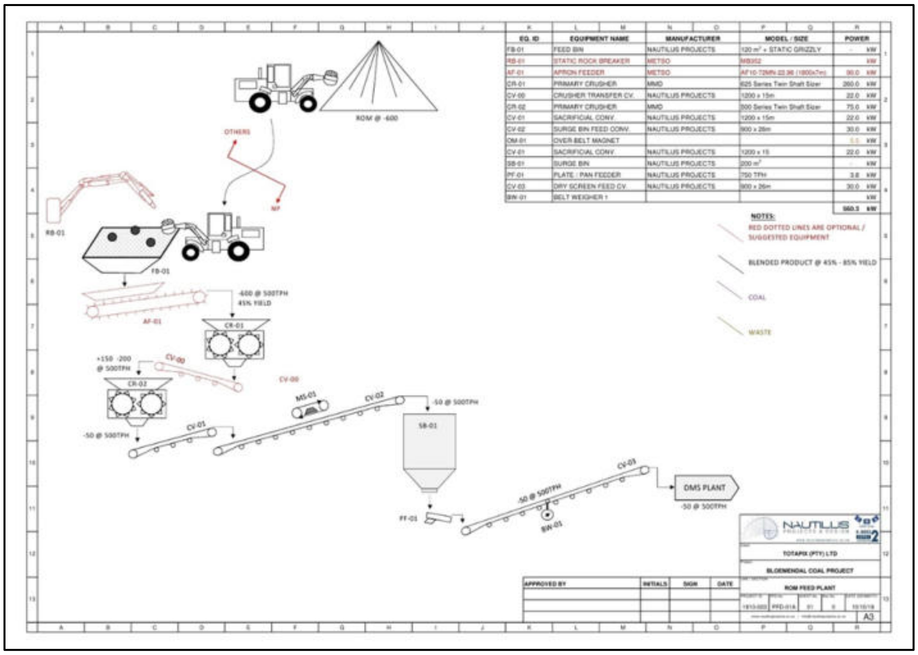
Construction Phase

The construction phase will commence immediately upon granting of a mining right and will include the following items and expected timeframes:

- Preparation of Access Roads (3 Weeks)
- Construction of contractor's yard (1 Week)
- Workshop Construction (3 Weeks)
- Fencing and trenching of Mining Area (4 Weeks)
- Construction of Security (Boom Gates, Security house) (4 Weeks)
- Installation of Weighbridge (3 Weeks)
- Construction of Ablutions (5 Weeks)
- Construction of Diesel bunds and Installation of Tanks (2 Weeks)
- Construction of Mine haul roads (4 Weeks)
- Development of trenches and pollution control facilities (8 Weeks)
- Setting up crushing, screening and washing plant (8 weeks)
- Boxcut development (9 Weeks)

A basic plant design is indicated in Figure 3-3 below (supported by a process flow diagram, of the plant).





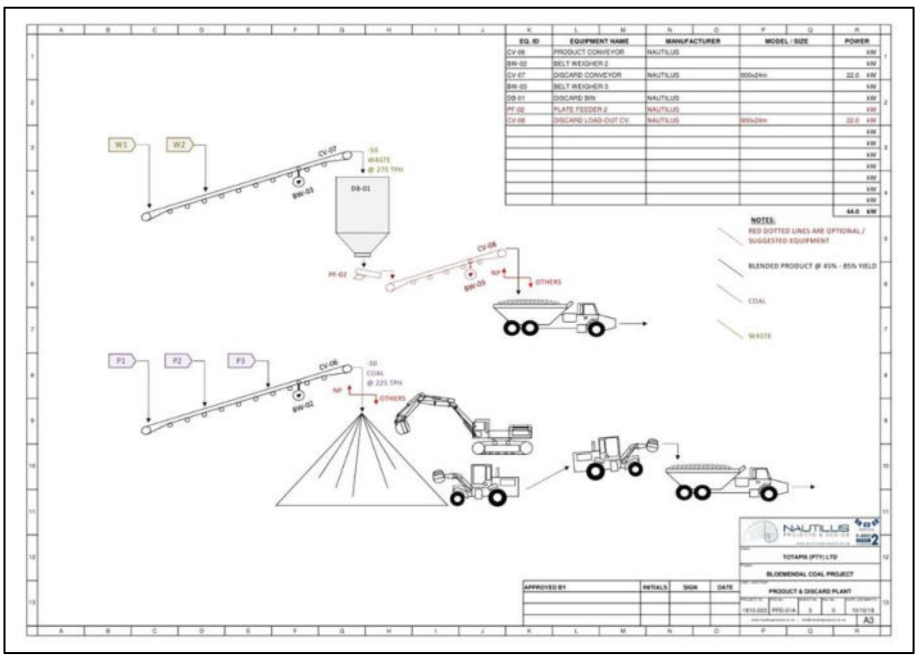


Figure 3-3: Basic plant design.

INFRASTRUCTURE REQUIREMENTS

- Access & Haul roads (with necessary security) including the upgrading of the access point to the gravel road;
- Contractor’s Yard with septic/chemical ablution facilities;

- Offices;
- Weighbridge, workshop and stores (with septic/chemical ablution facilities);
- Rail Siding;
- Diesel facilities and a hardstand;
- Power and Water;
- Boxcut;
- Stockpiles (topsoil, overburden, subsoil/ softs, ROM);
- Surface water management measures (storm water diversion berms and trenches, pollution control dams, tailings dam etc); and
- Crushing, screening & wash facility.

The preliminary mining layout including infrastructure and the opencast pits is indicated in Figure 3-4 below. This layout was informed by specialist investigations, from an optimal operational perspective of the mine and also according to the best practice guidelines.

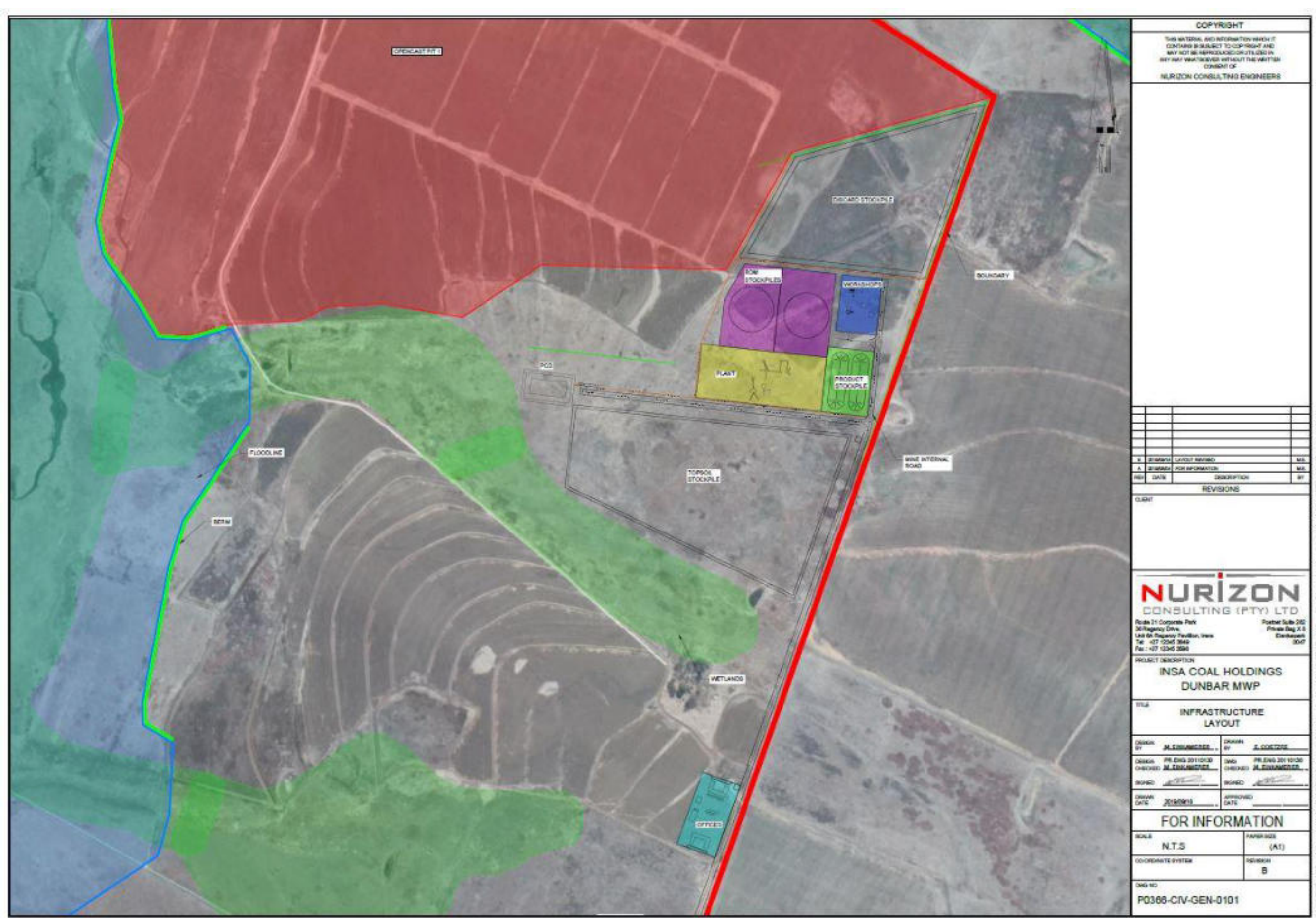


Figure 3-4: Preferred mining layout for the proposed Dunbar Coal Mine.

Construction Phase

The construction phase will commence immediately upon granting of a mining right and will include the following items and expected timeframes:

- Preparation of Access Roads (3 Weeks)
- Construction of contractor's yard. (1 Week)
- Workshop Construction (3 Weeks)
- Fencing and trenching of Mining Area (4 Weeks)
- Construction of Security (Boom Gates, Security house) (4 Weeks)
- Installation of Weighbridge (3 Weeks)
- Construction of Ablutions (5 Weeks)
- Construction of Diesel bunds and Installation of Tanks (2 Weeks)
- Construction of Mine haul roads (4 Weeks)
- Development of trenches and pollution control facilities (8 Weeks)
- Setting up crushing, screening and washing plant (8 weeks)
- Boxcut development. (9 Weeks)

Access Roads (3 Weeks).

Currently there is an existing gravel road to the mine, linking up with the provincial road. The access road from the Mine to the provincial road is to be upgraded. The upgrade will include excavating the road base to a depth of 0.5m and to backfill with sandstone to create a permeable base. A 0.30m ferricrete layer will be placed on the sandstone base to create the road surface. The road will be shaped to ensure adequate drainage.

Contractors Yard (3 Weeks).

The topsoil and softs over the area will be excavated to a depth of 1.00m and a sandstone base levelled and to accommodate offices, workshops, diesel storage facilities for the appointed contractor. The topsoil will be stockpiled as per the EMPR. The contractor already has most of these facilities and all that is required is levelling and fencing of the area.

Workshop (3 Weeks).

A 10m x 10m workshop will be constructed within the contractor's yard. A reinforced concrete platform will be constructed as the base of the workshop.

Fencing and trenching, of the Mining Area (4 Weeks).

A fence (5 Strand Barbed wire) will be established around the perimeter of the mining area. A 2m deep trench will be dug along the boundaries.

Security and access control (4 Weeks).

A permanent security house and boom gates will be constructed at the Mine entrance. The structures will comprise of brick and mortar and will be supplied with electricity from a diesel driven generator.

Ablutions (5 Weeks).

An area has been identified between the security and contractors camp area for ablution facilities. The ablutions will be constructed from brick and mortar and will comply with the requirements of the EMPr.

Haul roads (4 Week).

Permanent haul roads are to be constructed. The roads will be constructed of suitable material eg. laterite and will conform to minimum safety requirements in terms of slopes and widths etc.

Drainage and Pollution Control Facilities (8 Weeks).

The principle of keeping clean water out of the mining operation and retaining dirty water shall apply to the proposed Mine. A series of clean water drains are to be constructed along the boundary and along the sub-outcrop line to divert clean water away from the mining operations.

Transport of Equipment to site and establishment of the contractor - Crush, Screen & Wash Plant Establishment.

A crushing, screening and washing plant with filter presses will be erected at the indicated location. This will ensure the product meets the relevant criteria in terms of sizing and blending.

Weighbridge (3 Weeks).

An area adjacent to the security has been identified for the weighbridge and will require limited cut and fill prior to installation. An accredited weighbridge will be installed by contractors.

Boxcut 1 (9 Weeks).

A double boxcut has been planned. Mining operations will commence in boxcut 1 and the overburden will be load and hauled to the northern pit extremity for dozing into final void once the area has been depleted. Based on the overburden volume and production capacity of the contractor, it is envisaged that the boxcut development will be completed in 9 weeks.

Operational Phase

The operational phase, known as steady-state, will commence after the completion of the boxcut. A conventional strip mining [roll-over] method will be employed. Material from the boxcut phase will be stored per overburden classification, with the bulk of the material placed in a position alongside the final strip, to facilitate filling of the final void.

Steady-state mining includes the processes and equipment as indicated in Figure 3-5. The following mining sequence will occur during the operational phase.

Topsoil Removal: Topsoil will be removed and will be either stockpiled separately. Topsoil will be removed using excavators and hauled with articulated dump trucks (ADT's).

Softs Removal: Soft subsoil will be removed and will be stockpiled. Softs will be removed using excavators and hauled with articulated dump trucks (ADT's).

Overburden Drill and Blast: Drilling of the overburden will be done using a mobile drill rig, drilling a hole of a 110mm diameter and with a planned burden and spacing of 4m x 5m. This may be adjusted once mining has commenced.

Overburden Dozing: The first overburden removal process will be to doze overburden material to the spoil side. For modelling purposes it is assumed that 40% of the overburden can be dozed. The assumption is based on current mining practice at similar sites where the contractor is employed.

Overburden Load and Haul: The remaining overburden, after dozing, will be load and hauled and dumped on the spoil side of the current strip. The load and haul will be conducted using excavators and ADT's.

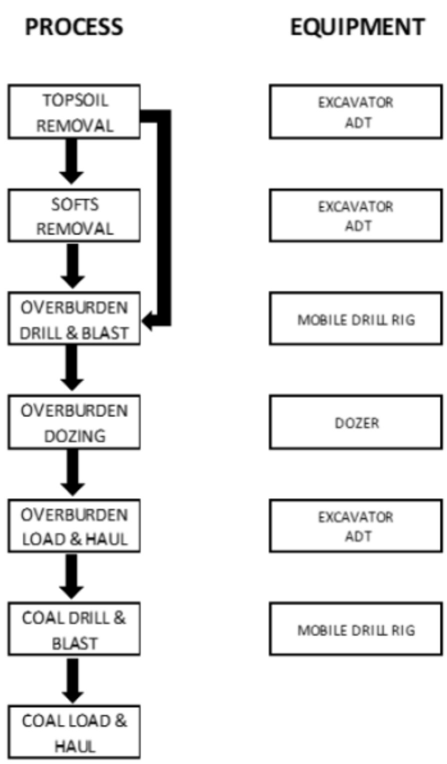


Figure 3-5: Steady-state mining processes and equipment.

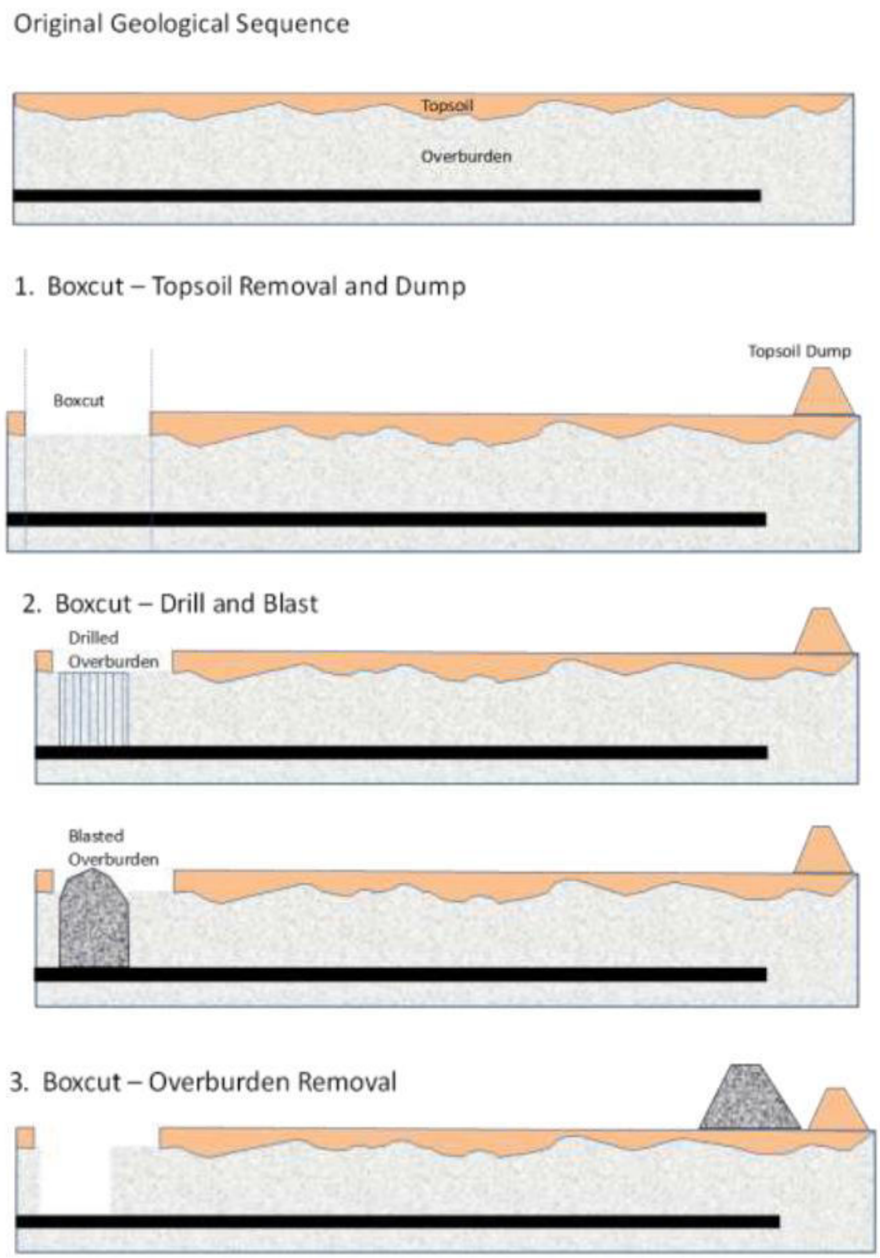
Coal Drill and Blast: Drilling of the coal will be done using a mobile drill rig drilling a hole of a 110mm diameter and with a planned burden and spacing of 7m x 8m. This may be adjusted once mining has commenced.

Coal Load and Haul: The coal be load and hauled and dumped on the Run of Mine Stockpile. The load and haul will be conducted using excavators and ADT's.

Crush & Screen: A ROM tip feeding the crushing and screening plant; the proposed position of the Crushing and Screening Plant is indicated on the layout Map attached (Appendix D).

Crush, Screen and Wash: A ROM tip feeding the crushing and screening plant; the proposed position of the Crushing and Screening Plant is indicated on the layout Map attached. The blasted coal will be loaded and hauled to the ROM coal stockpile, from where the coal will be initially sent to the crushing and screening plant before being hauled via road to the markets.

A graphic presentation of the above mining sequence is presented in Figure 3-6.



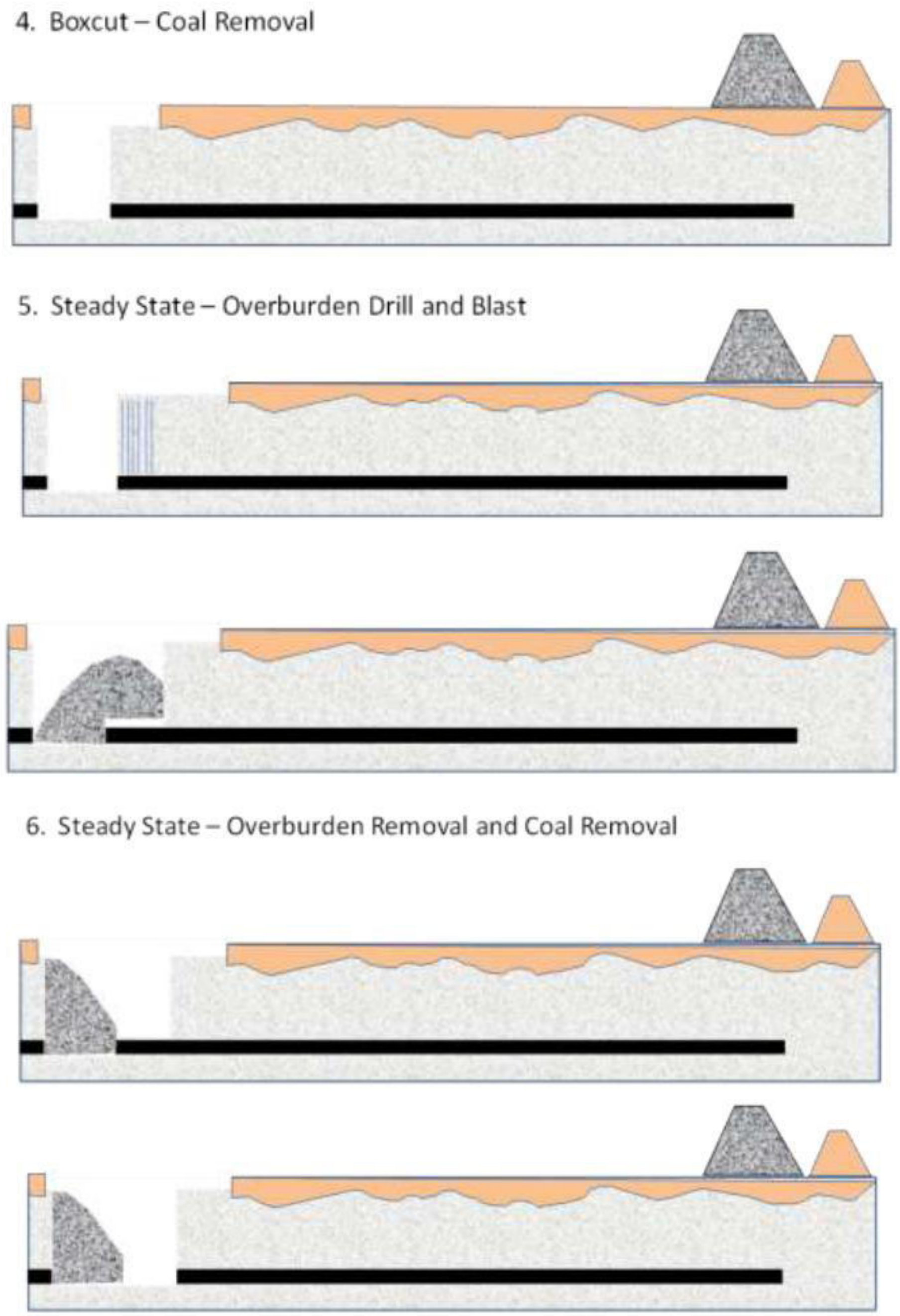


Figure 3-6: A graphic presentation of the mining sequence.

3.3 ITEM 3(E): POLICY AND LEGISLATIVE CONTEXT

This section provides an overview of the governing legislation identified which may relate to the proposed project.

APPLICABLE LEGISLATION AND GUIDELINES USED TO COMPILE THE REPORT (A description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process).	**REFERENCE WHERE APPLIED** (I.e. Where in this document has it been explained how the development complies with and responds to the legislation and policy context).	**HOW DOES THIS DEVELOPMENT COMPLY WITH AND RESPOND TO THE POLICY AND LEGISLATIVE CONTEXT** (E.g. Water Use License has/has not been applied for).
Constitution of the Republic of South Africa, Act 108 of 1996 Section 24 states: *"Everyone has the right—* *(b) to an environment that is not harmful to their health or well-being; and* *(c) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that—* *(i) prevent pollution and ecological degradation;* *(ii) promote conservation; and* *(iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development".*	The EIA process is being undertaken to determine the impacts associated with the project, including environmental, social and economic. As part of the EIA process, mitigation measures and monitoring plans are recommended to ensure that any potential impacts are managed to acceptable levels to support the rights as enshrined in the Constitution. The project must prove to be sustainable and balance the social, economic and environmental aspects of sustainable development.	An Application for IEA for the proposed project was submitted to the DMR on 9 May 2019. A Scoping Report was compiled and submitted to the DMR on 3 July 2019 which detailed the biophysical, economic and social environments which will be affected and was accepted by the DMR on 21 August 2019. An EIA phase is undertaken where the impacts associated with the proposed activities as well as measures to mitigate, manage and monitor the impacts are being determined and included in the EMPr.

Mineral and Petroleum Resources Development Act The Mineral and Petroleum Resources Development Act, 2002 (MPRDA), outlines the procedural requirements an applicant must follow to get a mining right who wishes to proceed with a mining project, part of which requires the applicant to obtain Environmental Authorisation (EA) in terms of the National Environmental Management Act (1998, as amended). The MPRDA is administered by the Department of Mineral Resources (DMR) and governs the sustainable utilisation of South Africa's mineral resources. The MPRDA requires that mining companies assess the socio-economic impacts of their activities from start to closure and beyond. Companies must develop and implement a comprehensive Social and Labour Plan (SLP) to promote socio-economic development in their host communities and to prevent or lessen negative social impacts.	A Mining Right Application for the proposed Project was submitted to the DMR on 9 May 2019. This EIA Report, which relates specifically to the Dunbar Mining Right applied for, has been compiled in accordance with the MPRDA.	Vandabyte (Pty) Ltd has submitted a Mining Right Application, together with the SLP, to mine coal. The EIA process will be undertaken to meet the requirements of the MPRDA read with the NEMA EIA Regulations (2014, as amended). Financial Provisioning and Closure Costs will be included in the EIA.

National Environmental Management Act, 1998 (Act 107 of 1998) and EIA Regulations (December 2014) The main aim of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) is to provide for co-operative governance by establishing decision-making principles on matters affecting the environment. In terms of the NEMA EIA regulations, the applicant is required to appoint an environmental assessment practitioner (EAP) to undertake the EIA, as well as conduct the public participation process. In South Africa, EIA became a legal requirement in 1997 with the promulgation of regulations under the Environment Conservation Act (ECA). Subsequently, NEMA was passed in 1998. Section 24(2) of NEMA empowers the Minister and any MEC, with the concurrence of the Minister, to identify activities which must be considered, investigated, assessed and reported on to the competent authority responsible for granting the relevant environmental authorisation. On 21 April 2006 the Minister of Environmental Affairs and Tourism promulgated regulations in terms of Chapter 5 of the NEMA. These regulations, in terms of the NEMA, were amended in June 2010 and again in December 2014. The December 2014 NEMA regulations are applicable to this project. Mining Activities officially became governable under the NEMA EIA in December 2014. Section 24 (1)(a) and (b) of NEMA state that: *The potential impact on the environment and socio-economic conditions of activities that require authorisation or permission by law and which may significantly affect the environment, must be considered, investigated and assessed prior to their implementation and reported to the organ of state charged by law with authorizing, permitting, or otherwise allowing the implementation of an activity.*	This EIA Report is informed by the requirements of the NEMA and Regulations there under. An Application for Environmental Authorisation was made on 21 May 2018. The listed activities which are triggered under the NEMA have been identified and provided in Figure 3-1.	In terms of the listed activities, an S&EIA process is required. Proposed management and mitigation measures for identified impacts responds to the Duty of Care principle as per Section 28 of the NEMA. An Application for EA for the proposed project was submitted to the DMR: Mpumalanga Regional Office in Johannesburg on 9 May 2019. A Scoping Report was compiled and submitted to the DMR on 3 July 2019, and acceptance was received on 21 August 2019. An EIA phase (this report) has been undertaken where the impacts associated with the proposed activities as well as measures to mitigate, manage and monitor the impacts have been determined.

National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) The objectives of NEM:WA involve the protection of health, wellbeing and the environment by providing reasonable measures for the minimization of natural resource consumption, avoiding and minimizing the generation of waste, reducing, recycling and recovering waste, and treating and safely disposal of waste as a last resort. In terms of the NEMWA, all waste management activities must be licensed. On 29 November 2013, the list of waste management activities published under GN R718 of 3 July 2009 (GN R718) was repealed and replaced with a new list of waste management activities under GN R921 of 29 November 2013. Included in the new list are activities listed under Category A, B and C. A distinction is made between: • **Category A** describes waste management activities requiring a Basic Assessment process to be carried out in accordance with the EIA Regulations supporting an application for a waste management licence; • **Category B** describes waste management activities requiring an Environmental Impact Assessment process to be conducted in accordance with the EIA Regulations supporting a waste management licence application; and • **Category C** describes waste management activities that do not require a WML but these activities will have to comply with the prescribed requirements and standards as prescribed by the Minister, which includes the Norms and Standards for Storage of Waste, 2013.	The listed activities which are triggered under the NEM: WA have been identified and provided in Figure 3-2. Category B activities were identified, therefore a full EIA process is required the proposed Project. The triggered waste management activities have been applied for as part of the Environmental Application to the DMR. GNR 633 includes the establishment or reclamation of a residue stockpile or residue deposit resulting from prospecting or mining activities as a listed activity.	Various Category waste management activities as indicated in Figure 3-2 are applicable to the proposed mining operation. A WML is included as part of the 'one environmental system'.

National Water Act, 1998 (Act No. 36 of 1998) (NWA) NWA also has a role to play in regulating mining. Mining almost always uses water and/or has an impact on a water resource such as a stream, wetland or river. The NWA is administered by the Department of Water and Sanitation (DWS). The NWA provides for the sustainable and equitable use and protection of water resources. It is founded on the principle that the National Government has overall responsibility for and authority over water resource management, including the equitable allocation and beneficial use of water in the public interest, and that a person can only be entitled to use water if the use is permissible under the NWA. GN 704- Regulations on use of water for mining and related activities aimed at the protection of water resources.	An Integrated Water Use Licence Application (IWULA) and an associated Integrated Water and Waste Management Plan (IWWMP) are required in terms of Section 21 of the NWA for the Project, and will be submitted to DWS for the applicable Section 21 water uses.	An IWULA has been submitted to the DWS for the triggered water uses under Section 21 of the NWA. The pre-application process commenced on 19 July 2019. The final report will be submitted by December 2019.
NEM: WA WASTE CLASSIFICATION AND MANAGEMENT REGULATIONS, 2013 (GN R. 634) Chapter 9 of the above-mentioned Regulations stipulates the requirements for a motivation for and consideration of listed Waste Management Activities that do not require a Waste Management License. The motivation must: • Demonstrate that the waste management activity can be implemented without unacceptable impacts on, or risk to, the environment or health; • Must provide a description of the waste; • Description of waste minimisation or waste management plans; • Description of potential impacts, etc.: • The transitional provisions under Chapter 6 of this Regulation prescribes timeframes in which all waste must be classified within 18 months from the date of commencement of these regulations (23 August 2013).	A Waste Classification Assessment was done (Refer to Appendix F13).	Waste streams generated from mine activities will, where applicable, be classified accordingly to determine their nature (i.e. general or hazardous), and subsequently managed and disposed of in accordance with the relevant legislative requirements.

National Environmental Management: Air Quality Act The National Environmental Management: Air Quality Act (NEM: AQA) (Act No. 39 of 2004 as amended) is the main legislative tool for the management of air pollution and related activities. The Object of the Act is: • To protect the environment by providing reasonable measures for- o the protection and enhancement of the quality of air in the republic; o the prevention of air pollution and ecological degradation; and o securing ecologically sustainable development while promoting justifiable economic and social development; and • Generally to give effect to Section 24(b) of the constitution in order to enhance the quality of ambient air for the sake of securing an environment that is not harmful to the health and wellbeing of people. The NEM: AQA mandates the Minister of Environmental Affairs to publish a list of activities which result in atmospheric emissions and consequently cause significant detrimental effects on the environment, human health and social welfare. The Listed Activities and Minimum National Emission Standards were published on the 22nd November 2013 (Government Gazette No. 37054). According to the Air Quality Act, air quality management control and enforcement is in the hands of local government with District and Metropolitan Municipalities as the licensing authorities. Provincial government is primarily responsible for ambient monitoring and ensuring municipalities fulfil their legal obligations, with national government primarily as policy maker and co-ordinator. Each sphere of government must	An Air Quality Assessment (Appendix F12) has been undertaken as part of the EIA Phase to determine the baseline conditions prior to the implementation and potential subsequent impacts.	The Project's activities will set out to abide by the NEM: AQA and standards set out in the NAAQS. The required mitigation is included in the Environmental Management Programme (EMPr) as part of this EIA.

appoint an Air Quality Officer responsible for co-ordinating matters pertaining to air quality management. Given that air quality management under the old Act was the sole responsibility of national government, local authorities have in the past only been responsible for smoke and vehicle tailpipe emission control. The National Pollution Prevention Plans Regulations which came into effect on 21 July 2017 and tie in with The National Greenhouse Gas Emission Reporting Regulations which took effect on 3 April 2017. In summary, the regulations aim to prescribe the requirements that pollution prevention plans of greenhouse gases declared as priority air pollutants need to comply with, in terms of the NEM: AQA. The regulations specify who needs to comply, and by when, as well as prescribing the content requirements. Mines do have an obligation to report on the GHG emissions under these regulations		

National Environmental Management: Biodiversity Act The overarching aim of the National Environmental Management: Biodiversity Act (No 10 of 2004) (NEMBA), within the framework of NEMA, is to provide for: • The management and conservation of biological diversity within South Africa, and of the components of such biological diversity; • The use of indigenous biological resources in a sustainable manner; and • The fair and equitable sharing among stakeholders of benefits arising from bio-prospecting involving indigenous biological resources. The South African National Biodiversity Institute (SANBI) was established on 1 September 2004 through the signing into force of the NEMBA, its purpose being (inter alia) to report on the status of the country's biodiversity and the conservation status of all listed threatened or protected species and ecosystems. Other objectives include the identification, control and eradication of declared weeds and alien invaders in South Africa. These are categorised according to one of the following categories, and require control or removal: • Category 1a Listed Invasive Species: Category 1a Listed Invasive Species are those species listed as such by notice in terms of section 70(1)(a) of the Act as species which must be combated or eradicated; • Category 1b Listed Invasive Species: Category 1b Listed Invasive Species are those species listed as such by notice in terms of section 70(1)(a) of the Act as species which must be controlled; • Category 2 Listed Invasive Species: Category 2 Listed Invasive Species are those species listed by notice in terms of section 70(1)(a) of the Act as species which	A Terrestrial Ecology Assessment (Appendix F3) was undertaken during the EIA phase. The activities according to Listing Notice 3 Of NEMA EIA Regulations 2014 (as amended) have been included for Mpumalanga.	The provisions of this Act have been considered and where relevant incorporated into the proposed mitigation measures and requirements of the EMPr. All Alien Invasive species (AIS) will be monitored and managed according to an eradication and management plan during the construction, operational and rehabilitation phases. Topsoil should be protected from AIS.

require a permit to carry out a restricted activity within an area specified in the Notice or an area specified in the permit, as the case may be; and • Category 3 Listed Invasive Species: Category 3 Listed Invasive Species are species that are listed by notice in terms of section 70(1)(a) of the Act, as species which are subject to exemptions in terms of section 71(3) and prohibitions in terms of section 71A of Act, as specified in the Notice.		
National Environment Management Act: Protected Areas Act National Environment Management Act: Protected Areas Act, 2003 (Act No. 57 of 2003) This Act provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes. It also seeks to provide for the sustainable utilization of protected areas and to promote participation of local communities in the management of protected areas.	A Terrestrial Ecology Assessment has been undertaken to determine whether any protected areas are located within the project site. There are currently no protected areas within the study area.	No action is required as mining is not taking place within a protected area.

The National Heritage Resources Act The National Heritage Resources Act (NHRA) (Act 25 of 1999) stipulates that cultural heritage resources may not be disturbed without authorization from the relevant heritage authority. Section 34(1) of the NHRA states that, "no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…" The NHRA is utilized as the basis for the identification, evaluation and management of heritage resources and in the case of CRM those resources specifically impacted on by development as stipulated in Section 38 of NHRA, and those developments administered through NEMA, MPRDA and the NEMWA legislation. In the latter cases the feedback from the relevant heritage resources authority is required by the State and Provincial Departments managing these Acts before any authorizations are granted for development. The last few years have seen a significant change towards the inclusion of heritage assessments as a major component of Environmental Impacts Processes required by NEMA and MPRDA. This change requires us to evaluate the Section of these Acts relevant to heritage. The NEMA 23(2)(b) states that an integrated environmental management plan should, "…identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage". A study of subsections (23)(2)(d), (29)(1)(d), (32)(2)(d) and (34)(b) and their requirements reveals the compulsory inclusion of the identification of cultural resources, the evaluation of the impacts of the proposed activity on these resources, the identification of alternatives and the management procedures for such cultural resources for each of the documents noted in the Environmental Regulations. A further important	In accordance with the legislative requirements and EIA rating criteria, the regulations of the South African Heritage Resources Agency (SAHRA) and Association of Southern African Professional Archaeologists (ASAPA) have also been incorporated to ensure that a comprehensive and legally compatible Heritage Impact Assessment (HIA) is compiled. So far no comments have been received from SAHRA, but all comments made during the draft EIA report will be included. Refer to Appendix 7 for HIA	The applicable legislation will be followed in terms of sensitive historical features such as buildings and graves prior to any construction activities should the mine be approved. During the site investigation by the heritage specialist, no sensitive features were recorded that will be impacted on by the proposed mine.

aspect to be taken account of in the Regulations under NEMA is the Specialist Report requirements laid down. The MPRDA defines 'environment' as it is in the NEMA and, therefore, acknowledges cultural resources as part of the environment. Section 39(3)(b) of this Act specifically refers to the evaluation, assessment and identification of impacts on all heritage resources as identified in Section 3(2) of the National Heritage Resources Act that are to be impacted on by activities governed by the MPRDA. Section 40 of the same Act requires the consultation with any State Department administering any law that has relevance on such an application through Section 39 of the MPRDA. This implies the evaluation of Heritage Assessment Reports in Environmental Management Plans or Programmes by the relevant heritage authorities (Fourie, 2008b).		
The Conservation of Agricultural Resources Act (Act No. 43 of 1983) To provide for control over the utilization of the natural agricultural resources in South Africa in order to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants; and for matters connected therewith.	A Soil, Land Capability, and Agricultural Potential Assessment, was undertaken during the EIA phase (Refer to Appendix F4). The study area is located on High Agricultural Potential land.	Rehabilitation of the mining operations will be required post-mining operations. The land needs to be rehabilitated to pre-mining conditions. It is anticipated that the land will be restored to grazing capacity land. The preservation of topsoils is vital to ensure successful rehabilitation measures.

GN R 1147 (Financial Provisioning Regulations), 2015 The Financial Provisioning Regulations prescribe methods for determining the quantum of financial provision for rehabilitation and mechanisms for providing for it. Section 41 (1) of the MPRDA has been repealed and Section 24N, 24P and 24R of the NEMA, as amended, which provides that the holder of a mining right must make financial provision for rehabilitation of negative environmental impacts. The financial provision must guarantee the availability of sufficient funds. The annual rehabilitation plan will form a component of the environmental management programme to be submitted in terms of section 24N of the Act and the Environmental Impact Assessment Regulations, 2014 and will be subjected to the same requirements of the environmental management programme with regards opportunities for stakeholder review and comment as well as auditing.	The Financial Provisioning Regulations are applicable to rehabilitation and closure plans as they prescribe the minimum content of an annual rehabilitation plan and the minimum content of a final rehabilitation, decommissioning and mine closure plan (Refer to Appendix G).	Rehabilitation, decommissioning and the mine closure plan, including the financial provision estimate, were assessed during the EIA Phase.

Spatial Planning and Land Use Management (SPLUMA) Act 16 of 2013 The Spatial Planning and Land Use Management Act 16 of 2013 (SPLUMA) is a framework law, which means that the law provides broad principles for a set of provincial laws that will regulate planning for the country. The Act introduces provisions to cater for development principles; norms and standards; inter-governmental support; Spatial Development Frameworks (SDFs) across national, provincial, regional and municipal areas; Land Use Schemes (LUS); and municipal planning tribunals. SPLUMA also provides clarity on how planning law interacts with other laws and policies. It is a uniform, recognisable and comprehensive system that addresses the past spatial and regulatory imbalances, and promotes optimal exploitation of minerals and mineral resources. SPLUMA achieves this by strengthening the position of mining right holders when land needs to be rezoned for mining purposes. SPLUMA's impact on optimal exploitation is particularly evident where conflict exists between mining right holders and landowners. Economic and policy considerations, as well as practical necessities, often motivate the state to grant mining rights to entities other than landowners. SPLUMA is a new national framework Act that provides clear principles and standards for provincial and local governments to formulate their own new spatial planning and land use policies. The new provincial legislation can regulate, among other things, land development, land use management, spatial planning and municipal planning.	The MRA is currently zoned as agriculture. Rezoning of the land is required if the mining right is granted.	The affected properties would have to be rezoned from agriculture to mining in order for the mine to continue, should a mining right be approved.

Environment Conservation Act, 1989 (Act 73 of 1989) – Noise Control Regulations In terms of section 25 of the ECA, the national Noise Control Regulations (GN R154 in Government Gazette No. 13717 dated 10 January 1992) were promulgated. The NCRs were revised under GN R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations. The Gauteng Province promulgated provincial regulations: Noise Control Regulations of Gauteng 1999, (Provincial Gazette, Extraordinary no 75 of August 1999). Section 4 of the regulations prohibits a person from making, producing or causing a disturbing noise, or allowing it to be made produced or caused by any person, machine, device or apparatus or any combination thereof. A disturbing noise is defined in the regulations as 'a noise level which exceeds the zone sound level or if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7 dBA or more. Section 5 of the noise control regulations in essence prohibits the creation of a noise nuisance. A noise nuisance is defined as 'any sound which disturbs or impairs or may disturb or impair the convenience or peace of any person'. Noise nuisance is anticipated from the proposed project particularly to those residents that are situated in close proximity to the project sites. South African National Standard 10103 also applies to the measurement and consideration of environmental noise and should be considered in conjunction with these regulations. There are a few South African Bureau of Standards (SABS) relevant to noise from mines,	The noise control regulations will need to be considered in relation to the potential noise that may be generated mainly during the construction and decommissioning phases of the proposed project. The two key aspects of the noise control regulations relate to disturbing noise and noise nuisance. A Noise Impact Assessment is provided in the EIA report (Appendix 10).	The proposed project activities will be set out to abide by the National Noise- Control Regulations and standards set out in the South African National Standards 10103. The noise impacts associated with the proposed activities have been determined and mitigation and monitoring measures were proposed to minimise the impacts during the LOM.

industry and roads. They are: • South African National Standard (SANS) 10103:2008. 'The measurement and rating of environmental noise with respect to annoyance and to speech communication'; • SANS 10210:2004. 'Calculating and predicting road traffic noise'; • SANS 10328:2008. 'Methods for environmental noise impact assessments'. • SANS 10357:2004. 'The calculation of sound propagation by the Concave method'; • SANS 10181:2003. 'The Measurement of Noise Emitted by Road Vehicles when Stationary'; and • SANS 10205:2003. 'The Measurement of Noise Emitted by Motor Vehicles in Motion'. The relevant standards use the equivalent continuous rating level as a basis for determining what is acceptable. The levels may take single event noise into account, but single event noise by itself does not determine whether noise levels are acceptable for land use purposes. With regards to SANS 10103:2008, the recommendations are likely to inform decisions by authorities, but non-compliance with the standard will not necessarily render an activity unlawful per se.		

4 ITEM 3(F): NEED AND DESIRABILITY OF PROPOSED ACTIVITIES

The Integrated Environmental Management Guideline Series 9: Guideline on Need and Desirability was promulgated in terms of the Environmental Impact Assessment (EIA) Regulations, 2010 in Government Notice 891 of 2014. According to these guidelines, the consideration of “need and desirability” in EIA decision-making requires the consideration of the strategic context of the proposed Project along with the broader public interest and societal needs. The guidelines further state that the development must not exceed ecological limits and the proposed actions must be measured against the short-term and long-term public interest to promote justifiable social and economic development, essentially ensuring the simultaneous achievement of the triple bottom line (i.e. social, economic and environmental aspects).

This section will examine the need and desirability of the proposed Dunbar Coal Mine project as well as the importance of coal as a mineral resource and the desirability of coal mining operations at the proposed study area.

4.1 ECONOMIC CONSIDERATION

It is recognised that mining activities are an essential component of South Africa’s economic development. According to the Chamber of Mines of South Africa’s Integrated Annual Review (2017) the mining sector accounted for 6.8% of South Africa’s Gross Domestic Product (GDP), contributing R312 billion to GDP. Due to higher mining production, employment is estimated to have increased by 1.6% to 464,667 during 2017. This eventually arrested the rate of job losses which stood at 30,000 jobs between 2014 and 2017. The following economical components are applicable to the mining sector:

- Mining employment represents 6.1% of private non-agricultural employment and 4.8% of total non-agricultural employment.
- The sector contributed R80.9 billion to fixed investment in 2017, which constituted 18.2% of private-sector fixed investment and 10.8% of the country’s total fixed investment for the year.
- The industry exported R307 billion worth of produce, which is 27% of the country’s R1.1 trillion export book.
- In the 2016/2017 fiscal year, the industry paid R5.8 billion in royalties, representing a 56% increase on the previous year. The industry paid R16 billion in taxes over the same period.
- The overall weighted dollar commodity price index (coal, iron ore, gold and platinum) for South Africa hardly moved between 2016 and 2017. In dollar terms, this was due to gold’s lacklustre price trend (+0.8%) and the decline in the platinum price (-4%), negating increases in the price movements of coal (+28%) and iron ore (+22%).
- The coal industry employed 81,962 people totalling R 22,415,572 in 2017.
- Coal specifically is a national requirement to meet the demand for electricity supply.

According to the Chamber of Mines (2018)[5] coal provides 82% of the power generated within South Africa. South Africa is home to 3.5% of the world's coal reserves and produces 3.3% of the world's annual coal production. South Africa is a net exporter of coal and exports amount to 6% of total global exports. This ranks South Africa as the 6th largest coal-exporting nation in the world. Eskom operates 16 power stations and is building two more that will come on stream by 2021.

The National Development Plan 2030 (NDP) identifies the sufficient production of energy to support industry and providing access to poor households as an enabling milestone toward the reduction of inequality and elimination of income poverty by the year 2030 (National Planning Commission, 2011). It is therefore essential that sufficient coal resources are available to meet the demand required for electricity generation. The coal that would be produced through the proposed Project would be of suitable quality for use in local markets, thereby assisting with the alleviation of the shortage of supply.

In addition to providing an essential resource for power generation in South Africa, the proposed project will have knock-on benefits. These include tax contributions, an overall improvement of the local socio-economic profile job creation and procurement.

4.2 SOCIAL CONSIDERATION

The SLP stipulates that the Applicant will appoint contractors who will manage and employ the workforce within the directly affected wards. The Applicant will also provide skills development to employees thereby advancing the future employability of these individuals.

However, the surrounding community not directly benefitting from this project has negative perceptions on coal mines, which could cause significant problems in the future if not dealt with in the appropriate manner. There are several positive as well as negative social impacts for the proposed project (Refer to the Socio-Economic Assessment – Appendix F5).

4.3 COAL AS AN IMPORTANT RESOURCE

Coal, because of its strategic importance, is one of the five minerals selected by the DMR for local beneficiation as it is considered critical to the on-going development of South Africa (Department of Mineral Resources, 2011). The driving force behind the emphasis of the importance of coal, coal mining and local beneficiation is primarily due to concerns voiced by Electricity Supply Commission (Eskom) over the future security of supply in both the medium and long term of the mineral to its coal fired electricity generating power stations, which has economical impacts if not met.

South Africa's energy is predominately coal fuelled, with limited renewable energy alternatives. South Africa consumes approximately 175 Mtpa of coal where Eskom consumes approximately 110 Mtpa (Eskom, 2017)[6]. Eskom is a South African electricity public utility, established in 1923 as the Eskom by the government of South Africa in terms of the Electricity Act (1922). The utility is the largest producer of electricity in Africa, is among the top seven utilities in the world in terms of

[5] http://www.mineralscouncil.org.za/component/jdownloads/send/25-downloads/535-coal-strategy-2018
[6] http://www.eskom.co.za/AboutElectricity/FactsFigures/Documents/CO0004AshManagementRev13.pdf

generation capacity and among the top nine in terms of sales. The company is divided into Generation, Transmission and Distribution divisions and together Eskom generates approximately 82% of electricity used in South Africa. Currently, Eskom has 24 power stations in commission, consisting of 13 coal-fired stations (3 of which are in cold reserve storage, 1 nuclear station, 2 gas turbine stations, 6 hydroelectric stations and 2 pumped storage schemes).

Eskom's existing coal fired power stations are critical in terms of electricity production and in meeting the growing energy requirements of South Africa as a whole. Coal and coal supply is consequently seen as critical and its importance is detailed in the Eskom Transmission Ten Year Development Plan 2018 to 2027 (Eskom, 2017)[7]. Without steady, secure supply of the mineral, it is unlikely that Eskom will be able to meet the energy demands of the country. As a result, coal mining, beneficiation and supply is of paramount importance to South Africa for continued electricity generation to meet the rising energy demands of the country in the short, medium and long term.

Coal produced is usually used locally within the municipal region but also exported. Eskom is the largest local buyer while China and India are the major international export buyers.

There are essentially three market segments for coal, these are:

- Eskom - Low Grade Coal (19.0Mj/kg – 23.3Mj/kg)
- Export - High Grade Steam Coal (>5,900Kcl/kg)
- Metallurgical - High Grade Low Phosphate, High Fixed Carbon

A low-quality thermal coal will be produced from the different coal seams that will be mined if the project gets approved. The current coal qualities that will be produced can be utilised by local power stations around the proposed mine. These power stations currently receive its coal from various suppliers. There is currently a shortage of coal supply to nearby power stations[8].

4.3.1 Eskom - Komati Power Station

Given the size and quality of the reserve for Dunbar, the proposed Colliery will target both domestic and export markets. The applicant has approached Eskom in order to supply coal to the Komati Power Station approximately 28 km away from the proposed study area). Eskom and the applicant are currently in discussion and negotiating the terms of supply, however this is dependent on the outcome of the granting of the mining right.

Eskom has indicated that they require coal for the Komati power station, especially from local coal mines close to the power station. The emerging coal crisis at Eskom was first revealed in an article by EE Publishers entitled "Inside the coal supply crisis at Eskom…", which was widely published and reported on in April 2018, and which gave the background and reasons behind the utility's coal supply shortages.

[7] http://www.eskom.co.za/Whatweredoing/TransmissionDevelopmentPlan/Pages/Transmission_Development_Plans.aspx
[8] This is not the opinion of the EAP but the need from Eskom to obtain coal resources

On 29 August 2018, EYEWITNESS NEWS reported that Eskom faced coal shortage at nine of its 15 coal-fired power stations, as stockpiles are below the company's accepted minimum. Six of them are below the National Energy Regulator of South Africa's (NERSA) requirement. At that time, the total system average coal stock level, excluding Medupi and Kusile, was 28.2 days. Since January of 2018, Eskom has concluded 13 new coal contracts and 10 more were approved by the board during the month of August. It's hoped these coal sources will increase stock levels at the affected power stations, but only in the short term.

The Daily Maverick reported on 17 September 2018 that "there are currently 10 stations with less than 20 days of coal, and five of these with less than 10 days of coal in their stockpiles", as confirmed by NERSA. Eskom has also indicated to NERSA that it is in the implementation phase of moving coal from Medupi to Kusile and Kendal power stations; however, this has been stalled, at least for the time being, in the face of objections raised by municipalities and other authorities along the route. This has resulted in the continued decline of coal stockpiles at Eskom's Mpumalanga power stations, which continue to burn coal faster than Eskom can source replacement coal. Eskom has also advised that while transportation of coal by rail is its preferred option, development work with Transnet Freight Rail is under way, and rail transfer of coal from Medupi has not begun.

The then Department of Energy (DoE) released the draft Integrated Resource Plan (IRP) 2018[9] on 22 August 2018 for public comments. The IRP 2010–2030 was promulgated in March 2011 as part of the National Development Plan (NDP), which identifies the need for South Africa to invest in a strong network of economic infrastructure designed to support the country's medium and long-term economic and social objectives, specifically energy infrastructure which is a critical component that underpins economic activity and growth across the country. The NDP envisages that, by 2030, South Africa will have an energy sector that provides reliable and efficient energy service at competitive rates is socially equitable through expanded access to energy at affordable tariffs and environmentally sustainable through reduced pollution. The promulgated IRP 2010–2030 incorporated government objectives such as affordable electricity, reduced greenhouse gas (GHG), reduced water consumption, diversified electricity generation sources, localisation and regional development

The draft IRP 2018 indicated the following important results for the period ending 2030:

- *The committed Renewable Energy Independent Power Producers Programme, including the 27 signed projects and Eskom capacity rollout ending with the last unit of Kusile in 2022, will provide more than sufficient capacity to cover the projected demand and decommissioning of plants up to approximately 2025.*
- *The installed capacity and energy mix for scenarios tested for the period up to 2030 will not differ materially. That will be driven mainly by the decommissioning of about 12GW of Eskom coal plants.*
- *The scenario without renewable energy annual build limits provides the least-cost option by 2030.*

For the period post 2030 the following were observed:

- *The decommissioning of coal plants (total 28GW by 2040 and 35GW by 2050), together with emission constraints imposed, imply that coal will contribute less than 30% of the energy supplied by 2040 and less than 20% by 2050.*

[9] http://www.energy.gov.za/IRP/irp-update-draft-report2018/IRP-Update-2018-Draft-for-Comments.pdf

- *Adopting no annual build limits on renewables or imposing a more stringent strategy to reduce greenhouse gas emissions implies that no new coal power plants will be built in the future unless affordable cleaner forms of coal-to-power are available.*
- *The scenario without renewable energy annual build limits provides the least-cost option by 2050.*

4.4 DUNBAR PROPOSED OPENCAST PIT MINING OPERATIONS

Mining in South Africa directly contributed to the establishment of the Johannesburg Stock Exchange in the late 19th century, and today it still accounts for a large portion of its market capitalisation. From this, it is clear that mining in South Africa has shaped the country politically, culturally, and economically and that the South African mining sector has provided the critical mass for a number of industries that are either suppliers to the mining industry, or users of its products. These include, but are not limited to, energy, financial services, water and engineering services, and specialist seismic geological and metallurgical services. The proposed Dunbar coal mine will not only contribute directly to the South African economy, but will also contribute to the development and growth of other industries supporting the mining sector.

The proposed opencast mining operations for the Dunbar coal mine project, will contribute to favourable economic impacts on both a local, regional and national scale. This will result in numerous job creation and skills development opportunities and provide an economic injection in the region. If the project was not to proceed the additional economic activity, skills development and available jobs would not be created, and the coal reserves would remain unutilized. It should be noted that many agricultural jobs will be lost if the mine was approved (Refer to the Socio-Economic Assessment – Appendix F5).

Existing coal mines occur within the surrounding areas of the proposed Dunbar mine including Halfgewonnen Colliery, Kleinfontein Colliery and Middelkraal Colliery to name a few. The proposed mining activity is therefore not a new feature to exiting landscape features in this region. If the applicant is not to proceed with the proposed application, mining of these coal reserves will not necessarily be avoided, as another application in terms of the MPRDA can be made by another company. Unless the government declares these areas as "NO-GO" for mining and/or the demand for coal subsides, mining houses will continue to attempt to mine these coal reserves.

4.5 PERIOD FOR WHICH ENVIRONMENTAL AUTHORISATION IS REQUIRED

The Mining Right and Waste Management Licence will be required for a period of 15 years given that the lifespan of the mining operation is proposed to be 10 years, which gives additional time to be able to complete the closure and rehabilitation activities.

5 ITEM 3(G): MOTIVATION FOR THE PREFERRED DEVELOPMENT FOOTPRINT WITHIN THE APPROVED SITE INCLUDING A FULL DESCRIPTION OF THE PROCESS FOLLOWED TO REACH THE PROPOSED DEVELOPMENT FOOTPRINT WITHIN THE APPROVED SITE

The location of the proposed Dunbar Coal Mine has been decided based on the location of the identified coal seams during the prospecting phase. An initial sensitivity analysis was undertaken to determine sensitive features that needed to be considered during the layout design of the project. These sensitivities informed the preliminary mine layout and alternatives were considered where required and possible. Areas of high sensitivities were avoided as far as possible. The location of the pit has excluded sensitive features such as watercourses with a minimum buffer of 60 meters as proposed by the wetland specialist. The infrastructure was shifted around after receiving inputs from the specialists to make it more optimal from an operational perspective.

5.1 ITEM 3(G)(I): DETAILS OF THE DEVELOPMENT FOOTPRINT ALTERNATIVES CONSIDERED

The identification and investigation of alternatives is a key aspect during the EIA process, which was initially investigated during the scoping phase. All reasonable and feasible alternatives must be identified and assessed during the EIA phase to determine the most suitable or preferred development footprint.

There are however some significant constraints that have to be taken into account when identifying alternatives for a project of this scope. The preferred option is to be highlighted and presented to the authorities.

Alternatives can typically be identified or categorised according to:

- Location alternatives – alternative project sites in the same geographic area;
- Process/design alternatives – alternative process/design/equipment/technologies;
- Associated infrastructure location and layout alternatives – consideration of the different options to place project infrastructure;
- Activity alternatives – consideration of different means to achieve the same project objective; and
- No-go alternatives – the proposed project/activity does not proceed, implying that the current situation or status quo remains.

For any alternative to be considered feasible such an alternative must meet the need and purpose of the development proposal without presenting significantly high associated impacts. The alternatives are described and the advantages and disadvantages are presented. It is further indicated which alternatives are considered feasible from a technical as well as environmental perspective.

Incremental alternatives typically arise during the EIA process and are usually suggested as a means of addressing identified impacts. These alternatives are closely linked to the identification of mitigation measures and are not specifically identified as distinct alternatives. This section provides information on the development footprint alternatives, the properties considered, as well as the type of activity, activity layout, technological and operational aspects of the activity.

5.1.1 Location Alternatives of open cast mining blocks

The study area was considered due to the positive results obtained during the prospecting phase and exploration drilling with regards to the underlying coal. As the applicant already has prospecting rights on the above-mentioned properties, and with the favourable results from the prospecting phase regarding coal deposits, the proposed study area locality is optimal for mining coal. No location alternatives therefore exist, as it is dependent on the underlying coal reserve.

5.1.2 Associated infrastructure location and layout alternatives

The proposed location and layout for the associated infrastructure for the proposed mine is a preliminary conceptual plan as decided by the applicant and consultation with engineers, and making use of available desktop information. This is, however, not necessarily the final version and would likely require changes once specialist investigations have been done. The sensitive areas and buffer zones have been overlain with the preferred location and layout for the associated infrastructure, and alternative sites surrounding the mining blocks have been identified, assessed and discussed with the applicant in order to reduce negative impacts on the environment.

The first location and layout of the infrastructure for the proposed mine (Figure 5-1) was not desirable, and prior to starting with the EIA phase this was amended to the preferred layout and location (Figure 5-2) as indicated in the Mining Works Programme (Appendix I). After the specialist reports were completed, the location of the mining infrastructure was changed (Figure 5-3) to meet the needs of the client from an operational perspective taking into account all sensitive features. The berms, not previously indicated, were also included.

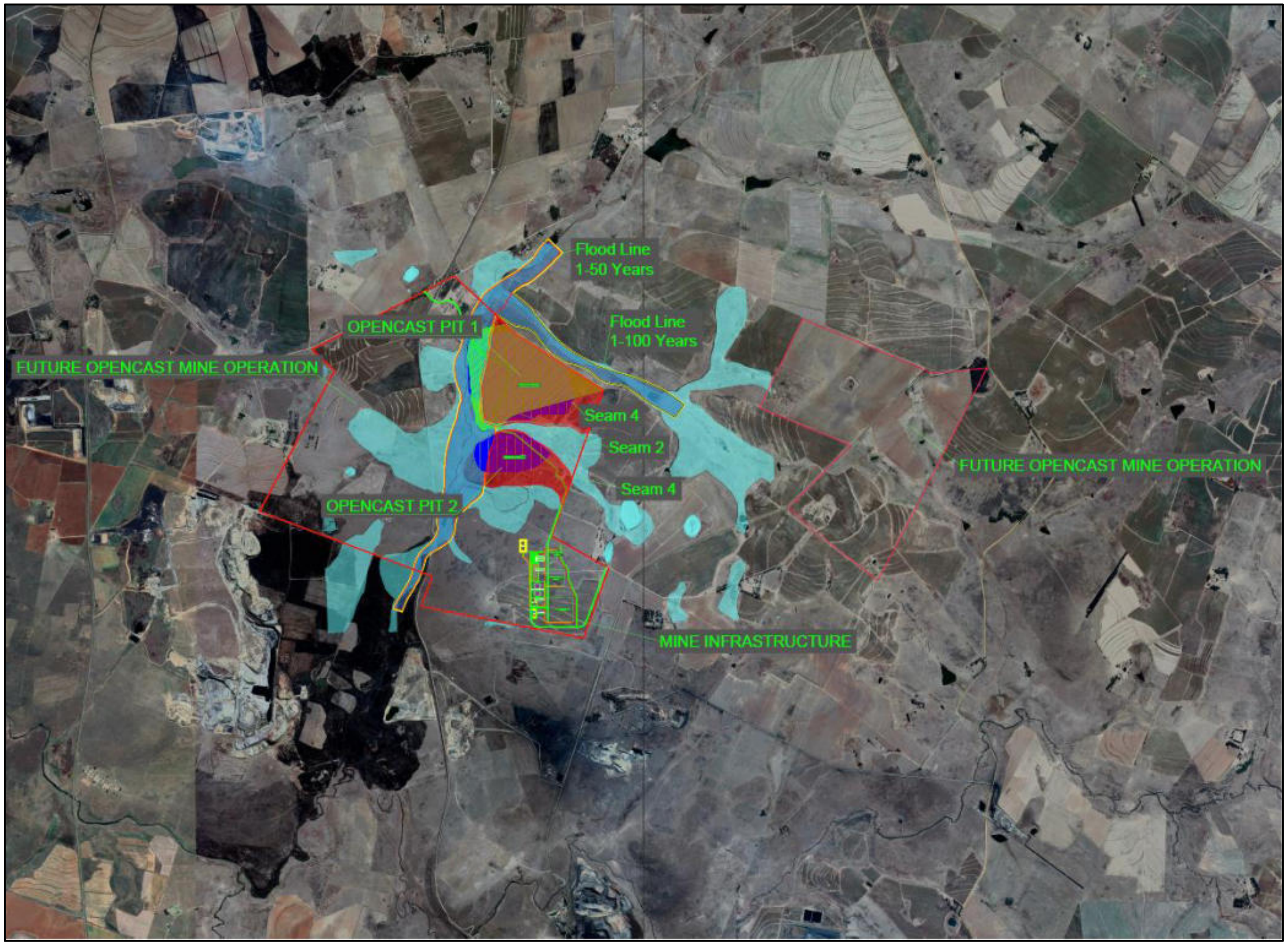


Figure 5-1: The preliminary location and layout of the infrastructure for the proposed Dunbar Coal mine.

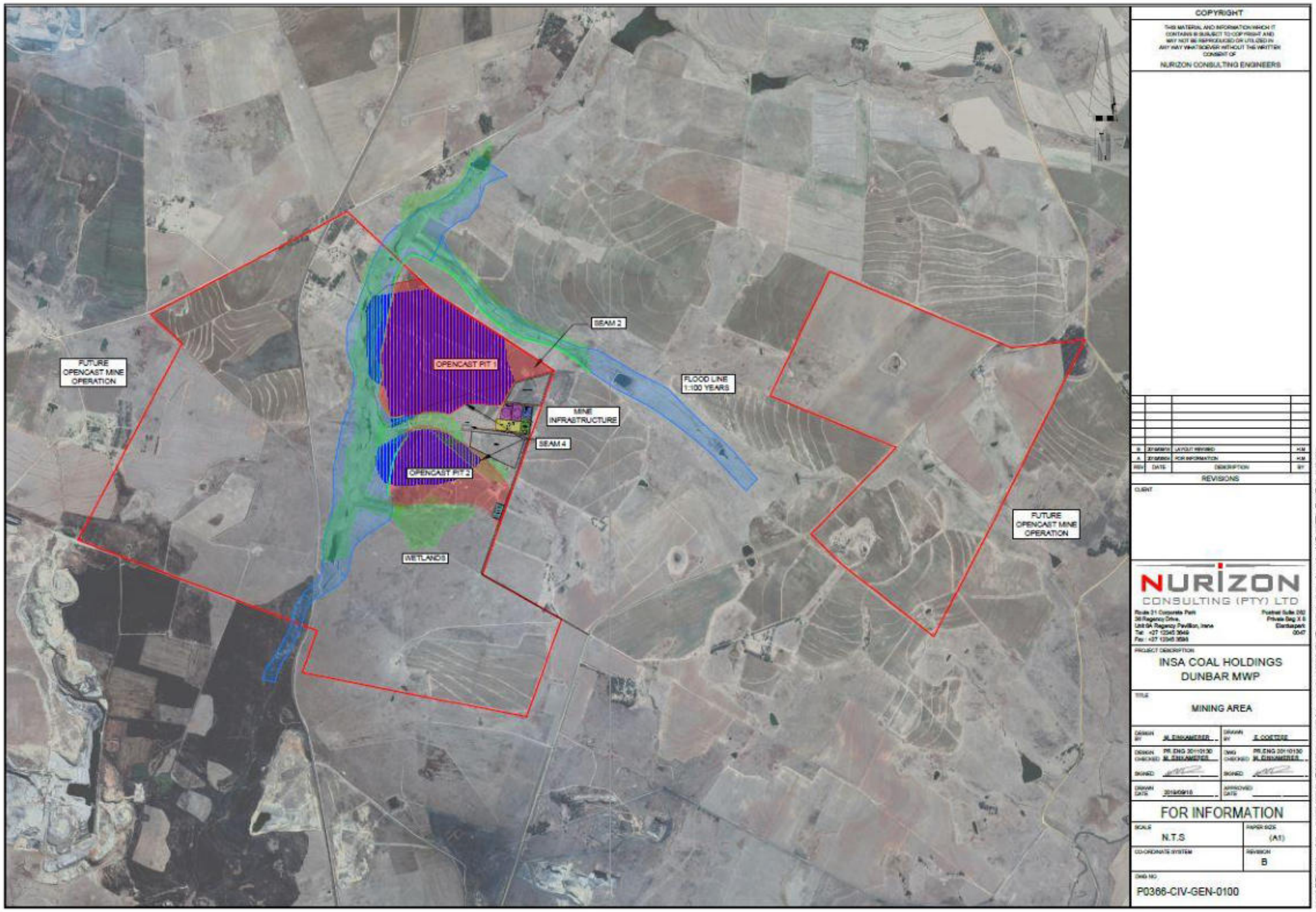


Figure 5-2: The preferred layout and location of the pits and infrastructure for the proposed Dunbar Coal mine.

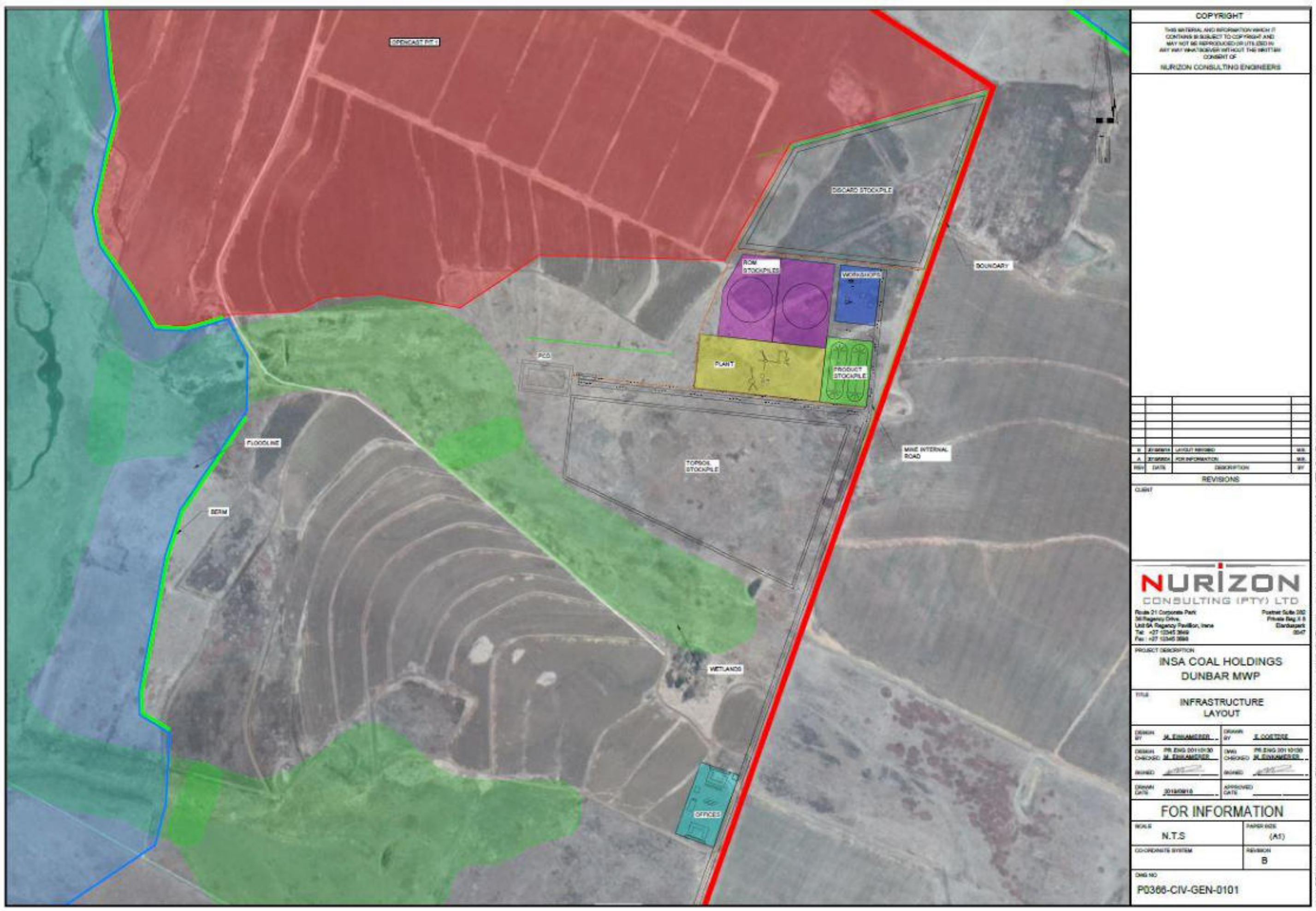


Figure 5-3: The amended layout and location of infrastructure for the proposed Dunbar Coal mine. Most of the infrastructure will be located at mining block 1 above.

5.1.3 Process Alternatives

5.1.3.1 Mining method

No alternative option for the main mining process has been identified. Only open cast mining is proposed by the MWP.

5.1.3.2 Water supply

Water required for mining operations will be supplied from the underground water, Municipality supply and extraction from streams (this will be addressed in the Water Use Licence Application). Excess mine water will be pumped to a Raw Water Dam from where is will be utilised in the mining operations as dust suppression and washing.

Potable water will be required for ablution and showers in the change house and office use.

The following table provides a summary of the daily potable water requirement.

	Total personnel	Potable Water (ℓ) per person per day
Total Mining Personnel	60	100
Total Staff Personnel	34	50
TOTAL (ℓ/day)		**7700**
TOTAL (m^3/day)		**7.7**

The following table shows the expected peak flow rate for potable water. This is based on an estimated peak water flow rate for 20 showers at 10 ℓ/min per shower and 2 ℓ/s for ablution facilities.

Building	Peak Flow (ℓ/s)
Change house	2.5
Offices and other buildings	0.5
TOTAL Peak Flow (excluding fire flows)	3

Should water be sourced from ground or surface water sources, the necessary water uses triggered would be included in the IWULA (Appendix L for proof of the IWULA application submission).

5.1.4 No-Go Alternative

The no-go alternative would entail not mining the coal reserve and leaving the area mainly as agricultural land.

No-Go Alternative: As mentioned, the current land use is mainly cultivated land, grassland and wetlands. Should the proposed mining development not take place, it entails that the land will continuously be used for agricultural purposes, depending on the landowners needs and desirability for the future. Food security is undoubtedly one of the most important sectors in Mpumalanga and nationally, with agriculture contributing to the province and South Africas GDP, but not nearly as much as the mining sector.

As highlighted in the project motivation, coal resources are essential to ensure economic growth in a developing country such as South Africa. In the absence of renewable energy sources (for now), South Africa is still largely dependent on the burning of coal as the main energy source from a social and economic perspective. By not implementing this project both permanent and temporary jobs including unskilled jobs will not be created. The coal reserves which could potentially have benefitted the economy would become sterilised.

The no-go alternative also means that all potential negative impacts associated with the proposed mine and its associated infrastructure would not occur. The potential negative impacts on the environment would not exist should the project not be implemented.

Project Alternative: Coal has always been a very strategic resource in South Africa as approximately 80% of the current electricity supply is acquired from coal burning power stations. Furthermore, coal has also played a major role as an export commodity to countries which still use coal as the primary recourse for electricity generation. Coal as a resource is therefore essential to ensure economic growth in South Africa, until such a time that renewable energy resources have been established and supply sufficient and fairly cheap electricity to the national grid. This will however only be implemented within the next 5-10 years, and will only contribute to a portion of the national grid energy supply. The effects of renewable resources contributing significantly more than coal will only be seen after 2030, depending on national policy and implementation. The reality is that South Africa has been slow to transformation regarding renewable energy sources; accordingly coal will still be a necessary and dominant energy source for the next 12-32 years.

However, the counter to not implementing this project has significant positive impacts from an environmental and social perspective. Greenhouse gases which contribute to climate change impacts will significantly be reduced (or not exist should coal not be burned at power stations), and communities affected negatively from the construction and operational phases of the project as well as the scars left from unsatisfied rehabilitation and poor topsoil restoration efforts (as seen with many coal mines on the Highveld including Witbank, Delmas and Ogies areas), will not impact on the local communities, receiving environment and the surrounding environment. Coal mines have a legacy of depleting water resources and polluting water sources, required for human consumption.

The negative and positive impacts are addressed in the impact assessment section where mitigation measures and recommendations are made to decrease negative impacts where possible. Where this is not possible, fatal flaws are identified which needs to be addressed.

6 ITEM 3(G)(II): DETAILS OF THE PUBLIC PARTICIPATION PROCESS FOLLOWED

The Public Participation Process (PPP) was developed to ensure compliance with environmental regulatory requirements and to provide I&APs with an opportunity to evaluate the proposed project. During this process stakeholders are able to provide inputs and to receive feedback from the environmental specialists, other stakeholders and the competent authority.

Please refer to Appendix E for the Public Participation Report.

6.1 OBJECTIVES OF PUBLIC PARTICIPATION

- Provides Interested and Affected parties (I&APs) with an opportunity to voice their support, concerns and questions regarding the project, application or decision;
- Provides an opportunity for I&APs, Environmental Assessment Practitioners (EAPs) and the Competent Authority (CA) to obtain clear, accurate and understandable information about the environmental, social and economic impacts of the proposed activity or implications of a decision;
- Provides I&APs with the opportunity of suggesting ways of reducing or mitigating negative impacts of an activity and for enhancing positive impacts; and
- Enables the applicant to incorporate the needs, preferences and values of affected parties into the application.

6.2 LEGISLATION

The PPP must comply with the several important sets of legislation that require public participation as part of an application for authorisation or approval; namely:

- The Mineral and Petroleum Resources Development Act (Act No. 28 of 2002 - MPRDA);
- The National Environmental Management Act (Act No. 107 of 1998 - NEMA);
- The National Environmental Management Waste Act (NEM: WA, Act No. 59 of 2008); and
- The National Water Act (NWA, Act No. 36. Of 1998).

Adherence to the requirements of the above-mentioned Acts will allow for an Integrated PPP to be conducted, and in so doing, satisfy the requirement for public participation referenced in the Acts. The details of the Integrated PPP are provided below.

6.3 IDENTIFICATION OF I&APS

During the Scoping Phase, the following methods were used to develop a stakeholder database which was utilised to ensure a proper representation of stakeholders interested in or affected by the proposed Project. This included the following:

- Searchworks[10] and desktop searches were conducted in and around the project area to verify land ownership and obtain contact details;
- Responses were received from newspaper advertisements and site notices;
- Responses were received from distribution of the Background Information Document (BID) and notification letter;
- Identification and consultation with stakeholders including commenting authorities; and
- Consultations with affected landowners.

An Interested and Affected Parties (I&AP) database was compiled of key stakeholders and I&AP's identified for notification of the Environmental Authorisation Application. The I&AP database includes, amongst others; landowners, communities, regulatory authorities and other specialist interest groups. A list of I&APs is attached in Appendix E.

[10] http://www.searchworks.co.za

6.4 NOTIFICATION AND REGISTER OF I&APS

The PPP commenced on 9 May 2019 with an initial notification and call to register for a period of 30 days during the scoping phase, ending on the 16 of June 2019. The notification procedure included (Appendix E):

- Newspaper advertisement: published in the Middleburg Observer on 17 May 2019;
- Site Notices: erected at prominent points on along the property boundaries and noticeable places on 16 May 2019; and
- Public Notices: distributed to identified stakeholders, landowners and residents (where possible), and left at the Bethal and Kriel Libraries.
- Either registered letters and/or emails were composed and sent to the identified authorities, adjacent landowners, ward councillors and I&APs that have registered thus far.

6.5 BACKGROUND INFORMATION DOCUMENT

Included in the I&AP notification letters, facsimiles, and e-mail is a Background Information Document (BID). The BID includes the following information:

- Locality map and description
- Project description and background
- Legal framework
- Explanation of the Scoping and EIA Process to be followed
- Provide opportunity to get involve and comment on the proposed project

6.6 NOTIFICATION OF AVAILABILITY OF SCOPING REPORT

All registered I&APs and stakeholders have been notified via email of the availability of the Draft Scoping Report for review for a period of 30 days from 29 May to 28 June 2019. The report was made available at the following locations:

	Address	**Telephone number**
Kriel Public Library	c/o Quintin &, Heinrich St, Kriel, 2271	017 648 2241
Bethal Public Library	Kerk Street, Bethal	017 624 3029

The report was also made available at Enviro-Insight website: http://www.enviro-insight.co.za/download-it/project-downloads/

All comments received from stakeholders on the Draft Scoping Report have been included in the Issues and Comments register (Appendix E). No comments were received by the competent authority (DMR). In addition, no comments were received within the 30 day review period by the following Departments which have received a hard copy of the DSR on the 30 May 2019: Department of Water and Sanitation (DWS), Govan Mbeki Local Municipality (GMLM), and the Mpumalanga Department of Agriculture, Rural Development, Land & Environmental Affairs (DARDLEA) (Appendix E). The only Stakeholder that provided comments on the DSR within the prescribed 30 day period was the Steve Tshwete Local Municipality (Appendix K) on 18 June 2019.

The Final Scoping Report was submitted to the DMR on 3 July 2019. The DMR reviewed it and approved the report on 21 August 2019. The EIA process therefore commenced on this date, and the final EIA report will be submitted to the DMR within the prescribed NEMA 106 days.

6.7 CONSULTATION WITH STAKEHOLDERS DURING THE SCOPING PHASE

Multiple consultation meetings and one public meeting was held with directly affected landowners, other stakeholders and I&APs (Appendix E):

- Peter Kane Berman (landowner): 24 May 2019
- Umcebo / Glencore (landowner): 28 May 2019
- WA De Klerk (landowner): 29 May 2019
- Public meeting: 24 June 2019

The consultation meeting with Mr Anton Pelser (landowner) did not take place as numerous attempts were made but due to unforeseen circumstances Mr Pelser was not available. From beginning of June 2019 Mr Pelser was taken up in hospital for tests, and no new date was proposed for a meeting. Mr Pelser has received updates throughout the process, and no comments were received on the scoping report and Mr Pelser did not attend the public meeting. Enviro-Insight only became aware on 17 September 2019 that Mr Pelser's internet connection was not working for several weeks and no correspondence was received by him from Enviro-Insight until the social specialist consulted with him. The EAP phoned Mr Pelser on 18 September 2019 to remind him of the process and provided an update of the progress so far. No issues or concerns were raised and the EAP indicated that he will meet with Mr Pelser at his earliest convenience. Feedback on the consultation will be included in the Final EIA report.

Requests for consultation were also sent out to the Steve Tshwete Local Municipality on 24 June 2019 without any response. They did however comment on the draft scoping report (refer to Appendix E and Appendix K).

6.8 CONSULTATION WITH STAKEHOLDERS DURING THE EIA PHASE

During the EIA Phase the following main PP activities will be undertaken:

- Provide opportunity for I&APs to comment on specialist findings, impacts assessments, EMPr and MWP;
- Verify that comments raised by I&APs have been accurately recorded;
- Have a public meeting after releasing the draft EIA report;
- Provide all stakeholders with the opportunity to comment on the draft EIA report;
- Consult with stakeholders where necessary.

A notification of the approval of the scoping report was sent to all registered I&APs on 23 August 2019 (Appendix E).

This draft EIA report is submitted for public review for a period of 30 days (15 October to 13 November 2019). All comments received will be incorporated into the final EIA report which will be submitted to the DMR for final decision-making.

The draft EIA report will be available for review from Enviro-Insight website: http://www.enviro-insight.co.za/download-it/project-downloads/. An electronic copy (CDs) is also available from Enviro-Insight on request. The location of the hard copy will be communicated to the registered I&APs once this has been finalised.

A public meeting is scheduled for early November 2019. All registered I&APs will be notified of the details including the date, time, and place of the public meeting.

6.9 ITEM 3(G)(III): SUMMARY OF ISSUES RAISED BY I&APS

A detailed list of registered Interested and Affected Parties and a detailed Issues and Comments register is attached in Appendix E. Comments and issues of concern raised so far in the process has been captured and responded to and will be updated in the Final EIA report (Appendix E – VI).

Interested and Affected Parties **List the names of persons consulted in this column, and Mark with an X where those who must be consulted were in fact consulted.**		**Date comments received**	**Issues raised**	**EAPs response to issues as mandated by the applicant**	**Section and paragraph reference in this report where the issues and or response were incorporated**
Affected Parties					
Landowners					
BEESTEPAN BOERDERY: Peter Kane Berman	X		No comments on the draft scoping report were received.		Refer to Appendix E
WA DE KLERK FAMILIE TRUST: WA de Klerk	X		No comments on the draft scoping report were received.		Refer to Appendix E
UMCEBO PROP PTY LTD: Hugo Grobler/ Arno Lottering	X		No comments on the draft scoping report were received.		Refer to Appendix E
ANTON PELSER EIENDOMS TRUST: Anton Pelser	X		No comments on the draft scoping report were received.		Refer to Appendix E
Landowners or lawful occupiers on adjacent properties		None			Refer to Appendix E
Municipality/ies					
Govan Mbeki Local Municipality		None			Refer to Appendix E

Steve Tshwete Local Municipality Municipal Manager: B Khenisa		21 June 2019	**Application for a mining right to mine coal on a Portion of Portion 1, Portion 2 and remaining extend of the Farm DUNBAR 189 is, Portion 1 of the Farm Middelkraal 50 IS and Portion 6 of the Farm Halfgewonnen 189 IS, situated within Steve Tshwete Local Municipality, Nkangala District Municipality, Mpumalanga Province.** Comments by the Director: Environmental and Solid Waste Management. 1. Based on the assessment of the draft scoping report for the proposed Dunbar opencast coal mine submitted to the council, this municipality does not have an objection to the proposed activity subject to the following condition: 2. The applicant must submit the final Environmental Impact Assessment and Environmental Management Plan (EMP), Waste Management Plan and Rehabilitation plan to the council prior to commencing with the project. 3. Dust monitoring and management Plan must be developed to address dust generated from the site and monitoring must be done on a regular basis.	1. Comment noted. 2. The draft and final Environmental Impact Assessment, Environmental Management Plan (EMP), Waste Management Plan and Rehabilitation plan will be made available. 3. An Air Quality specialist has been appointed and will include a monitoring plan for dust. 4. An Emergency Preparedness Plan and Response will be developed and made available during the EIA phase of the project. 5. Interested and affected parties have been identified and public participation has commenced in May 2019 already, and will continue throughout the process. 6. The heritage and environmental features will be assessed and included in the EIA phase of the	Refer to Appendix E

			4. Emergency Preparedness Plan and Response must be developed and the procedure must include risk identification, preparedness, response and reporting. 5. Interested and affected parties must be notified of the proposed project and prove of consultation and records of public participation must be submitted prior to issuing approval of the right. 6. The applicant must take into consideration the heritage and environmental features on site in order to allow the environment to continue to provide the ecological services and to regenerate ecological function of the site from within the site and beyond. 7. The applicant must make sure that the proposed project complies with all other environmental regulations applicable to the proposed project including any other legislation, applicable in the undertaking of the proposed project.	project. 7. The applicant is aware of all environmental regulations applicable to the project, which includes an application for an Environmental Authorisation, Waste Management Licence, Water Use Licence and Mining Right applications and the relevant regulations that govern them.	
Govan Mbeki Local Municipality Ward 15: Cllr MJ Mtsweni		None			Refer to Appendix E

Steve Tshwete Local Municipality Ward 3: Cllr Lindiwe K Mahlangu		None			Refer to Appendix E
Steve Tshwete Local Municipality Ward 4: Cllr Nobesuthu C Mkhuma		None			Refer to Appendix E
Organs of state (Responsible for infrastructure that may be affected Roads Department, Eskom, Telkom, DWA etc.)					
Transnet		None			Refer to Appendix E
DWS		None			Refer to Appendix E
Department of Public Works, Roads & Transport		None			Refer to Appendix E
South African Heritage Resources Agency		None			Refer to Appendix E
Communities		None			Refer to Appendix E
Dept. Land Affairs		None			Refer to Appendix E
Traditional Leaders - None identified so far		None			Refer to Appendix E
Dept. Environmental Affairs		None			Refer to Appendix E
Other competent authorities affected					

Mpumalanga Department of Agriculture, Rural Development, Land & Environmental Affairs		None			Refer to Appendix E
Mpumalanga Tourism & Parks Agency		None			Refer to Appendix E
Interested Parties		None			Refer to Appendix E

Dieter Kassier		30 May 2019	A quick question from browsing through the documentation – what is the value of the Draft Mining Works Program when so many of the Tables in the document are empty, and no detail is provided in Sections 10, 11, 12, 13, 14 and 15, all of which are just copy and paste from the template with no information added? Should there not at the very least be an explanation as to why this has not been completed? And also when this information would then be available? Or am I missing something?	As you will know, a Mining Works Program is a working document. Accordingly the engineers are updating it as more information becomes available throughout the process. The MWP is also dependent on various specialist inputs and cost implications are dependent on numerous factors such as the mining layout and mitigation measures proposed (including rehabilitation). For the purposes of the draft scoping report, the applicant was satisfied with the current level of the draft MWP. Enviro-Insight is dependent on the engineers for completing it and provide valuable information. Please remember that the draft EIA report will also be made available for public review where the preferred mining layout and updated MWP will be available.	

7 ITEM 3(G)(IV): THE ENVIRONMENTAL ATTRIBUTES ASSOCIATED WITH THE DEVELOPMENT FOOTPRINT

A number of specialist studies were undertaken during the EIA phase for the proposed project, as shown in Figure 7-1 below. Due to the quantity of information within each specialist report, the information where necessary only were duplicated in the draft EIA report. For detailed information on a specific environmental attribute, please refer to the relevant specialist report attached as an Appendix to the draft EIA report.

Figure 7-1: Specialist Reports conducted during the EIA phase and Associated Appendices.

Specialist Study	**Appendix**
Aquatic, Wetland and Surface Water Assessment	Appendix F1
Geohydrological Assessment (Groundwater)	Appendix F2
Terrestrial Ecology Assessment	Appendix F3
Soil, Land Use and Agriculture Potential Assessment	Appendix F4
Socio-economic Assessment	Appendix F5
Palaeontological Assessment	Appendix F6
Heritage Assessment	Appendix F7
Traffic Impact Assessment	Appendix F8
Visual Assessment	Appendix F9
Noise Assessment	Appendix F10
Blast and Vibration Assessment	Appendix F11
Air Quality Assessment	Appendix F12
Waste Classification	Appendix F13

The section below provides the baseline bio-physical and socio-economic environmental conditions currently present on the Project site, obtained from the abovementioned specialist reports and inputs were required.

7.1 DESCRIPTION OF CURRENT LAND COVER

Land cover information is a crucial reference dataset that informs a wide variety of activities ranging from environmental planning and protection, development planning, economic development, compliance monitoring, enforcement and strategic decision making.

When the global accessibility of Landsat 8 satellite imagery became available, it offered the opportunity to create the national land-cover dataset for South Africa, circa 2013-14, which replaced and updated the previous 1994 and 2000 South African National Landcover datasets (GEOTERRAIMAGE, 2015). The 2013-14 National Landcover dataset is based on 30x30m raster cells, and is ideally suited for ± 1:75,000 - 1:250,000 scale GIS-based mapping and modelling applications.

From the 2013-14 National Landcover dataset, the current land cover for the study area included multiple classes, the majority being: cultivated commercial fields, grassland and wetlands (Figure 7-2).

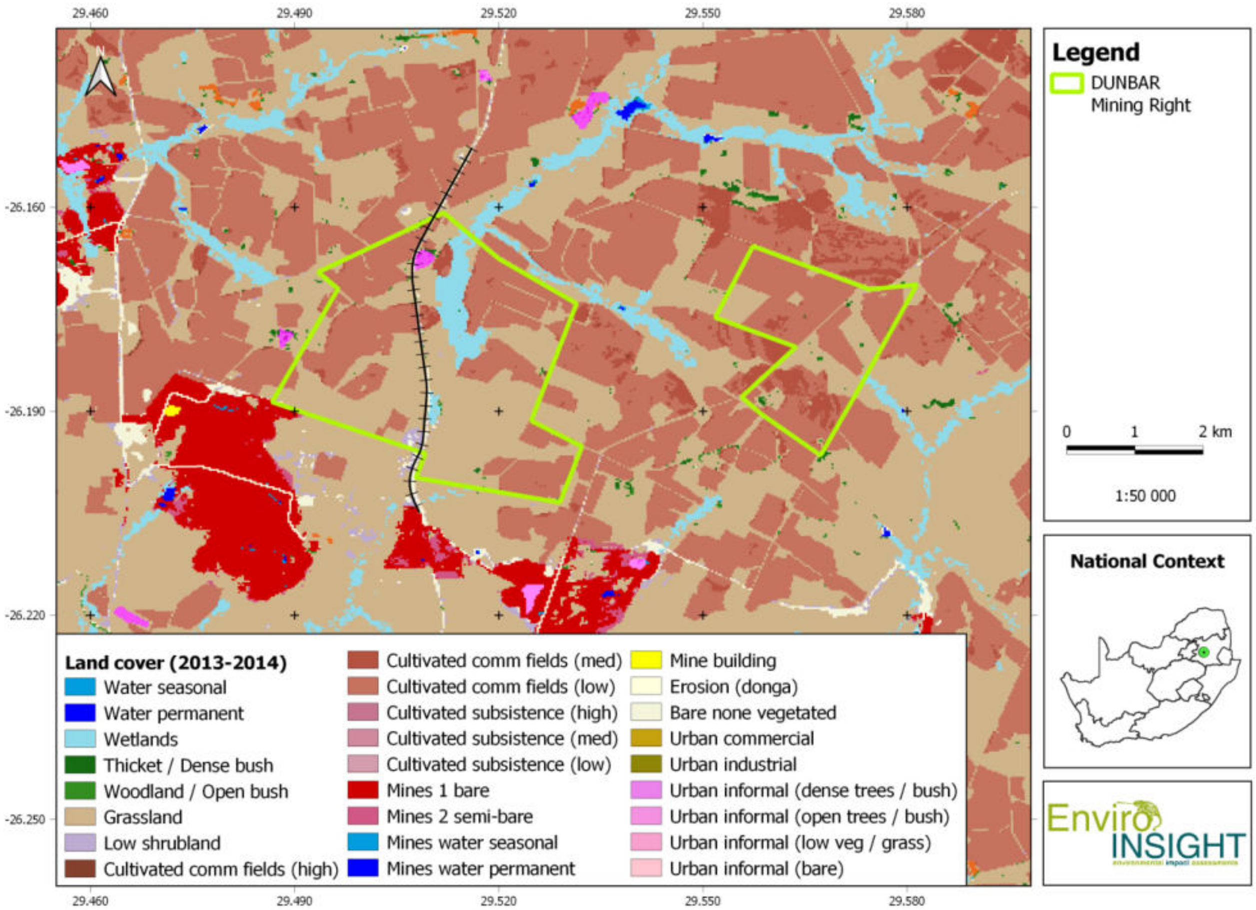


Figure 7-2: The study area in relation to current land cover.

The vast majority of the land is used for agricultural purposes, most notably the farming of maize and soya but also include grazing lands for livestock (Figure 7-3). The crops were already harvested during the site visit, showing only a barren landscape. As mentioned above, large sections of Grassland and Wetlands are also included in the mining right area (Figure 7-4). Numerous species as well as humans are dependent on these habitats. The Leeufonteinspruit runs through the western section of the mining right (Figure 7-5). During the site visit in August, the entire landscape burnt down (Figure 7-6). It was unknown whether the fire was legally started or not, but it spread for kilometres in all directions. Historical buildings were also observed within the study area (Figure 7-7).

Figure 7-3: Agricultural activities on the proposed project study area. (Please note: Photos were taken during the dry winter month conditions).

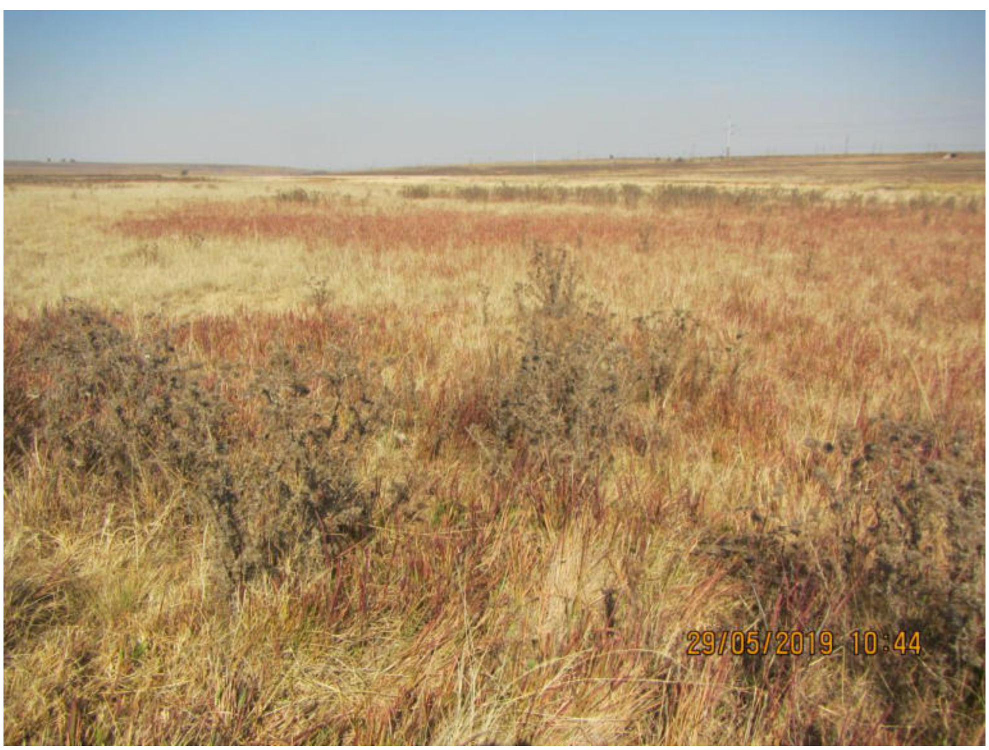


Figure 7-4: Grassland and wetlands on the study area.

Figure 7-5: The Leeufonteinspruit was dry from May till September, with only seasonal pans visible.

Figure 7-6: The entire study area burnt during August 2019.

Figure 7-7: Infrastructure and associated activities on the proposed project area.

7.2 REGIONAL GEOLOGY

South Africa's Coal Resources are restricted to the area east of the longitude 26° E and are hosted by the Late Carboniferous to middle Jurassic sedimentary deposits of the Karoo Supergroup (320-180 Ma).Within the main Karoo Basin, coal is hosted in the Vryheid Formation of the Ecca Group, where rank increases eastwards, as well as in the Emakwezini Formation of the Beaufort Group. In the Eastern Cape, the Molteno Formation hosts coal deposits, with rank increasing to the southeast.

South Africa is host to 19 coalfields (Figure 7-8) which encompass a total area of about 9.7 million hectares. The largest of these coalfields by coal reserves are the Highveld and Witbank coalfields, followed by Ermelo and Waterberg where bituminous coal dominates. South Africa's coal seams are characteristically thin and are found at relatively shallow depths and extraction is thus easier and often more economical.

South Africa's coal deposits form part of the Permian age Karoo Supergroup which was deposited on the Gondwanaland Supercontinent. The Main Karoo basin is underlain by the Kaapvaal Craton in the north and the Namaqua-Natal Metamorphic Belt in the south. The Karoo Supergroup from the base upwards is sub-divided into the following subgroups from bottom to top as:

- Dwyka Group
- Ecca Group
- Beaufort Group
    - Molteno Formation
    - Elliot Formation
    - Clarens Formation

- The volcanic rocks of the Stormberg Group

The vast majority of coal beds occur in the Ecca Group with some minor coal seams in the Beaufort Group and the Molteno Formation as well.

During coal deposition, fluvio-deltaic complexes prograded in a southerly direction across an epicontinental platform, resulting in the infilling of pre-existing glacial valleys. These glacial valleys controlled the flow of water during deposition as well as the extent and position of the swamps and resultant coal development. Present day coal beds are restricted to some of these valleys.

The 19 coalfields of South Africa are mainly concentrated in the north-eastern parts of the country in the provinces of KwaZulu-Natal, Mpumalanga, Limpopo and the Free State with lesser deposits in Gauteng and the Eastern Cape.

The Witbank / Highveld Coalfields are currently the most important coalfields in the RSA. There are normally four major coal seams developed, namely:

- Seam 5,
- Seam 4,
- Seam 2, and
- Seam 1.

Basement topography and the present-day erosional surface control the distribution of the coal seams and not all the seams may be present at any one locality. Seams 5 and 1 are usually thin to absent over much of the coalfield. The Seams 4 and 2 are most widely developed, and often achieve mineable thicknesses in the coalfield. Seam 4 usually splits into the 4 Upper ("4U") and 4 Lower ("4L") Seams, and similar Seam 2 into a 2 Upper ("2U") and 2 Lower ("2L"). The 5 Seam has, over large areas of the northern and central areas of the coalfield, been removed by erosion (Figure 7-10).

A west to east section and general stratigraphy column for the Western Witbank Coalfield and Northern Highveld Coalfield (representative of the Site region) (after Venmyn-Deloitte, 2017) is shown in Figure 7-9 and Figure 7-10.

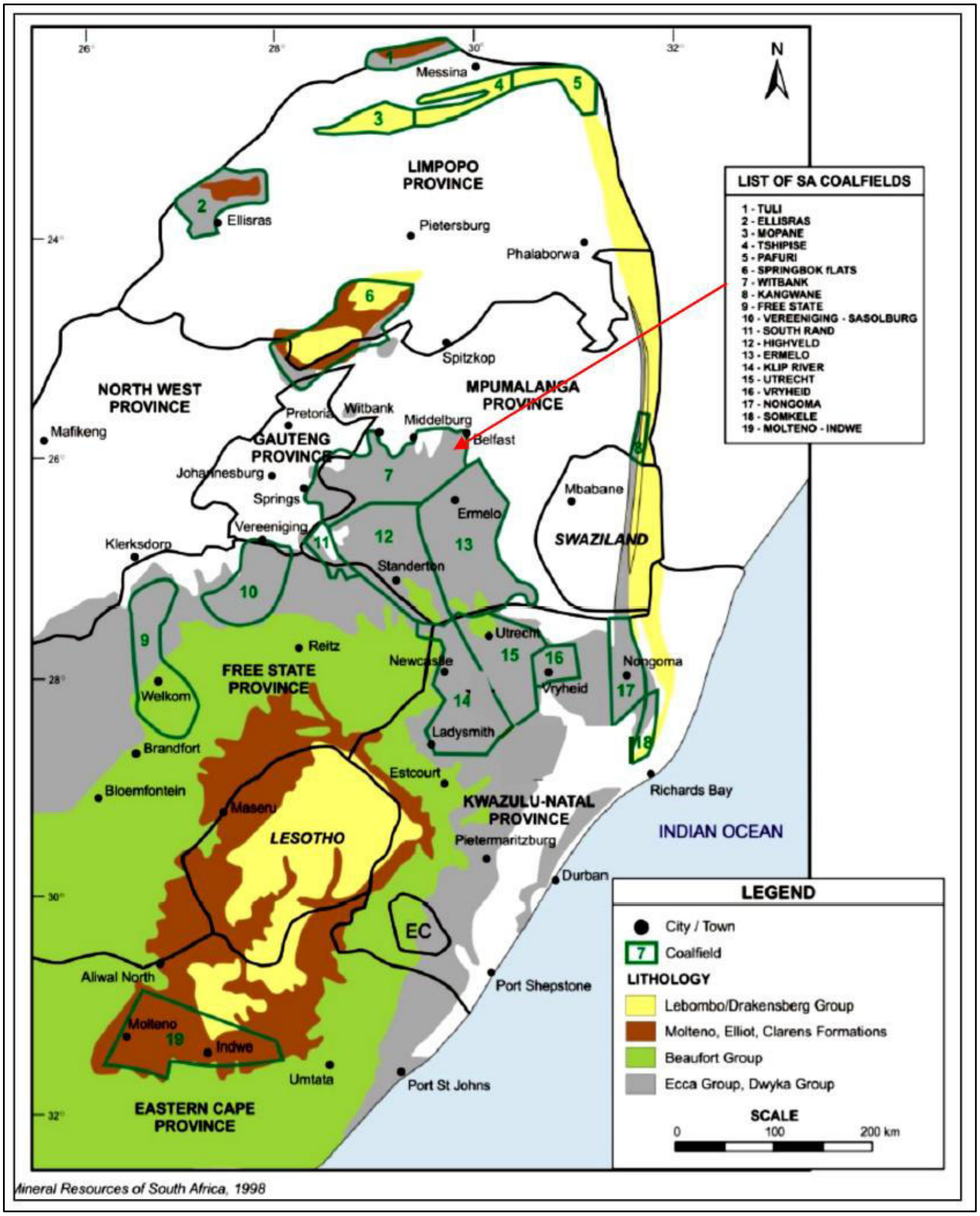


Figure 7-8: The Coalfields of South Africa.

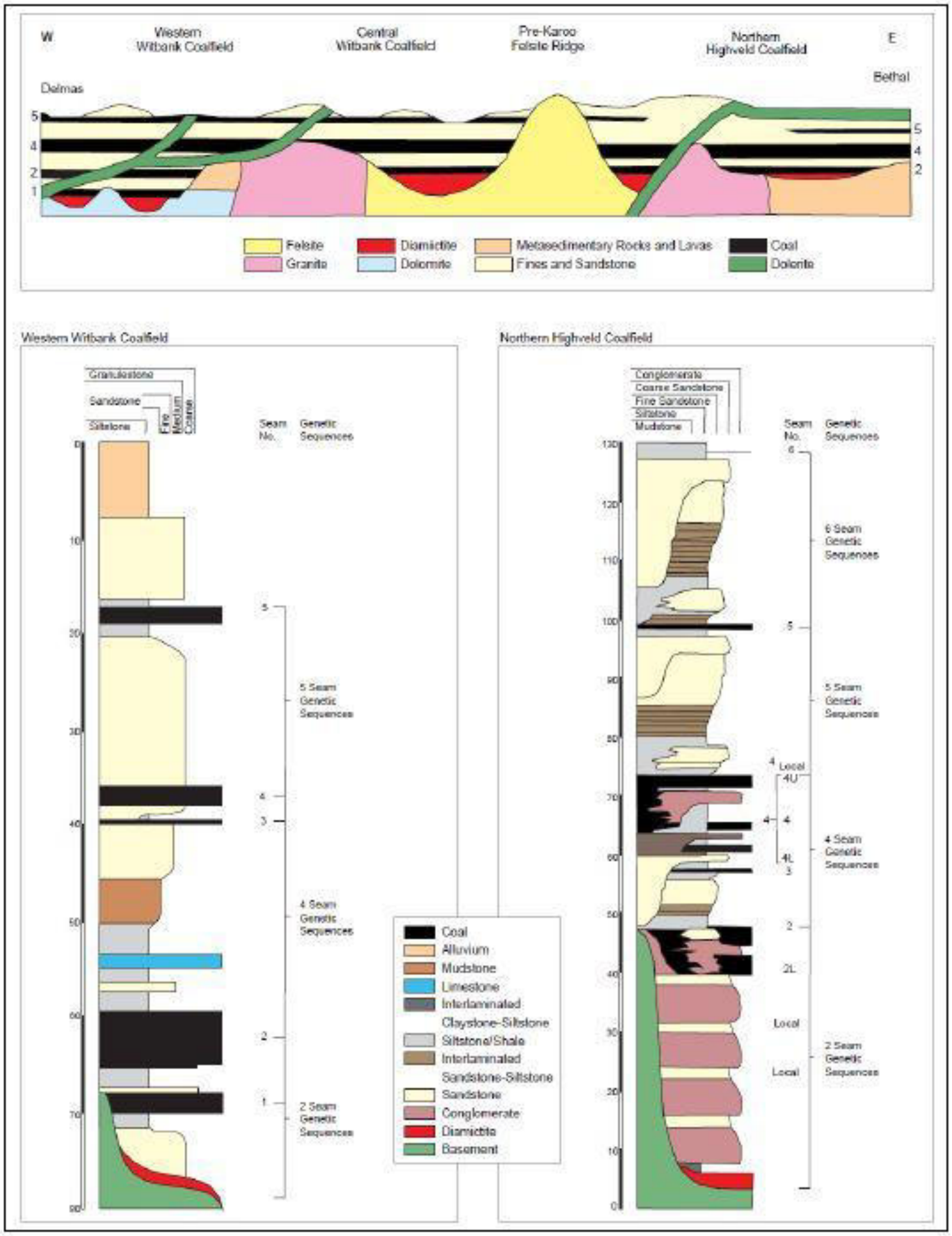


Figure 7-9: Regional Geological Section and General Stratigraphy (after Venmyn-Deloitte, 2017).

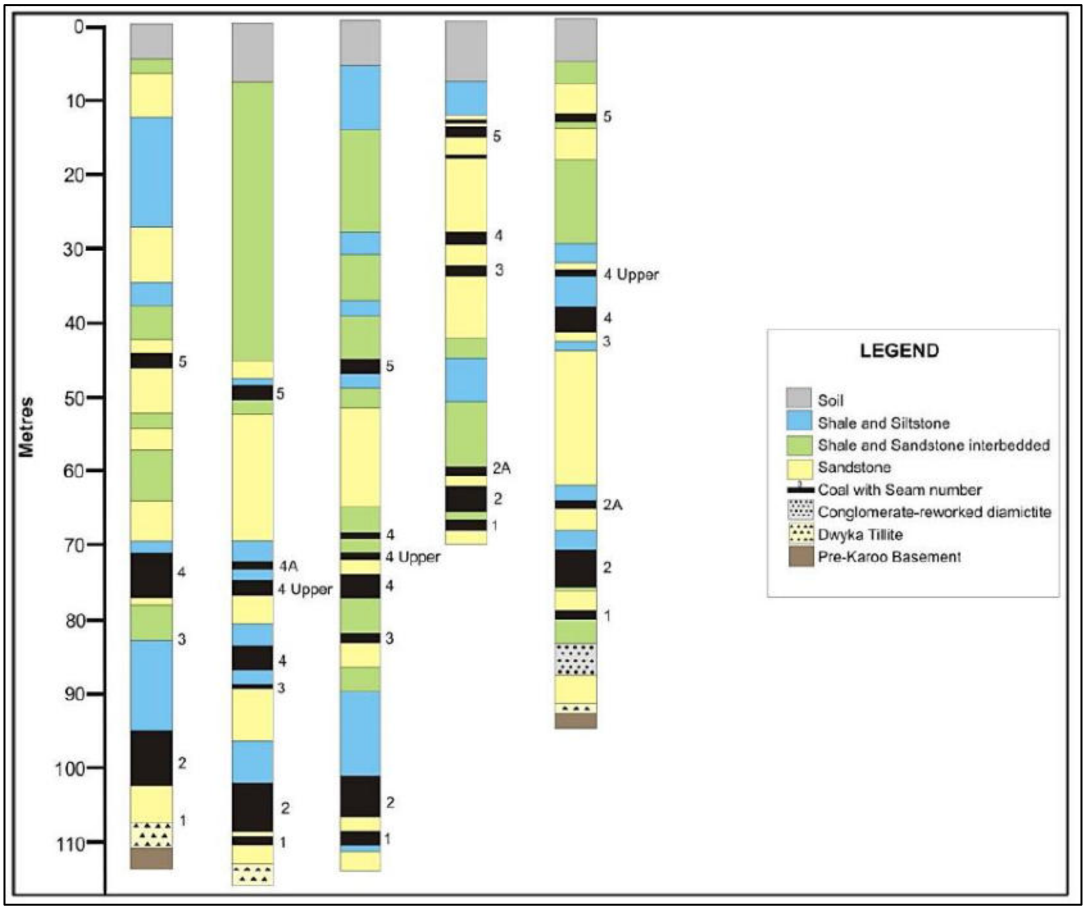


Figure 7-10: Regional Stratigraphy.

Figure 7-11 shows the regional geological structures for the Site.

As indicated in the MWP, there is sufficient data available for Dunbar West to make an initial assessment of its potential. Both Seams 4 and 2 occur on the PR area with Seam 4 reaching a maximum thickness of 5.89 m and Seam 2 a maximum of 9.95 m. In the shallowest parts, Seam 4 starts at a depth of 2.45 m and goes as deep as 100.9 m with Seam 2 at depths from 29.80 to 122.70 m. Seam 5 is thin and not regarded as economical. The typical stratigraphy of the Dunbar West area is displayed in Figure 7-12. There is a persistent dolerite sill in the western part and another in the north-east that caused large areas of the coal to be burnt or devolatilised.

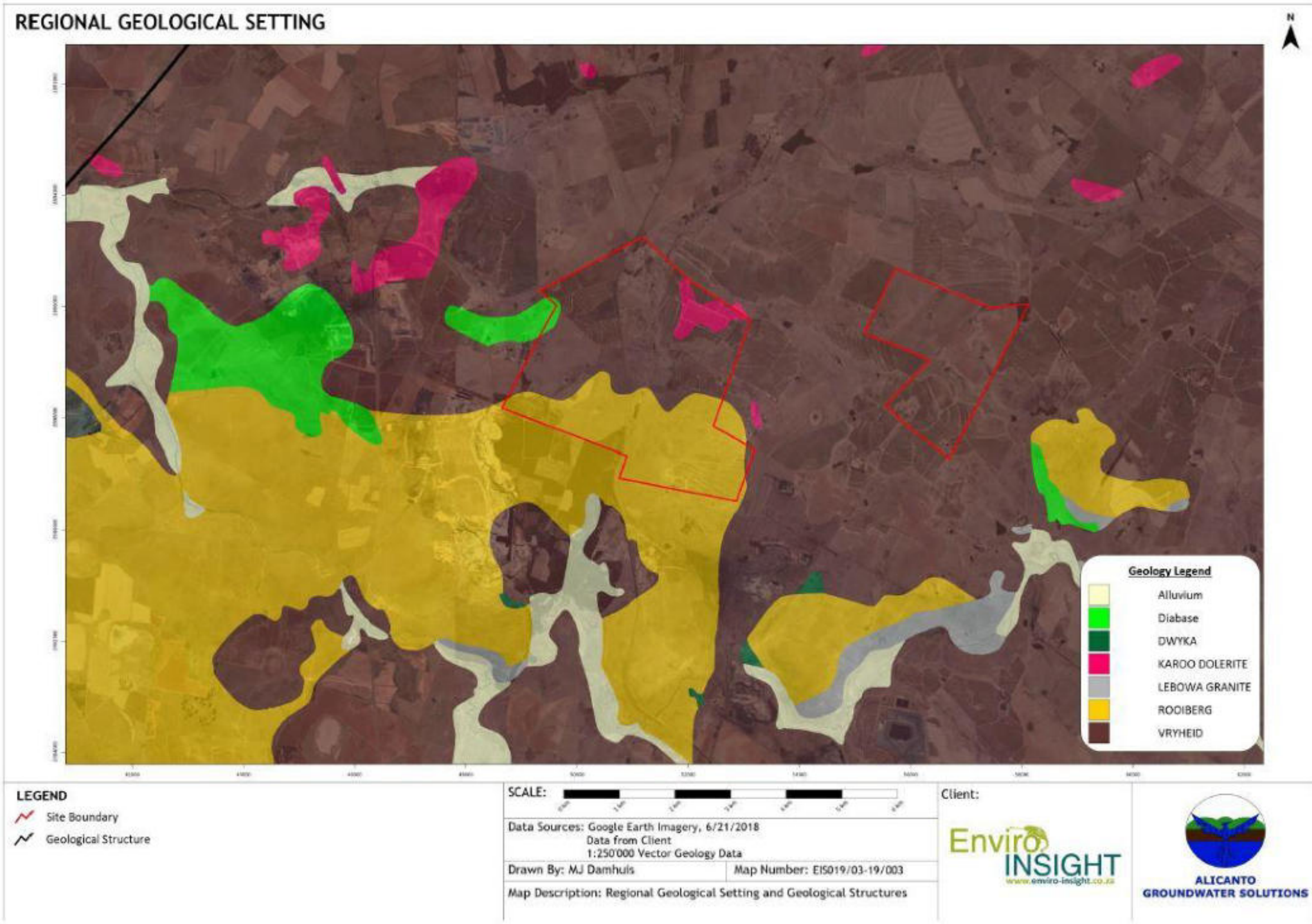


Figure 7-11: Regional Geological Setting.

Ave (m)	Profile	Lithology
0 to 27		Overburden
0.46		5 Seam
35		Interburden
< 1.0		4U Seam
2.5		Interburden
3.76		4L Seam
15		Interburden
5.72		2 Seam
		Tillite
		Felsite

Figure 7-12: Detailed Seam Stratigraphy.

7.3 CLIMATE

Precipitation[11]

This area normally receives approximately 482mm of rain per year, with most rainfall occurring during the summer months of October to March. October to January is predicted the highest rainfall months with between 76 mm to 107 mm predicted per month during these months. The least amount of rainfall occurs in July and the greatest amount of precipitation occurs in December, with an average of 93mm. The chart below (Figure 7-13) shows the average rainfall values for Hendrina per month. February and March is predicted to receive 54 mm to 55 mm precipitation. All other months are predicted to receive less than 26 mm precipitation on average during the month.

[11] https://www.meteoblue.com/en/weather/forecast/modelclimate/hendrina_south-africa_996930

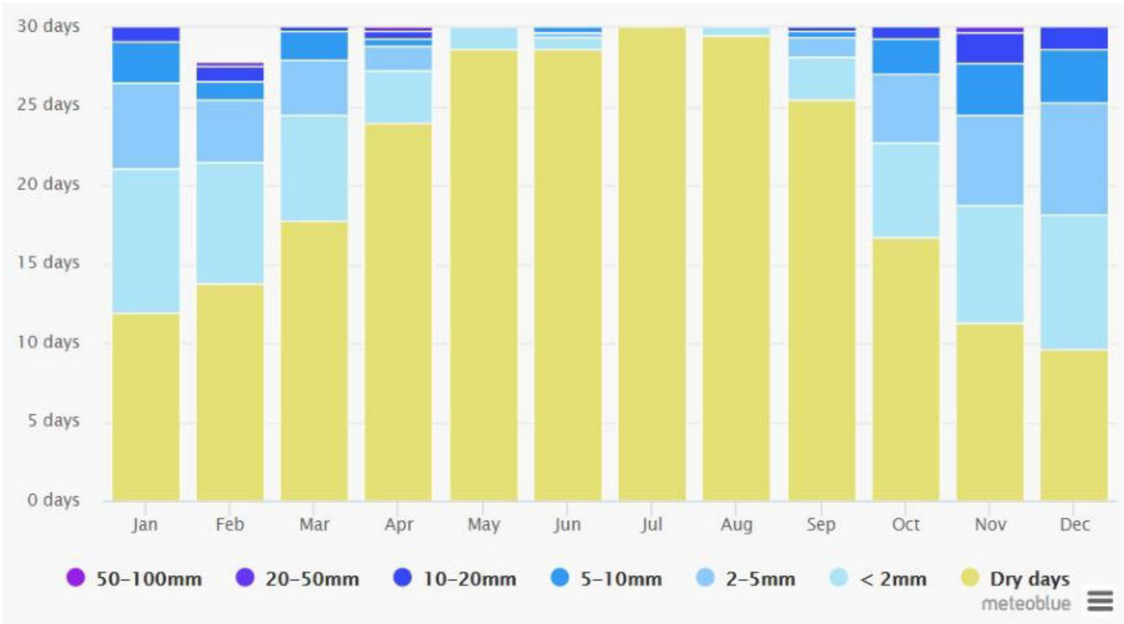


Figure 7-13: Monthly precipitation for the Hendrina area.

Temperature

The temperatures are highest on average in October where temperatures rise above 30°C from September until February. The coldest months in the year are in June and July (>5°C) where the number of frost days are the highest (Figure 7-14). In the summer months' maximum average daily temperatures are predicted to be 23°C to 26°C on average with a maximum of 32°C possible during hot days, dropping to a predicted 9°C to 13°C on average at night and 4°C minimum on cold nights. During winter months the average day time temperature are predicted in the 18°C to 21°C range while cold winter night time temperatures predicted to drop to -3°C.

Chemical reaction rates tend to increase with temperature and the warmer the air, the more water it can hold and hence the higher the humidity. When relative humidity exceeds 70%, light scattering by suspended particles begins to increase, as a function of increased water uptake by the particles (CEPA/FPAC Working Group, 1999). This results in decreased visibility due to the resultant haze. Many pollutants may dissolve in water to form acids. Temperature also provides an indication of the rate of development and dissipation of the mixing layer.

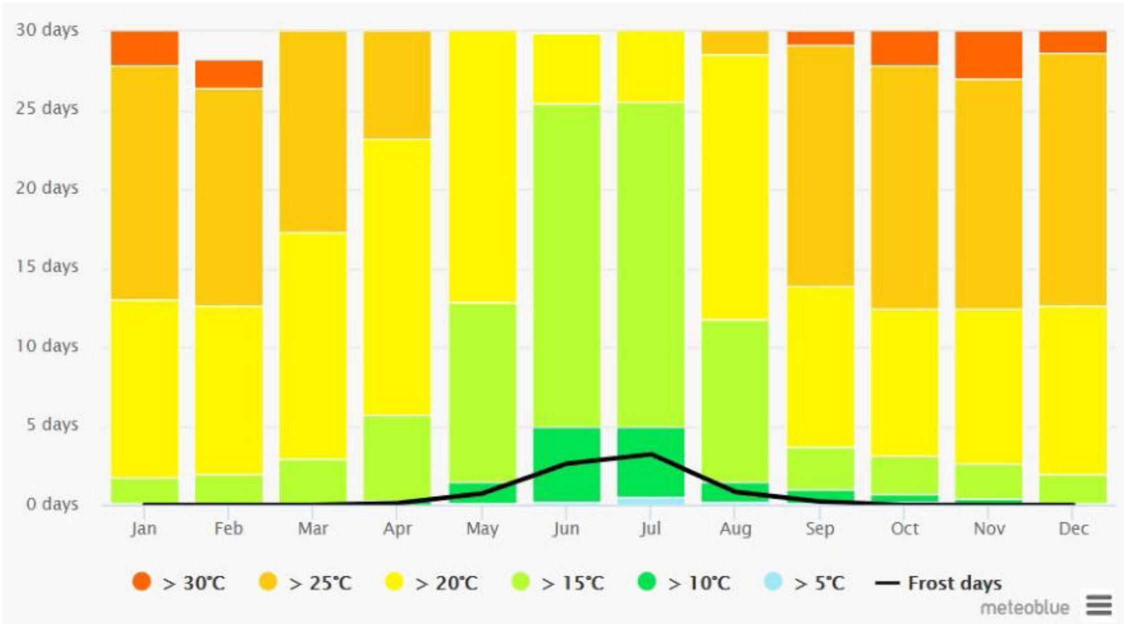


Figure 7-14: Monthly temperatures for the Hendrina area.

Wind speed

The average wind speed ranges from >1 km/h to >38 km/h throughout the year. Wind speed is high during the months of August, September and October, reaching speeds of more than >38 km/h on some days. From February to June, average wind speed is approximately 12 km/h per day (Figure 7-15).

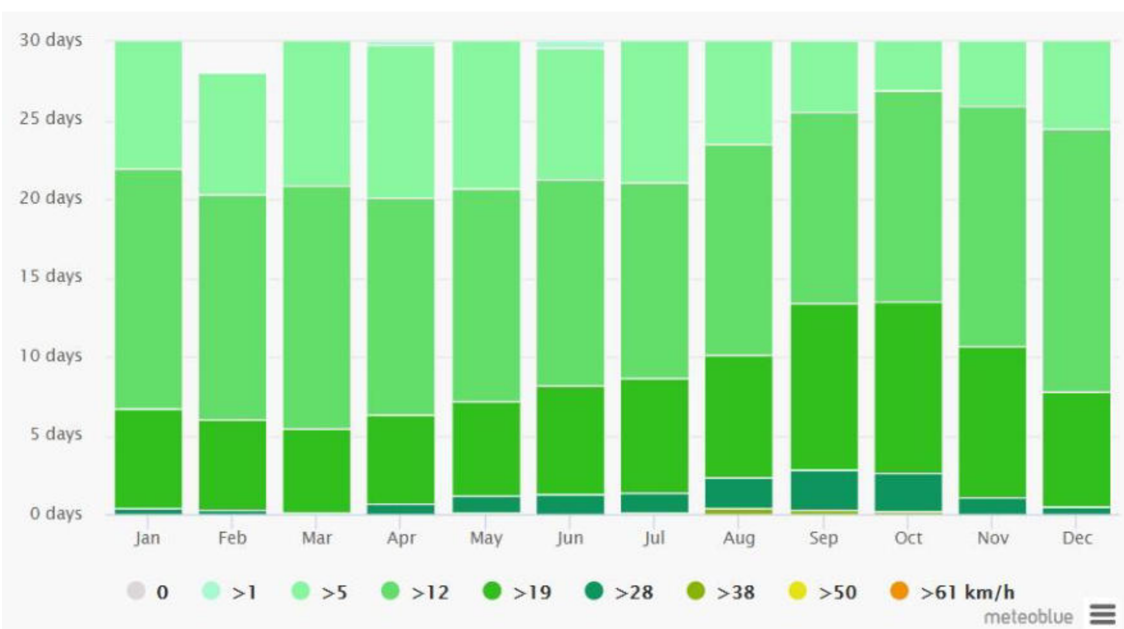


Figure 7-15: Monthly wind speed for the Hendrina area.

7.4 SURFACE WATER

The Surface Water Assessment undertaken for the project is attached as Appendix F1.

7.4.1 Regional Hydrology

South Africa is divided into 9 Water Management Areas (WMAs) which have been published in the Government gazette number 40279 of 19/09/16 (Notice no 1056, DWS, 2016), managed by their own water boards. Each of the WMAs is made up of quaternary catchments which relate to the drainage regions of South Africa. The project area falls mostly within quaternary catchments B11A and a small section towards the east in B11B (Figure 7-16).

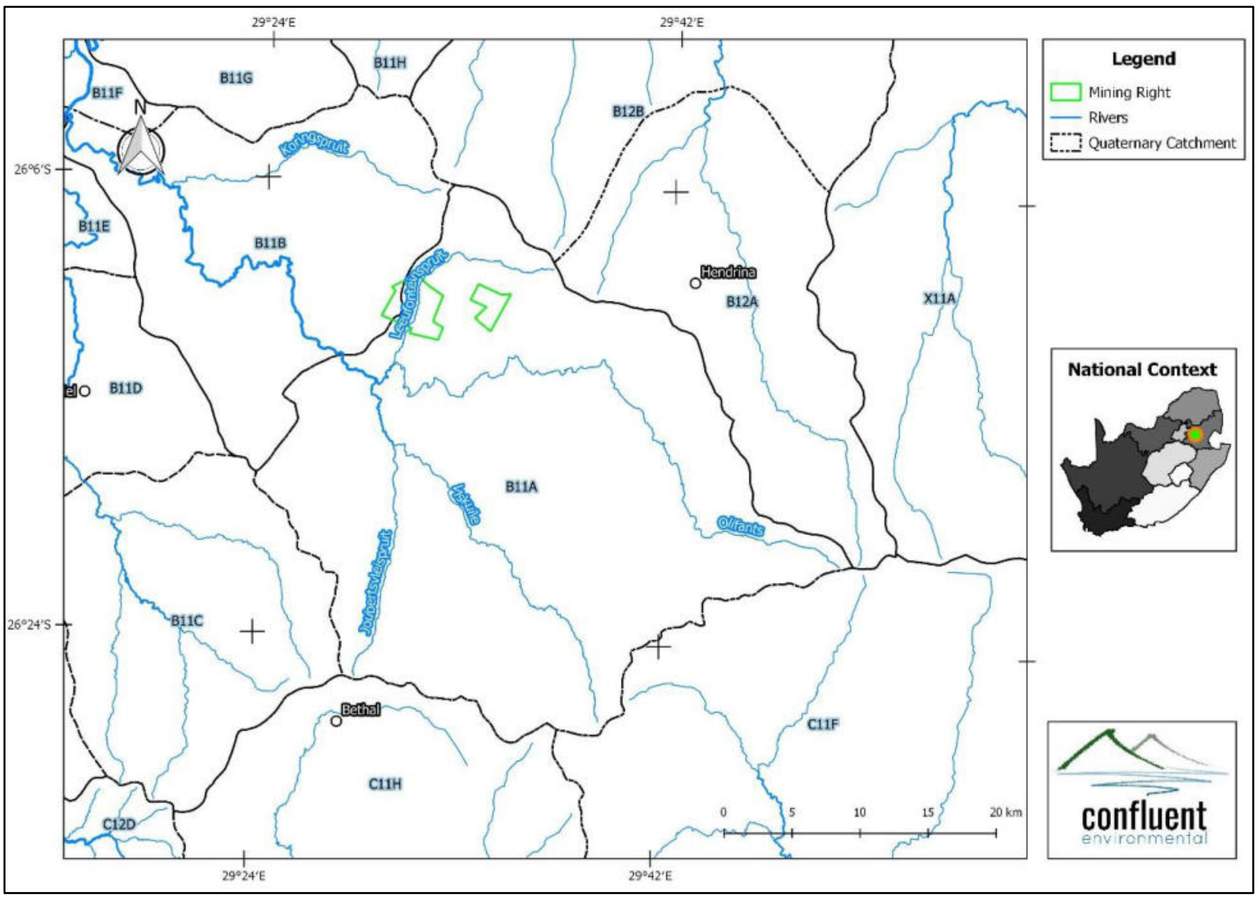


Figure 7-16: The study area in relation to the quaternary catchment.

7.4.2 Local Hydrology: Mpumalanga Highveld Wetlands (MHW, 2014)

Regulatory decision-making involving freshwater ecosystems is particularly relevant for the mining sector. In areas like Mpumalanga, with conflicting land uses and trade-offs between mining, food and water security, generating a clear and accurate picture of the extent, distribution, condition and type of freshwater ecosystems is an essential prerequisite to informed and consistent decision-making by regulators. This project thus presented a timely opportunity to develop standardised methods for ground-truthing and refining the NFEPA data, and to apply these methods in an area where the trade-offs between mining and wetlands are highly contested.

This project maps the extent, distribution, condition and type of freshwater ecosystems in the Mpumalanga Highveld coal belt. These refined layers will eventually be incorporated into the atlas of high-risk freshwater ecosystems and guidelines for wetland offsets, currently being developed by SANBI, in order to improve the scientific robustness of these tools.

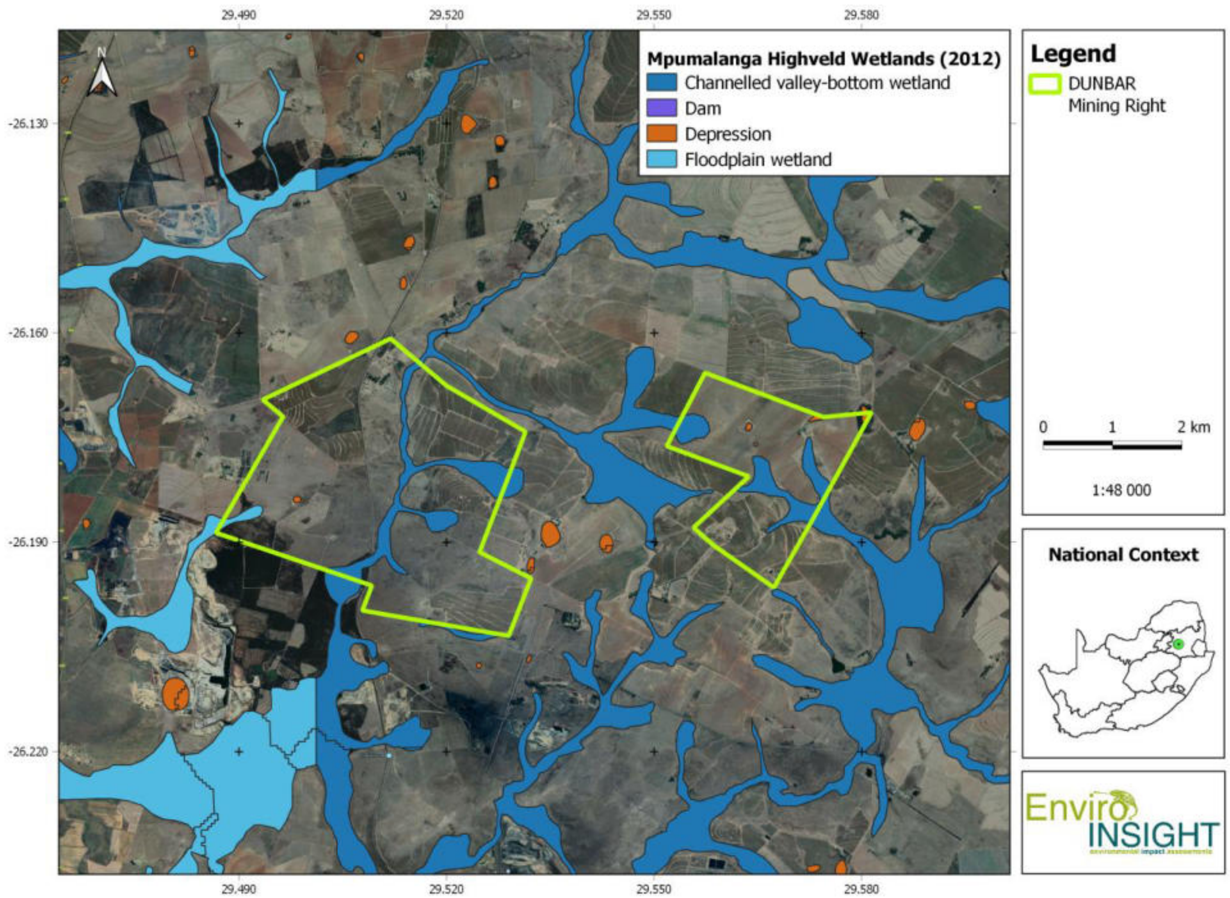


Figure 7-17: The study area in relation to the Mpumalanga Highveld wetlands.

7.4.3 Rainfall and evaporation

The proposed Dunbar Coal Mine is situated on the Mpumalanga Highveld which experiences warm summers and cold winters. The Highveld is in the summer rainfall region of southern Africa, with the majority of rain falling from October to March. The climate is temperate with hot summers and dry cold winters. Summer precipitation occurs in the form of mist, drizzle, hail and thunderstorms. Based on available weather data the mean annual precipitation for the catchment is 617 mm, with mean annual evaporation far exceeding rainfall.

Table 7-1: Mean monthly precipitation and evaporation for the B11A quaternary catchment (Schulze et al., 2008).

Month	Mean Rainfall (mm)	A-Pan Evaporation (mm)
January	107	203
February	83	169
March	67	170
April	35	136
May	16	121
June	4	100
July	5	112
August	7	153
September	27	185
October	64	206
November	105	202
December	100	215
Mean Annual Statistics	**617**	**1976**

7.4.4 Mean Annual Runoff

Mean annual runoff (MAR) for the B11A quaternary catchment is 38.9 mm (Bailey and Pitman, 2016) which is approximately 6.3 % of the MAP. Given a catchment area of 945 km^2, this corresponds to a MAR of 36.76 million cubic meters (Mm^3) (Table 7-2).

According to GN704 requirements pertaining to mine water use, all runoff emanating from dirty water areas such as mine infrastructures, operational areas and ROM stockpiles need to be contained within these areas, so as not to mix with the downstream clean water. The total area of the mine layout, including the opencast pits, is 1.7 km^2. Considering that a roll-over strip mining method will be employed, the excavated area of the pit at any given point in time will be considerably less that 1.7 km^2 and will therefore have a minimal impact on loss of surface runoff. According to the Stormwater Management Plan, the total infrastructure area is approximately 0.33 km^2 which is 0.03 % of the total area of the B11A quaternary catchment. Containment of water within a dirty water system will therefore result in an approximate reduction of 0.02 Mm^3 to MAR (assuming that MAR is evenly distributed across the entire catchment area).

The catchment area for each wetland was delineated using a DEM that covers the entire B11A catchment area (Figure 7-18). The permanent infrastructure area for which dirty water will be diverted into the stormwater management network is less than 0.5 km^2 for each wetland and represents negligible losses to the channelled valley-bottom wetland (0.5 %) and up to 5 and 10 % for the seep and unchannelled valley-bottom wetland, respectively.

Table 7-2: Summary of the surface water attributes of the B11A quaternary catchment.

Catchment Area	Total Area (km^2)	MAR (Mm^3)	Mining Infrastructure Area (km^2)	Decrease in MAR (%)	Loss in MAR (Mm^3)
B11A	945	36.76	0.33	0.035	0.013
Channelled Valley-	70	2.72	0.33	0.5	0.013

Bottom Wetland					
Unchannelled Valley-Bottom Wetland	2.7	0.11	0.26	10	0.011
Seep Wetland	1.3	0.05	0.065	5	0.002

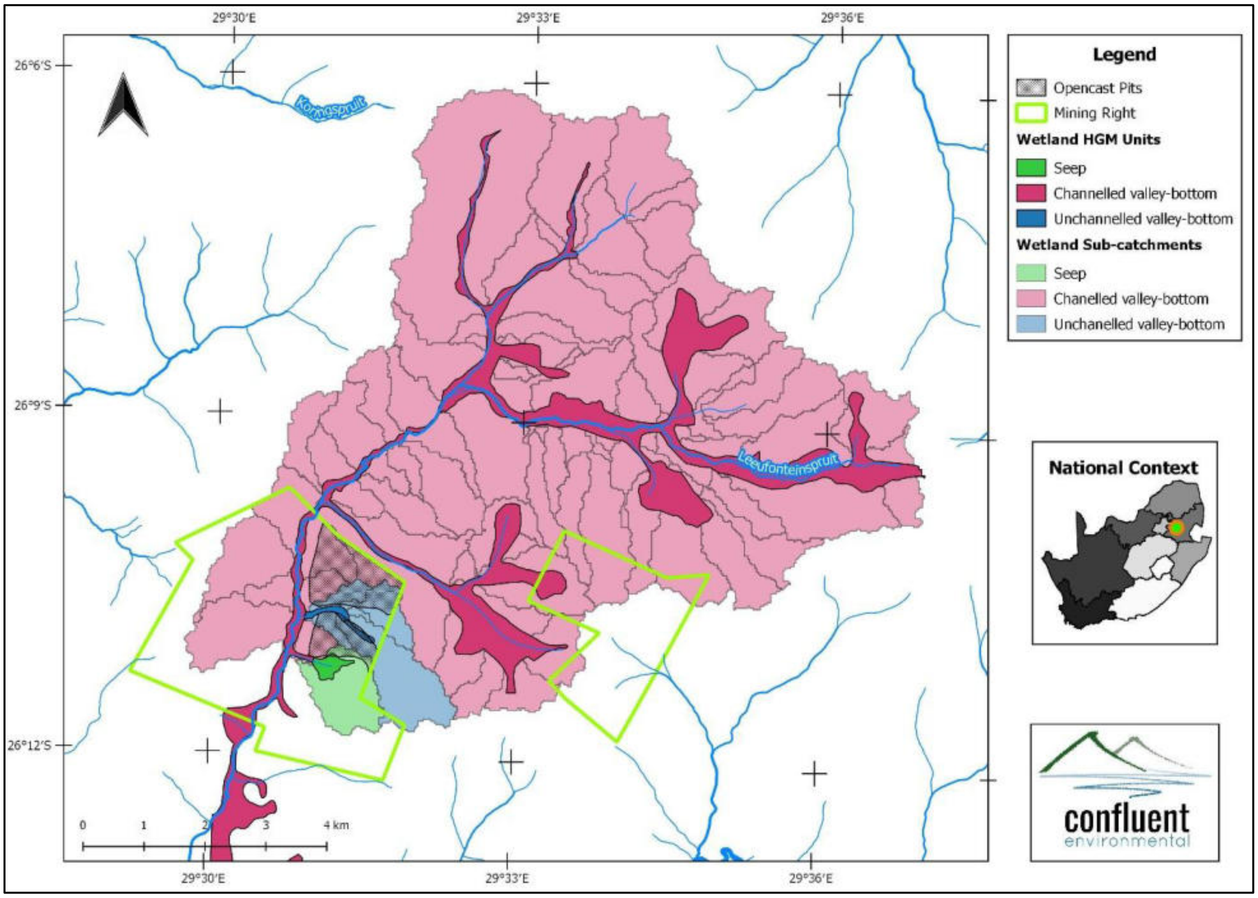


Figure 7-18: Delineated sub-catchments of the Leeufonteinspruit.

7.4.5 Topography

The topography of the general area consists of low to moderate relief. The opencast pits are situated on terrain that slopes gently (gradient of approximately 2 %) towards to channelled valley-bottom wetland with other wetlands occurring in the valleys adjacent to the pits (Figure 7-19).

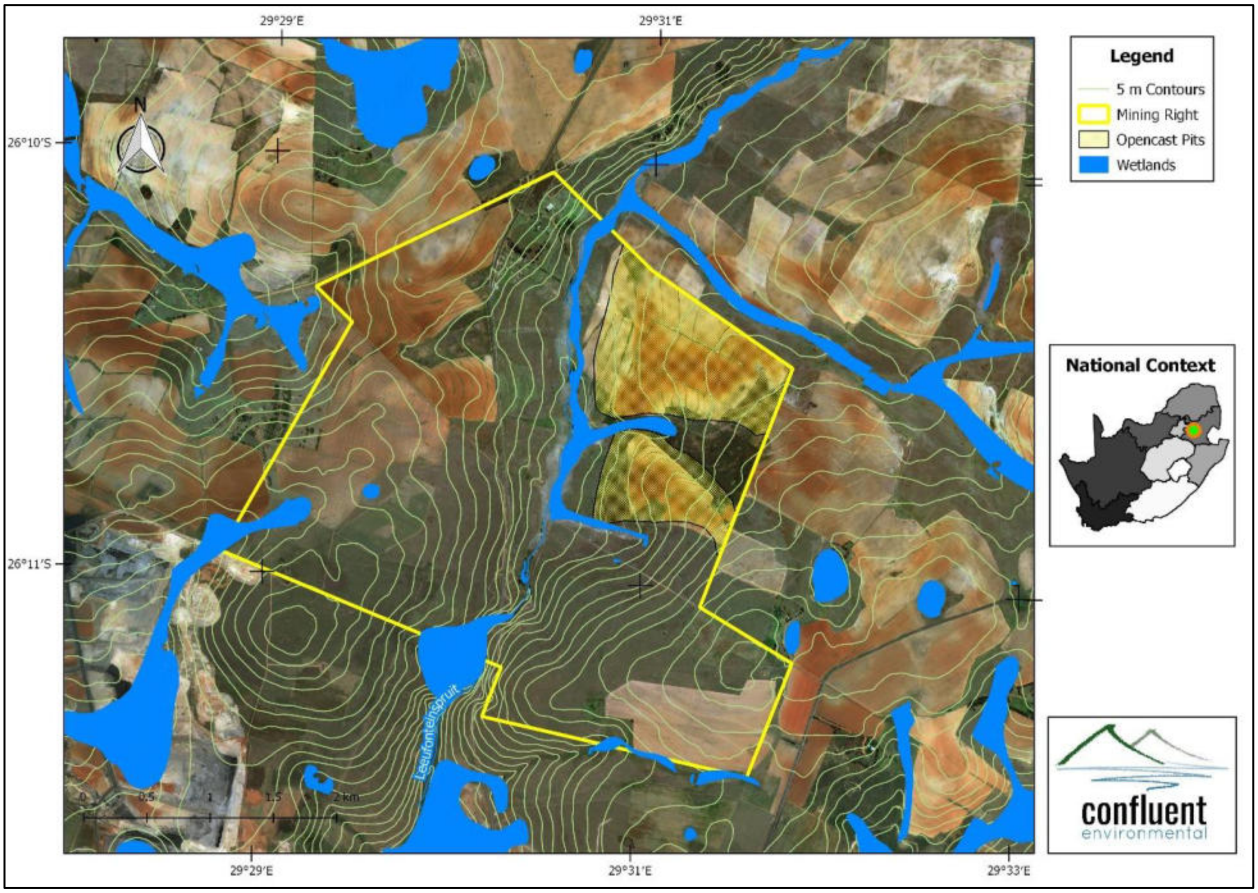


Figure 7-19: Map illustrating the topography associated with the proposed Dunbar Coal Mine.

7.4.6 Water Quality

Two water quality sampling sites were identified (Table 7-3; Figure 7-20). These were located approximately upstream and dowsntream of the proposed mining activities. Samples were collected in 1 litre plastic sampling bottles and were placed on ice until delivery to the analytical laboratory. Water quality parameters were analysed and quantified by Aquatico Scientific using accredited methods. In addition, *in-situ* water quality measurements (temperature, pH, electrical conductivity and dissolved oxygen) were taken using a handheld multiparameter water quality meter (Hanna HI98914).

Table 7-3: Location and description of water quality sampling sites

	Latitude	Longitude	Description
DB_1	-26.316761°	28.582839°	Upstream of proposed mining activities.
DB_2	-26.314045°	28.548779°	Downstream of proposed mining activities.

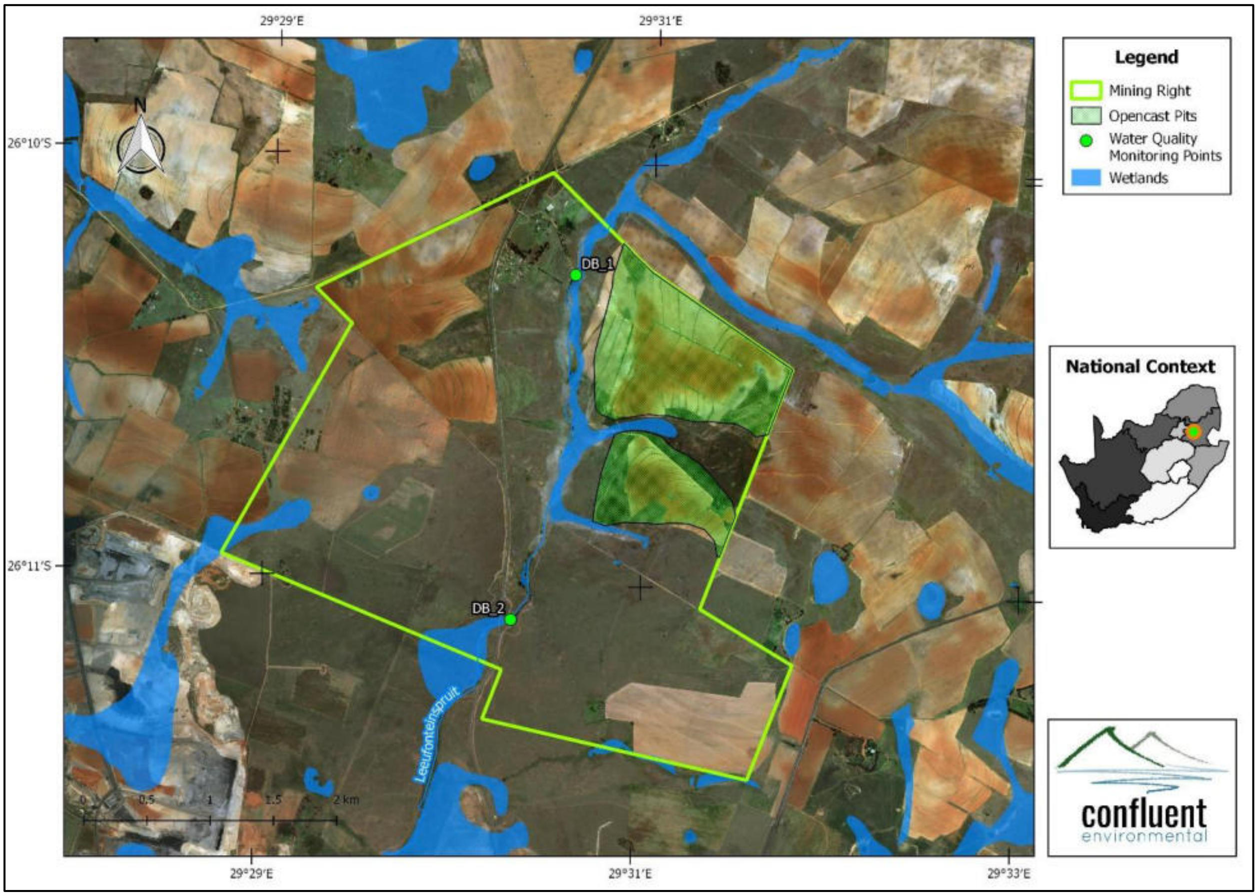


Figure 7-20: Map illustrating the location of water quality sampling points in relation to proposed mining activities.

In-situ Water Quality

It is recognised that some water resources, by virtue of their ecological importance, may require a high level of protection, whereas other water resources may serve the country's developmental and economic growth needs. The Water Resource Classification System is a step-wise process whereby water resources are categorized according to specific classes that represent a management vision of a particular catchment by taking into account the current state of the water resource and defining the ecological, social and economic aspects that are dependent on the resource.

The management class for the broader Upper Olifants River catchment has been classified as Class III which is regarded as a water resource that is heavily utilised, and the overall ecological condition of the resource is significantly altered from its pre-development condition. Based on this classification the Resource Quality Objectives (RQOs) for the Upper Olifants River catchment have been gazetted and set according to Government Notice No. 619 of 20 July 2015. RQOs establish clear goals relating to the quality of the relevant water resources and are a numerical or descriptive statement of the conditions which should be met in the receiving water resource, in terms of resource quality, in order to ensure that the water resource is protected. Generally speaking, the RQOs associated with all resource quality descriptors are relatively high, which is indicative of the Management Class set for the catchment. In terms of habitat and biota the ecological category must be maintained at a D (Largely Modified).

Table 7-4: Resource Quality Objectives for the Upper Olifants Catchment.

Resource Quality Descriptor	RQO	Indicator	Numerical Limit		
Water Quantity	Low flows should be improved in order to maintain the river habitat for the ecosystem and ecotourism.	EWR maintenance low and drought flows: Olifants EWR1 in B11J VMAR = 184.5x$10^6$$m^3$ PES-D category		Maintenance Low Flows (m3/s) (Percentile)	Drought Flows (m3/s) (Percentile)
			Oct	0.150 (99)	0.161 (99)
			Nov	0.272 (90)	0.185 (99)
			Dec	0.360 (80)	0.146 (99)
			Jan	0.447 (99)	0.675 (80)
			Feb	0.549 (99)	0.692 (90)
			Mar	0.442 (80)	0.261 (90)
			Apr	0.361 (80)	0.204 (90)
			May	0.249 (80)	0.164 (90)
			Jun	0.171 (80)	0.127 (99)
			Jul	0.130 (99)	0.131 (99)
			Aug	0.103 (80)	0.153 (70)
			Oct	0.150 (99)	0.161 (99)
Water Quality: *Nutrients*	Nutrient concentrations must be maintained in the river at mesotrophic or better levels	Nitrate (NO_3) & Nitrite (NO_2)	≤ 4.00 mg/L N		
		Phosphate	≤ 0.125 mg/L P		
		Total Ammonia	≤ 0.100 mg/L N		
Water Quality: *Salts*	Salt concentrations need to be maintained at levels where they do not render the ecosystem unsustainable.	Sulphate	≤ 500 mg/L		
		Electrical conductivity	≤ 111 mS/m		
Water Quality: *Toxicants*	Maintain the levels of toxic contaminants at concentrations acceptable for the ecosystem and users (B).	F	≤ 3.0 mg/L		
		Al	≤ 0.150 mg/L		
		As	≤ 0.130 mg/L		
		Cd	≤ 5 µg/L		
		Cr(VI)	≤ 200 µg/L		
		Cu	≤ 8.0 µg/L		
		Hg	≤ 1.7 µg/L		
		Mn	≤ 1.3 mg/L		

	Pb	≤ 13.0 µg/L
	Se	≤ 0.03 mg/L
	Zn	≤ 36 µg/L
	Chlorine	≤ 5.0 µg/L
	Endosulfan	≤ 0.2 µg/L
	Atrazine	≤ 100.0 µg/L
Habitat & Biota	• Instream habitat must be in a largely modified or better condition to support the ecosystem and for ecotourism users. • Instream biota must be in a largely modified or better condition and at sustainable levels. • Low and high flows must be suitable to maintain the river habitat for ecosystem condition and ecotourism.	• Instream Habitat Integrity category ≥ D (≥ 42) • Fish ecological category: ≥ D (≥ 42) • Macro -invertebrate ecological category: ≥ D (≥ 42) • Instream Ecostatus category ≥ D (≥ 42) • Hydrological category ≥ D (≥ 42) • Water Quality category: ≥ D (≥ 42)

Interrogation of DWS databases did not yield any data for the Leeufonteinspruit. The assessment of water quality is therefore based on water quality data collected on site (Figure 7-20; Figure 7-21). Concentrations of water quality parameters were compared to the RQOs set for the Upper Olifants River catchment. RQOs for all parameters that were analysed are not available. Similarly, there are some parameters for which RQOs have been set that were not included in the analysis performed for this study. In general, none of the analysed parameters exceeded RQOs and there is no indication that water quality is currently impacted by mining activities, which typically results in high TDS concentrations with sulphate comprising the largest proportion of major ions. Concentrations of water quality parameters are slightly lower downstream (at DB_2). Surface water at DB_1 was restricted to isolated pools with no flow through of water which most likely led to the slightly higher concentration of water quality parameters due to evaporation from the pool.

Table 7-5: Water quality measured at sites potentially affected by the proposed mine development.

Parameter.	Units	RQOs	DB_1	DB_2
In-situ Water Quality				
Temperature	°C		16.32	19.5
Dissolved Oxygen	mg/ℓ		18.1	15.6
E.C. (mS/m)	mS/m	< 111 mS/m	37.7	25.5
TDS (E.C. * 6.5)	mg/ℓ		188	128
pH			8.13	7.77
MAJOR CATIONS				
Calcium	mg Ca/ℓ		13.3	9.61
Magnesium	mg Mg/ℓ		8.48	6.02
Sodium	mg Na/ℓ		19.3	21
Potassium	mg K/ℓ		11.5	4.25

MAJOR ANIONS				
Chloride	mg Cl/ℓ		21.8	18
Sulphate	mg SO_4/ℓ	< 500 mg/L	33.5	14.9
Alkalinity	mg $CaCO_3$/ℓ		58.2	64.8
NUTRIENTS				
Nitrate + Nitrite (N)	mg N/ℓ	≤4.00 mg/L N	0.225	0.288
Nitrite nitrogen	mg N/ℓ		0.103	0.087
ortho Phosphate	mg PO_4-P/ℓ	<0.125 mg/L P	0.011	<0.005
Total Phosphate	mg P/ℓ		0.016	<0.01
TRACE METALS				
Aluminium	mg Al/ℓ	<0.105 mg/L	0.005	0.002
Iron	mg Fe/ℓ		<0.004	<0.004
Manganese	mg Mn/ℓ	<1.3 mg/L	0.004	0.001

Figure 7-21: Water quality monitoring points in the Leeufornteinspruit, DB_1 (left) and DB_2 (right).

7.5 AQUATIC ECOSYSTEMS

The Aquatic Ecosystem Assessment undertaken during the EIA Phase is attached as Appendix F1.

7.5.1 National Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) database (Nel *et al*., 2011) forms part of a comprehensive approach to the sustainable and equitable development of South Africa's scarce water resources. This database provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the National Water Act (Act 36 of 1998). This directly applies to the National

Water Act, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives (Nel *et al*., 2011). The NFEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's (NEM:BA) (Act 10 of 2004) biodiversity goals, informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel *et al*., 2011).

The proposed Dunbar Coal Mine falls within sub-quaternary catchment (SQC) 1331, which has not been categorized as a National Freshwater Ecosystem Priority Area (NFEPA) (Figure 7-22). Additionally, none of the wetlands that are indicated to occur within the SQC have been identified as wetland FEPAs.

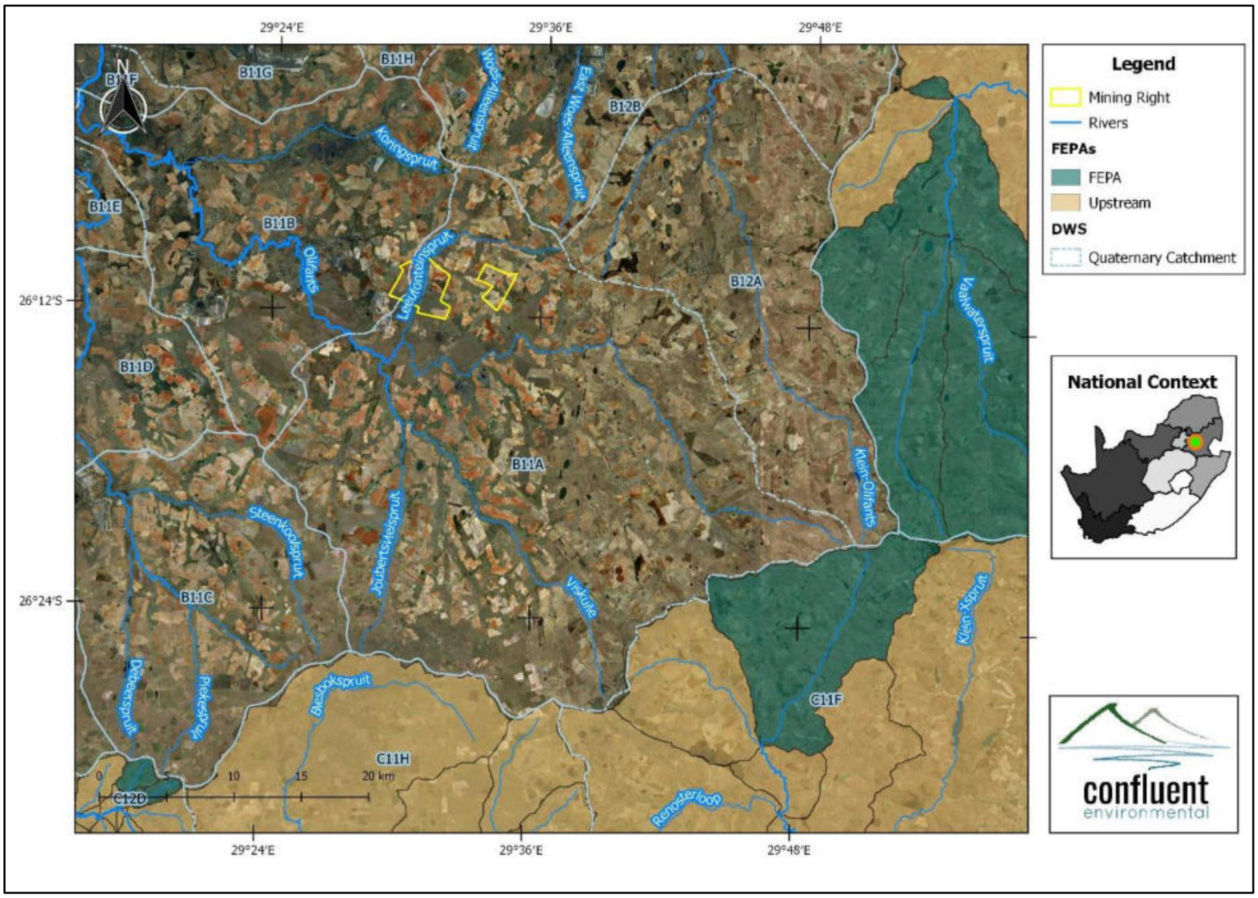


Figure 7-22: NFEPA categories for sub-quaternary reaches of the upper Olifants River.

7.5.2 Mpumalanga Biodiversity Sector Plan

The Mpumalanga Biodiversity Sector Plan (MBSP) is a spatial tool with land-use guidelines that forms part of a broader set of national biodiversity planning tools and initiatives that are provided for in national legislation and policy. It comprises a set of maps of biodiversity priority areas accompanied by contextual information and land-use guidelines that make the most recent and best quality biodiversity information available for use in land-use and development planning, environmental assessment and regulation, and natural resource management.

Classification of the Biodiversity Classification categories in the study area is as follows:

- CBA: Irreplaceable – sites where no other options exist for meeting targets for biodiversity features
- CBA: Important – best-design sites which represent an efficient configuration of sites to meet targets in an ecologically sustainable way that is least conflicting with other land uses and activities
- ESA: Natural, near-natural, degraded or heavily modified areas required to be maintained in an ecologically functional state to support Critical Biodiversity Areas and/or Protected Areas.

All wetlands that occur adjacent to the proposed mining area have been classified as Ecological Support Areas (ESAs) (Figure 7-23). Ecological support areas are not essential for meeting freshwater biodiversity targets but play an important role in supporting the ecological functioning of freshwater CBAs. Freshwater ESAs need to be maintained in at least a functional state, supporting the purpose of the ESA. Impacts in the upstream catchment should be mitigated or minimised through application of the land-use guidelines that accompany the CBA map.

Figure 7-23: Mpumalanga Biodiversity Sector Plan in relation to the location of water resources potentially affected by the proposed mine development.

7.5.3 Present Ecological State (PES)

According to DWS (2014), habitat, flow, riparian and physico-chemical characteristics of the Leeufonteinspruit have been **Largely Modified** and the desktop Present Ecological State (PES) is **D**. The Ecological Importance and Sensitivity of the stream is **Moderate**. Six fish species are expected to occur within the river and include *Barbus anoplus, Barbus neefi* (Greenwood, 1962)*, Barbus paludinosus, Clarias gariepinus, Pseudocrenilabrus philander* and *Tilapia sparrmanii.* All of these fish species are relatively tolerant to modifications in flow and water quality. Similarly, the expected invertebrate assemblage is also tolerant to flow and water quality modifications (DWS, 2014).

Table 7-6: Desktop Present Ecological State (PES) and Ecological Importance and Sensitivity of the Northern Tributary.

Present Ecological State		Ecological Importance		Ecological Sensitivity	
Seriously Modified (D)		**Moderate (C)**		**Moderate (C)**	
Modification to Instream Habitat Continuity	Large	Fish Species per Sub Quaternary Catchment	6	Sensitivity of Fish to Modification in Physico-chemistry	High
Modification to Riparian/Wetland Zone Continuity	Moderate	Invertebrate Taxa per Sub Quaternary Catchment	42	Sensitivity of Fish to No-Flow	High
Modification to Potential Instream Habitat	Large	Habitat Diversity Class	Low	Sensitivity of Invertebrates to Modification in Physico-chemistry	Very High
Modification to Riparian/Wetland Zone	Small	Instream Migration Link Class	Moderate	Sensitivity of Invertebrates to Velocity	Very High
Potential Flow Modifications	Large	Riparian-Wetland Zone Migration Link	High	Riparian/Wetland/Instream vertebrates (excl Fish) Intolerance to Water Level/Flow Changes	High
Potential Physico-Chemical Modifications	Moderate	Instream Habitat Integrity Class	Moderate	Stream Size Sensitivity to Modified Flow/Water Level Changes	Very High
		Riparian-Wetland Zone Habitat Integrity Class	Very High	Riparian/wetland Vegetation Intolerance to Water Level Changes	High

7.6 WETLANDS

The assessment of wetlands relied primarily on hydrological, geomorphological and vegetation characteristics of wetlands occurring in the area. While fish species are likely to occur within the main reach of the Leeufonteinspruit, these would have been restricted to the isolated dams occurring along the length of the river which were not sampled as part of this assessment.

The potential presence of wetlands was identified through use of desktop resources (e.g. NFEPA Wetlands layer – Nel *et al*., 2011) and confirmed during the field visit. Several wetlands occur adjacent to the proposed mining area. These wetlands were classified according to Ollis *et al*. (2013) and essentially comprise a channelled valley-bottom wetland located along the Leeufonteinspruit to the west of the proposed opencast pits, an unchanelled valley-bottom wetland running between the two pits and a hillslope seep wetland located to the south of the southern pit. Sub-surface flows are likely to be important sources of water for both the unchannelled valley-bottom and the seep wetland.

Table 7-7: Classification of wetlands occurring within 500 m of the proposed coal mine.

HGM Site	Level 1 System	Level 2 DWS Ecoregion	Level 3 Landscape Unit	Level 4 4A (HGM)	4B (Outflow Drainage)
1	Inland	Mesic Highveld Grassland	Valley floor	Channelled Valley-bottom Wetland	n/a
2	Inland	Mesic Highveld Grassland	Valley floor	Unchannelled Valley-bottom Wetland	n/a
3	Inland	Mesic Highveld Grassland	Slope	Seep	Channelled Outflow

The delineation of the wetland HGMs was confirmed based on a combination of terrain, vegetation and soil indicators (Figure 7-24). This was augmented with current and historical Google Earth imagery and orthophotos.

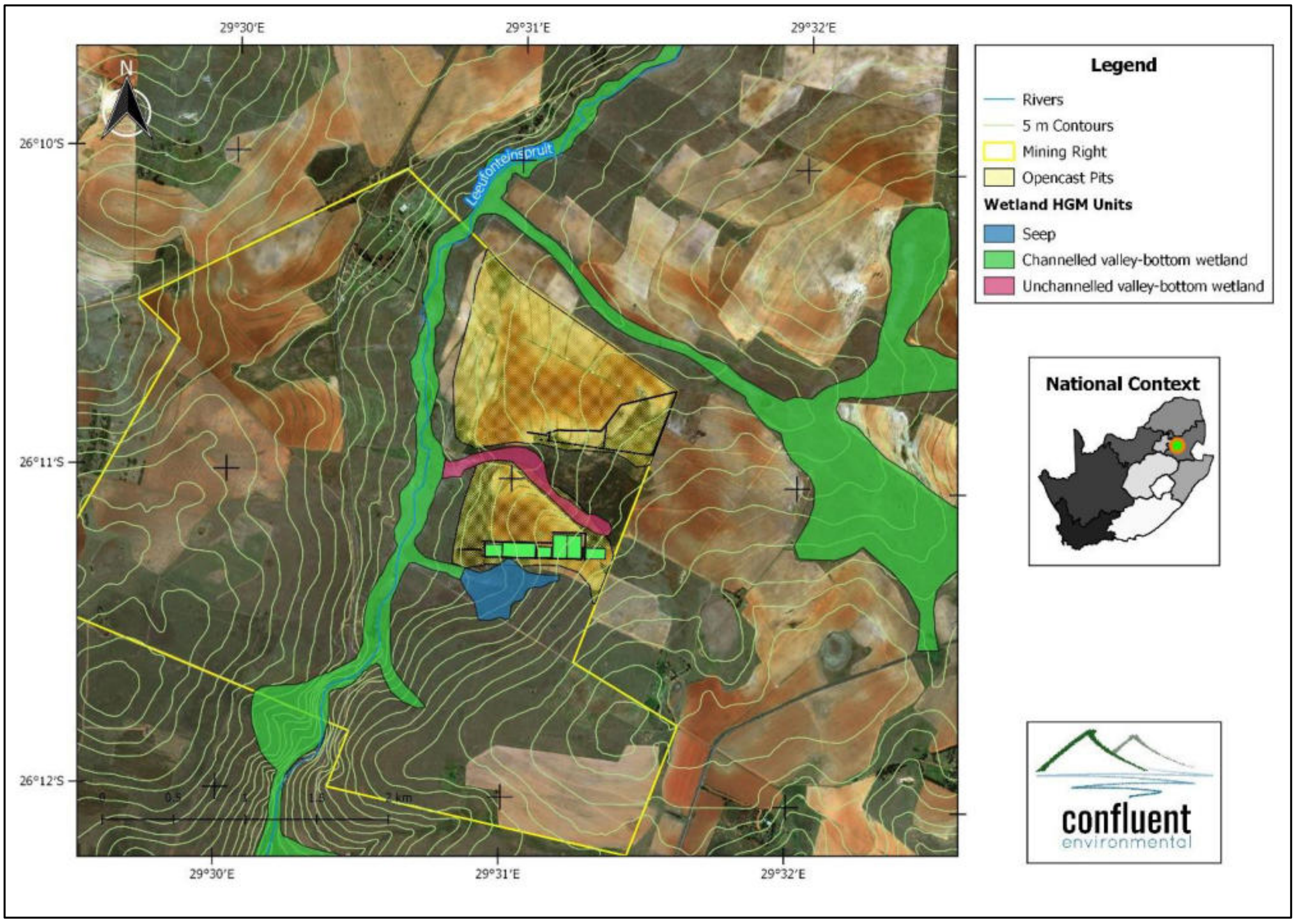


Figure 7-24: Classification of different wetland HGMs potentially affected by the development of the proposed Dunbar Coal Mine.

7.6.1 Present Ecological State

Impacts to the hydrology, geomorphology and vegetation of each wetland HGM were used to determine the PES. The PES of each wetland type is summarised in Table 7-8 and a description of impacts to each wetland type is discussed in the section below.

Table 7-8: PES scores for different wetland types potentially affected by the development of the proposed Dunbar Coal Mine.

Wetland	Hydrology	Geomorphology	Vegetation	Overall PES
HGM1	E (35 %)	B (86 %)	D (46 %)	D (54 %) – Largely Modified
HGM2	C/D (60 %)	A/B (90 %)	C (73 %)	C (68 %) – Moderately Modified
HGM3	B/C (80 %)	A/B (90 %)	C (73 %)	B/C (81 %) - Moderately Modified

7.6.2 Channelled Valley-Bottom Wetland (HGM1)

The channelled valley-bottom wetland runs along the non-perennial Leeufonteinspruit to the west of the proposed opencast pits. The hydrology of the wetland has been significantly impacted by the presence of several farm dams that are located along the length of the Leeufonteinspruit (Figure 7-25). These dams capture surface flows and reduce water inputs into downstream areas, reducing the surface area that would normally be saturated. These dams also have the effect of creating localized areas of inundation upstream of the dam wall and causing reduced saturation and more channelized flow paths downstream of the dam. These concentrated flow paths lead to localized areas of erosion and gulley formation. The dams also trap sediments which starves downstream reaches of sediment loads which further contributes to the erosion of the wetland. The surface roughness of the wetland has been largely modified due to grazing by livestock and transformation of natural areas into croplands which has the effect of reducing the ability of the wetland to retain water.

Figure 7-25: Photographs illustrating wetland vegetation along the channel (left) and one of several dams built within the course of the wetland (right).

7.6.3 Unchannelled Valley-Bottom Wetland

The unchannelled valley-bottom wetland lies in between to the two proposed pits (Figure 7-24). The main existing impacts are a series of three small dams located towards the lower end of the wetland (Figure 7-26). These dams create localized areas of inundation upstream of the dams and reduce surface water flows further downstream. Reduction in surface roughness is not as pronounced as in the channelled valley-bottom wetland and water retention is unlikely to be significantly affected. Agricultural croplands have however led to the encroachment of alien invasive weed species around the margins of the wetland (e.g. *Verbena* spp., *Cirsium vulgare*).

Figure 7-26: Photographs illustrating a landscape view of the unchannelled valley-bottom wetland (left) and one of three dams built along the course of the wetland (right).

7.6.4 Hillslope Seep Wetland

The hillslope seep is bordered by agricultural croplands along its northern perimeter (Figure 7-24). This disturbance has led to the encroachment of alien invasive weed species along this northern boundary. A small dam has been excavated into the slope to intercept and capture sub-surface and surface flows (). The extent of this infilling is limited to a relatively narrow section of the larger wetland area. Two farm roads traverse the wetland to the east (upslope) and west (downslope). The upper road is unlikely to significantly affect the hydrology of the wetland as flows are likely to be sub-surface at this altitude and should therefore not be impeded by the road. Surface flows during high rainfall periods are also unlikely to be impeded by the road. The lower road has resulted in an area of inundation upstream of the road and more channelized flow down slope of the road where the extent of saturation is limited to the lower points in the valley.

Figure 7-27: Photographs illustrating a landscape view of the seep wetland (left) and the small dam built into the wetland (right).

7.6.5 Ecological Importance & Sensitivity

The ecological importance of each wetland is moderate from the perspective of biodiversity support and landscape scale. The sensitivity of the channelled valley-bottom wetland is high given is sensitivity to changes in floods and low flow conditions. The reduced roughness of the channelled valley-bottom wetland and hydrological modifications has however compromised the ability of the wetland to retain water, trap sediments and assimilate pollutants. This capability is however less compromised in the unchannelled valley-bottom and seep wetlands, which due to their high vegetative cover and relatively large size have a relatively high hydro-functional importance. The direct human benefit for all wetland HGMs is low.

Table 7-9: Ecological Importance and Sensitivity importance criteria for wetlands

Ecological Importance and Sensitivity	Channelled Valley-Bottom	Unchannelled Valley-Bottom	Seep
Biodiversity Support			
Presence of Red Data species	**1**- Low likelihood given its hydroperiod	**2**- Moderate possibility	**2** – Possibility of red data species given relative rarity and size of wetland type
Populations of unique species	**1** – No uncommonly large populations of wetland species expected	**1** – No uncommonly large populations of wetland species expected	**2** – Possibility of unique wetland plant species given relative rarity and size of wetland type
Migration/feeding/breeding sites	**2** - Likely to be seasonally important for both aquatic and terrestrial species (wet season).	**1** - Relatively unimportant for both aquatic and terrestrial species (no open water habitats).	**1** - Relatively unimportant for both aquatic and terrestrial species (no open water habitats).
Average	**1.3 (Moderate)**	**1.3 (Moderate)**	**1.7 (Moderate)**
Landscape Scale			
Protection status of wetland	**1** - Not formally protected	**1** - Not formally protected	**1** - Not formally protected
Protection status of vegetation type	**1**-Mesic Highveld Grassland (Least threatened)	**1**-Mesic Highveld Grassland (Least threatened)	**1**-Mesic Highveld Grassland (Least threatened)
Regional context of the ecological integrity	**1**- Ecological integrity is average to low from a regional perspective (PES – D)	**2 –** Ecological integrity is relatively good from a regional perspective (PES – C)	**2 –** Ecological integrity is relatively good from a regional perspective (PES – C)
Size and rarity of the wetland	**1**- Medium sized wetland,	**2**- Medium sized wetland,	**3 –** Large seep wetland.

types present	relatively common throughout the landscape.	relatively rare throughout the landscape.	Relatively rare in the landscape
Diversity of habitat types	**3** – Relatively high diversity of habitat types expected during the wet season	**1 –** Relatively uniform habitat type across the wetland	**1 –** Relatively uniform habitat type across the wetland
Average	**1.4 (Moderate)**	**1.4 (Moderate)**	**1.6 (Moderate)**
Sensitivity of Wetland			
Sensitivity to changes in floods	**3** – Channelled valley-bottom wetland and sensitive to changes in floods	**2** – Relatively sensitive to changes in floods	**1** – Low sensitivity to changes in floods
Sensitivity to changes in low flows	**1** – Non-perennial with low sensitivity to low flow	**2** – Moderately sensitive to changes in low flow	**1** – Predominantly fed by sub-surface flows with low sensitivity to changes in low flows (no open water habitats)
Sensitivity to changes in water quality	**2** – Relatively large and non-perennial and moderately tolerant of water quality changes	**1** – Low sensitivity to changes in water quality (no open water habitats)	**1** – Low sensitivity to changes in water quality (no open water habitats)
Average	**2.0 (High)**	**1.7 (Moderate)**	**1.0 (Low)**
Overall Ecological Importance and Sensitivity			
	2.0 (High)	**1.7 (Moderate)**	**1.7 (Moderate)**

Table 7-10: Hydro-functional importance criteria results for the wetland

Hydro-functional Importance			**Channelled Valley-Bottom**	**Unchannelled Valley-Bottom**	**Seep**
Regulating & supporting benefits	Flood attenuation		**2** - Moderate potential to attenuate floods	**3** - Good potential to attenuate floods	**2** - Moderate potential to attenuate floods
Regulating & supporting benefits	Streamflow regulation		**2** - Non-perennial system	**1** - Non-perennial system	**1** - Moderate potential to attenuate floods
Regulating & supporting benefits	Water quality enhancement	Sediment trapping	**2** – Reduced surface roughness provides moderate retention of sediments.	**3** – Good surface roughness provides good retention of sediments.	**3** – Good surface roughness provides good retention of sediments.
Regulating & supporting benefits	Water quality enhancement	Phosphate assimilation	**2** - Reduced surface roughness provides moderate assimilation of phosphates	**3** – Good surface roughness provides enhanced assimilation of phosphates.	**3** – Good surface roughness provides enhanced assimilation of phosphates.
Regulating & supporting benefits	Water quality enhancement	Nitrate assimilation	**2** - Reduced surface roughness provides moderate retention of nitrates	**3** – Good surface roughness provides enhanced assimilation of nitrates.	**3** – Good surface roughness provides enhanced assimilation of nitrates.
Regulating & supporting benefits	Water quality enhancement	Toxicant assimilation	**2** - Reduced surface roughness provides moderate retention of toxicants	**3** – Good surface roughness provides enhanced assimilation of toxicants.	**3** – Good surface roughness provides enhanced assimilation of toxicants.
Regulating & supporting benefits	Water quality enhancement	Erosion control	**1** - Extended retention time reduces erosive power of flow	**3** – Good surface roughness provides enhanced assimilation of toxicants.	**3** – Good surface roughness provides enhanced assimilation of toxicants.
Regulating & supporting benefits	Carbon storage		**1** - Minor trapping of soil organic matter	**2** - Moderate trapping of soil organic matter	**2** - Moderate trapping of soil organic matter
HYDRO-FUNCTIONAL IMPORTANCE			**1.6 (Moderate)**	**2.6 (High)**	**2.6 (High)**

Table 7-11: Direct human benefit importance criteria results for the wetland

Direct Human Benefits		Channelled Valley-Bottom	Unchannelled Valley-Bottom	Seep
Subsistence benefits	Water for human use	**2** – Source of water for agriculture and livestock	**0** - None	**0** - None
	Harvestable resources / cultivated foods	**1** - Few resources of value	**1** - Few resources of value	**1** - Few resources of value
Cultural benefits	Cultural heritage	**1** - Very limited, if any	**1** - Very limited, if any	**1** - Very limited, if any
	Tourism and recreation	**1** - Limited recreational value	**1** - Limited recreational value	**1** - Limited recreational value
	Education and research	**1 –** Limited research value	**1 –** Limited research value	**1 –** Limited research value
DIRECT HUMAN BENEFITS		**1.2 (Moderate)**	**0.8 (Low)**	**0.8 (Low)**

7.6.6 Sensitivity Analysis and No-go Areas

Wetlands and their associated buffers are sensitive and must be designated as No-Go areas. With respect to buffers, GN 704 stipulates the following:

- The perimeter of the opencast pits should be located outside of the 1:50 year flood line or further than a horizontal distance of 100 m from a watercourse, whichever is the greatest.
- According to GN704, no residue deposit, dam, reservoir together with any associated structure or any other facility should be located within the 1:100 year flood line or within a horizontal distance of 100 m from any watercourse, whichever is the greatest.

The opencast pits and infrastructure of the mine take place outside of the 1:50 and 1:100 year floodlines. While GN704 stipulates a minimum buffer width of 100m, experience has shown that the Department of Water and Sanitation requires that the buffer width be scientifically determined. In this respect, the buffer tool developed by Macfarlane and Bredin (2017), determined a buffer of 60 m to be sufficient for the protection of wetlands from surface water impacts originating from the mine (Figure 16). This buffer assumes the full implementation of mitigation measures as described in Section 9 and takes the PES and EIS of wetlands into account, as well as the physical characteristics of the buffer (e.g. slope and soil and vegetation characteristics). Based on the delineation of the wetlands on site and their buffers, the layout of the pits (particularly the southern pit) must be reconfigured to avoid intruding into these areas. Furthermore, it is important to stress that the buffer determined in this report does not take sub-surface and groundwater impacts into account. The geohydrological and hydropedological reports should therefore be consulted with the aim of determining a buffer that that takes all hydrological pathways into account. This could result in a buffer that is substantially wider than the 60m proposed in this report.

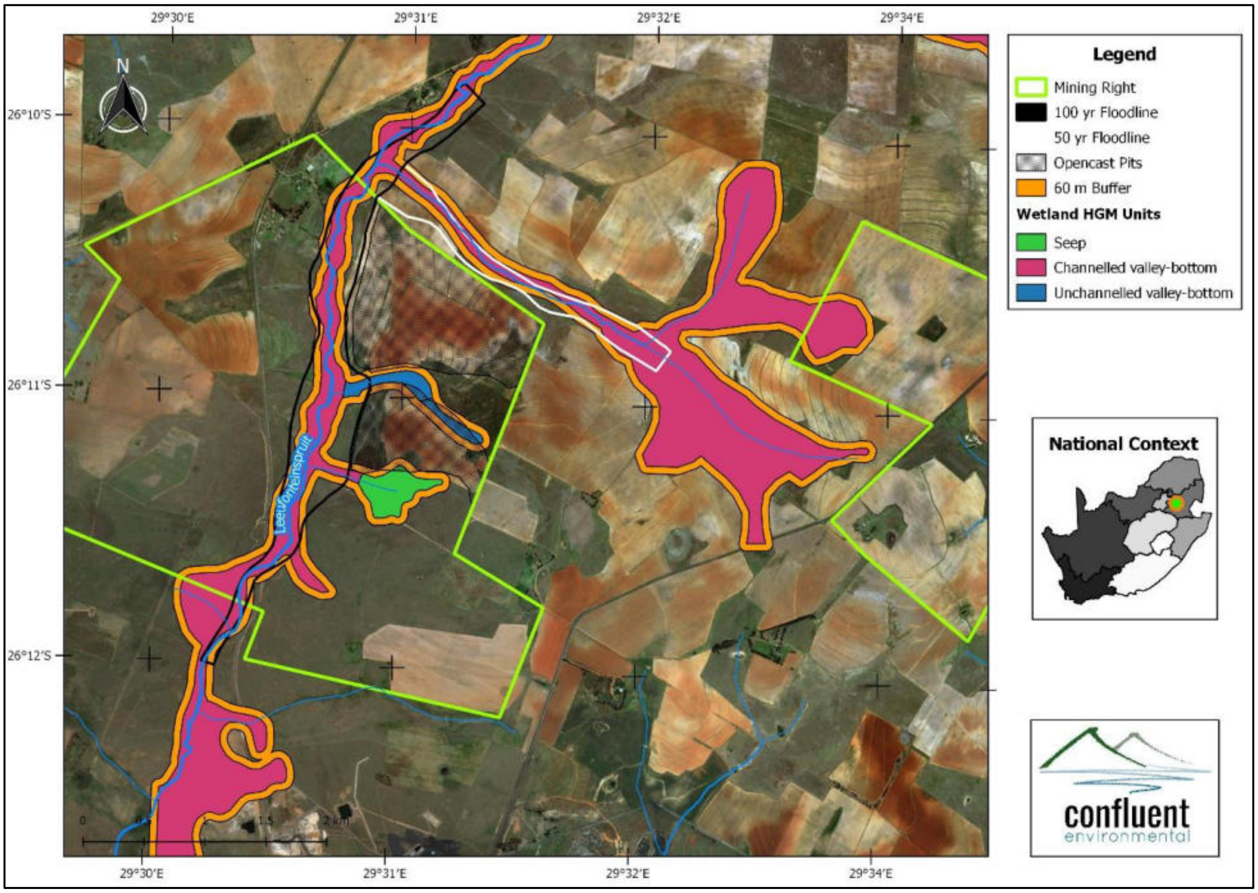


Figure 7-28: Sensitivity map indicating buffers and floodlines for all wetlands potentially affected by the proposed Dunbar Coal Mine.

7.7 GROUNDWATER

The Groundwater assessment undertaken during the EIA Phase is attached as Appendix F2.

7.7.1 Geochemical Assessment

The geochemical samples taken at the Site were representative of overburden material (samples 'DRB Carb Shl' and 'DC-OVB'), as well as the 4 seam coal resource at the Site (sample 'INDB08/4L/2') and were subjected to numerous tests.

7.7.1.1 Mineralogical Composition (XRD)

The mineralogical compositions of the samples were determined using XRD, with the following observations made:

- Organic carbon (%C) was highest in the coal sample (INDB08/4L/2) (45.49 weight %), followed by carbonaceous shale (5.59 weight %). No organic carbon was present in the overburden sample;
- Pyrite was present in small amounts in the coal sample, with no pyrite noted in the carbonaceous shale or overburden samples;
- Quartz content increased from the coal sample to carbonaceous shale with the overburden sample showing the highest quartz value; and
- Dolomite was present in the coal sample, with calcite values in the overburden and coal samples being similar.

Table 7-12: Mineralogical Composition (XRD).

DC-OVB		DBR Carb Shl		INDB08/4L/2	
Mineral	Amount (weight %)	Mineral	Amount (weight %)	Mineral	Amount (weight %)
Quartz	76.25	Kaolinite	59.49	Organic C	45.49
Plagioclase	12.73	Quartz	29.78	Kaolinite	35.25
Sepiolite	4.17	Organic C	5.59	Quartz	12.81
Orthoclase	3.01	Muscovite	3.53	Dolomite	4.33
Muscovite	1.94	Dolomite	0.96	Calcite	1.3
Calcite	1.9	Rutile	0.64	Rutile	0.43
		Calcite	0	Pyrite	0.39
		Pyrite	0	Muscovite	0

7.7.1.2 Net-Acid Generation (NAG) Testing

The net acid generating test provides a direct assessment of the potential of a material to produce acid after a period of exposure to weathering and a strong oxidant and is completed by using hydrogen peroxide to oxidise sulphide minerals present in a sample. NAG testing is often used to refine the ABA test results for a site.

The screening method of Miller *et al*. (1997) is used to determine the acid generation potential of a sample.

Table 7-13: NAG Test Screening Method (after Miller et al., 1997).

Rock Type	NAG pH	NAG Value (H_2SO_4 kg/t)	NNP ($CaCO_3$ kg/t)
Rock Type Ia. High Capacity Acid Forming.	< 4	> 10	Negative
Rock Type Ib. Lower Capacity Acid Forming.	< 4	≤ 10	-
Uncertain, possibly Ib.	< 4	> 10	Positive
Uncertain	≥ 4	0	Negative (Reassess mineralogy) *
Rock Type IV. Non-acid Forming.	≥ 4	0	Positive

*If non- or low acid forming sulphides are dominant the Rock Type IV

Based on the Miller et al. (1997) screening criteria, all of the samples collected at the Site were rock type IV (non-acid forming), as shown below:

Table 7-14: NAG Test Results.

Sample ID	NAG pH	NAG	NNP	Rock Type
DC-OVB	8.2	<0.01	7.98	Rock Type IV
DBR Carb Shl	6.5	0.2	1.8	Rock Type IV
INDB08/4L/2	7.0	<0.01	1.19	Rock Type IV

7.7.1.3 Acid-Base Accounting (ABA)

Acid-base accounting (ABA) is where the net potential of a rock to produce acidic drainage is assessed using a static test. ABA provides a first-order assessment of the potential drainage characteristics that could be expected from rock material (GCS, 2012). The component of ABA are as follows:

- **Acid Potential (AP)** is the theoretical amount of calcite that could be neutralized by the acid produced and is determined by multiplying the %S by 3.125. The units for AP are kg CaCO3/t rock; and
- **Neutralization Potential (NP)** is the theoretical amount of calcite available to neutralize acidic drainage and is determined by treating the sample with a known excess of standardized sulphuric or hydrochloric acid to form a paste. The paste is then back-titrated with standardized sodium hydroxide to determine the amount of unconsumed acid. NP is expressed as kg CaCO3/t rock.

The carbonaceous shale and coal samples both showed potential for acid generation (Rock Type II), while the overburden sample showed no acid generation potential (Rock Type IV). The ABA test results are summarised in Table 7-15, with Figure 7-29 showing the sample NPR compared to paste pH and Figure 7-30 showing sample NPR versus Total %S.

Table 7-15: ABA Test Results.

Sample ID	Paste pH	Total Sulphur (%) (LECO)	Acid Potential (AP) (kg/t)	Neutralization Potential (NP)	Nett Neutralization Potential (NNP)	Neutralising Potential Ratio (NPR) (NP : AP)	Rock Type
DBR Carb Shl	7.4	0.09	2.66	4.8	2.14	1.8	Rock Type II
INDB08/4L/2	7.6	1.25	39	46	7.54	1.19	Rock Type II
DC-OVB	8.4	0.06	1.9	15	13	7.98	Rock Type IV

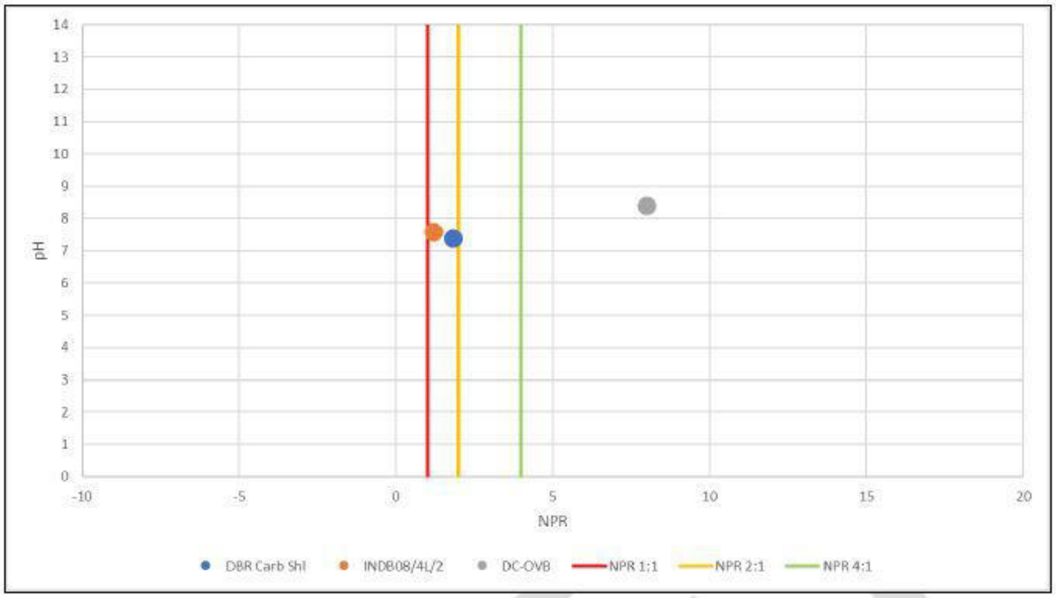


Figure 7-29: Sample NPR versus Paste pH.

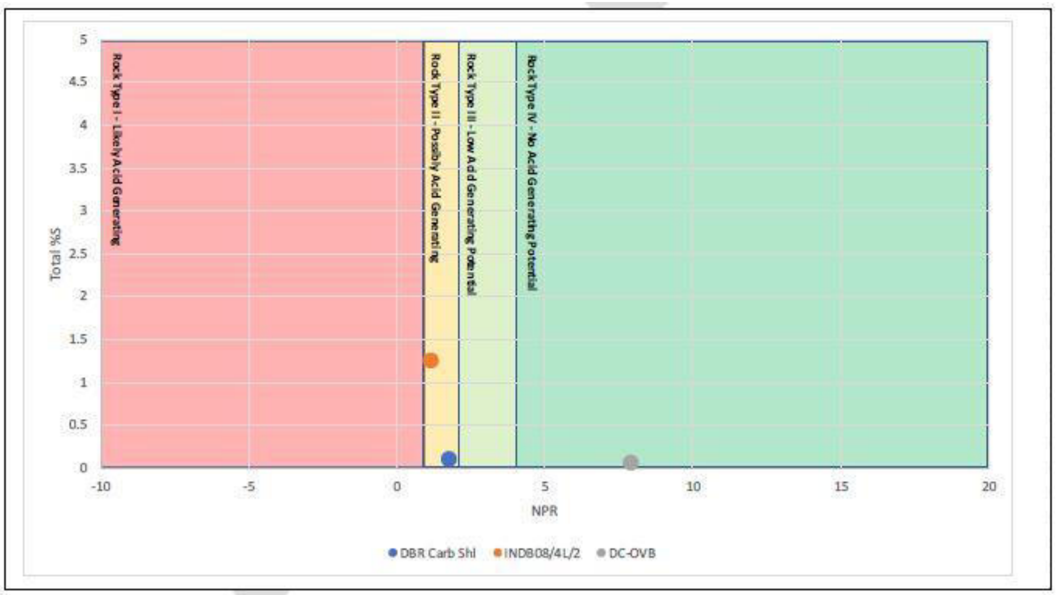


Figure 7-30: Sample NPR versus Total %S.

7.7.1.4 Sulphur Speciation

Sulphur speciation of the samples showed the coal sample to have the highest percentage of sulphur as S and sulphide sulphur, with the overburden sample showing sulphur as S to be dominant while the carbonaceous shale sample showed sulphide sulphur as dominant. The sulphur speciation results are shown below.

Table 7-16: Sulphur Speciation Results.

Sample ID	Total Sulphur (%) (ELTRA)	Sulphate Sulphur as S (%)	Sulphide Sulphur (%)
DBR Carb Shl	0.09	0.05	0.03
INDB08/4L/2	1.25	0.43	0.81
DC-OVB	0.06	0.01	0.05

7.7.1.5 Distilled Water Extraction

Each of the samples underwent distilled water extraction testing, where 1'000 ml of distilled water was added to 50 grams of sample material and the inorganic ions and selected metals present in the leachate product measured.

Table 7-17: Distilled Water Extraction Results: Inorganic Ions.

Analyses	DBR Carb Shl		INDB08/4L/2		DC-OVB	
TCLP / Acid Rain / Distilled Water / H_2O_2	Distilled Water		Distilled Water		Distilled Water	
Dry Mass Used (g)	50		50		50	
Volume Used (mℓ)	1000		1000		1000	
pH Value at 25˚C	6.8		6.9		6.6	
Inorganic Anions	mg/ℓ	mg/kg	mg/ℓ	mg/kg	mg/ℓ	mg/kg
Total Dissolved Solids at 180 ˚C	50	1000	54	1080	56	1120
Chloride as Cl	<2	<40	<2	<40	<2	<40
Sulphate as SO4	<2	<40	6	120	2	40
Nitrate as N	<0.1	<2.0	<0.1	<2.0	<0.1	<2.0
Fluoride as F	<0.2	<4.0	<0.2	<4.0	<0.2	<4.0
Hexavalent Chromium as Cr6+	<0.010	<0.200	<0.010	<0.200	<0.010	<0.200

Sulphate in the coal and carbonaceous samples were 6 mg/l (120 mg/kg) and 2 mg/l (40 mg/kg), respectively, with no sulphate generated in the overburden sample. None of the samples showed chlorine, fluoride or nitrate concentrations above the detection limit.

Table 7-18: Distilled Water Extraction Results: Selected Metals.

Sample Id	Unit	DBR Carb Shl	INDB08/4L/2	DC-OVB
Silver as Ag	mg/l	BDL	BDL	BDL
Aluminium as Al	mg/l	0.435	0.145	0.307
Arsenic as As	mg/l	BDL	BDL	0.004
Boron as B	mg/l	BDL	BDL	BDL
Barium as Ba	mg/l	0.138	0.056	0.036
Beryllium as Be	mg/l	BDL	BDL	BDL
Bismuth as Bi	mg/l	BDL	BDL	BDL
Calcium as Ca	mg/l	4	6	3
Cadmium as Cd	mg/l	BDL	BDL	BDL
Cobalt as Co	mg/l	BDL	BDL	BDL
Chrome as Cr	mg/l	BDL	BDL	BDL
Copper as Cu	mg/l	BDL	BDL	BDL
Iron as Fe	mg/l	0.041	BDL	0.108
Mercury as Hg	mg/l	BDL	0.030	BDL
Potassium as K	mg/l	1.0	0.8	1.7
Lithium as Li	mg/l	BDL	BDL	BDL
Magnesium as Mg	mg/l	2	3	2
Manganese as Mn	mg/l	BDL	BDL	0.102
Molybdenum as Mo	mg/l	BDL	BDL	BDL
Sodium as Na	mg/l	1	BDL	1
Nickel as Ni	mg/l	BDL	BDL	BDL
Phosphorous as P	mg/l	BDL	BDL	BDL
Lead as Pb	mg/l	0.004	BDL	BDL
Antimony as Sb	mg/l	BDL	BDL	BDL
Selenium as Se	mg/l	BDL	BDL	BDL
Silica as Si	mg/l	1.3	0.6	1.5
Strontium as Sr	mg/l	0.334	0.376	0.161
Titanium as Ti	mg/l	BDL	BDL	BDL
Tellurium as Te	mg/l	BDL	BDL	BDL
Vanadium as V	mg/l	BDL	BDL	BDL
Zinc as Z	mg/l	0.323	BDL	BDL

7.7.1.6 Acid Digestion Results

Acid digestion was done using 100 ml HNO3:HF acid solution added to 0.25 grams of sample material, with the total fluoride and hexavalent chromium (Table 5.9) and selected metals (Table 5.10) in the resultant leachate reported.

7.8 TERRESTRIAL ECOLOGY

The Terrestrial Ecology Assessment undertaken during the EIA Phase is attached as Appendix F3.

7.8.1 Regional Vegetation

The Eastern Highveld Grassland (Gm12) occurs on plains in the Mpumalanga and Gauteng Provinces (Figure 7-31). This vegetation type extends from Johannesburg in the west to Belfast in the east and Bethal and Ermelo in the south. This vegetation type is classified as Endangered (EN) with a conservation target of 24%, while only a small fraction conserved on statutory (Nooitgedacht Dam Nature Reserve and Jericho Dam Nature Reserves) and private reserves (Holkranse, Kransbank and Morgenstond). In 2010, approximately 44% of this vegetation type was classified as transformed primarily by cultivation (most extensive impact), plantations, mining, urbanisation and by building of dams (Mucina & Rutherford, 2010).

The landscape features consist of slightly to moderately undulating plains with some low hills and pan depressions. The vegetation is short dense grassland dominated by the usual highveld grass composition, including species from the genera *Aristida, Digitaria, Eragrostis, Themeda* and *Tristachya*, with small, scattered rocky outcrops of wiry, sour grasses and some woody species such as *Senegalia caffra, Celtis africana, Diospyros lycioides* subsp *lycioides, Parinari capensis, Protea caffra, P. welwitschii* and *Englerophytum magalismontanum* (Mucina & Rutherford, 2010).

Table 7-19: Attributes of the Eastern Highveld Grassland regional vegetation unit

Name of vegetation type	Eastern Highveld Grassland
Code as used in the Book (Mucina & Rutherford, 2010)	Gm12
Conservation Target (percent of area) from NSBA[12]	24%
Protected (percent of area) from NSBA	0.3%
Remaining (percent of area) from NSBA	56%
Description of conservation status from NSBA	Endangered
Description of the Protection Status from NSBA	Hardly protected
Area (km^2) of the full extent of the Vegetation Type	12669.037
Name of the Biome	Grassland Biome

Table 7-20: Characteristic Plant Species of the Eastern Highveld Grassland.

Plant form	Species
Graminoids (grasses and sedges)	*Aristida aequiglumis, A. congesta, Brachiaria serrata, Cynodon dactylon, Digitaria monodactyla, Elionurus muticus, Eragrostis chloromelas, E. curvula, E. plana, E. racemosa, Heteropogon contortus, Sporobolus africanus, Loudetia simplex, Microchloa caffra, Setaria sphacelata, Sporobolus africanus, Themeda triandra, Trachypogon spicatus and Tristachya leucothrix.*
Herbs	*Berkheya setifera, Haplocarpha scaposa, Justicia anagalloides, Pelargonium luridum, Acalypha angustata, Dicoma anomala, Euryops gilfillanii, Helichrysum aureonitens, H. caespititium, H. callicomum, H. oreophilum, H. rugulosum, Ipomoea crassipes, Pentanisia prunelloides, Selago densiflora, Senecio coronatus, Vernonia oligocephala, Wahlenbergia undulata.*
Geophytic bulbs	*Gladiolus crassifolius, Haemanthus humilis, Hypoxis rigidula, Ledebouria ovatifolia*.
Succulent herbs	*Aloe ecklonis*.
Low shrubs	*Anthospermum rigidum subs. pumilum, Seriphium plumosum*.

.

[12] National Spatial Biodiversity Assessment

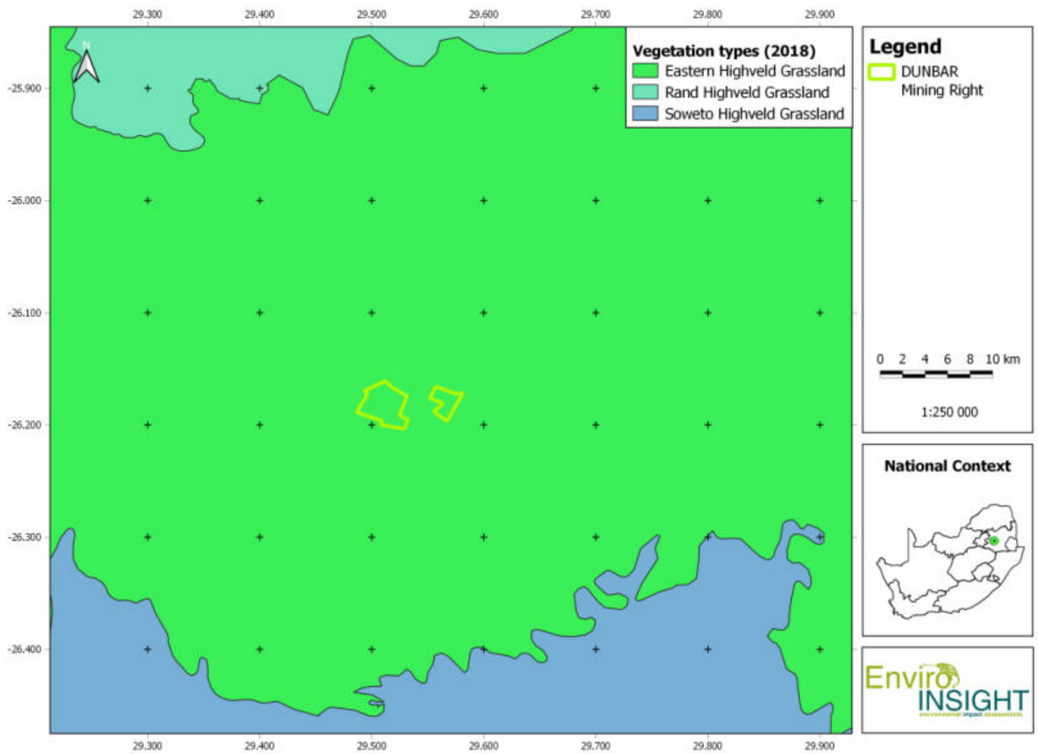


Figure 7-31: The study area with regards to the Regional Vegetation type (Mucina & Rutherford, 2018).

7.8.2 Threatened Ecosystem

The Eastern Highveld Grassland has also been listed as a threatened ecosystem (National Environmental Management: Biodiversity Act: National list of ecosystems that are threatened and in need of protection, G 34809, GoN 1002, 9 December 2011) with a status of Vulnerable (Figure 7-32).

7.8.3 Protected Areas and Important Bird Areas

Amersfoort-Bethel-Carolina Important Bird Area (Figure 7-33). This area is bounded by the main roads between the following towns: Ermelo, Amersfoort, Bethal, Hendrina and Carolina. It consists mostly of flat to undulating farmland between 1,650 and 1,832 m. In a landscape dominated by maize, several remnant patches of moist clay highveld grassland are scattered throughout the district, growing on black vertic clays. The grasslands hold several streams and pans, as well as the Willem-Brummer Dam near Ermelo. Rocky slopes, gullies and ravines favour the development of thicket, dominated by *Leucosidea*, *Buddleja* and *Rhamnus*. In the deeper, fire-protected gullies, secondary forest occasionally develops, with trees of *Euclea*, *Diospyros*, *Myrsine* and *Searsia.*

This site holds a large proportion of the global population of *Spizocorys fringillaris*. The grassland areas also hold *Neotis denhami*, *Eupodotis senegalensis*, *Saxicola bifasciata*, *Monticola explorator* and *Geronticus calvus*. *Falco naumanni*, *Glareola nordmanni* and (less frequently) *Circus macrourus* can be seen quartering the grasslands. Occasionally, all of South Africa's crane species can be found in the grasslands or cropfields within the site.

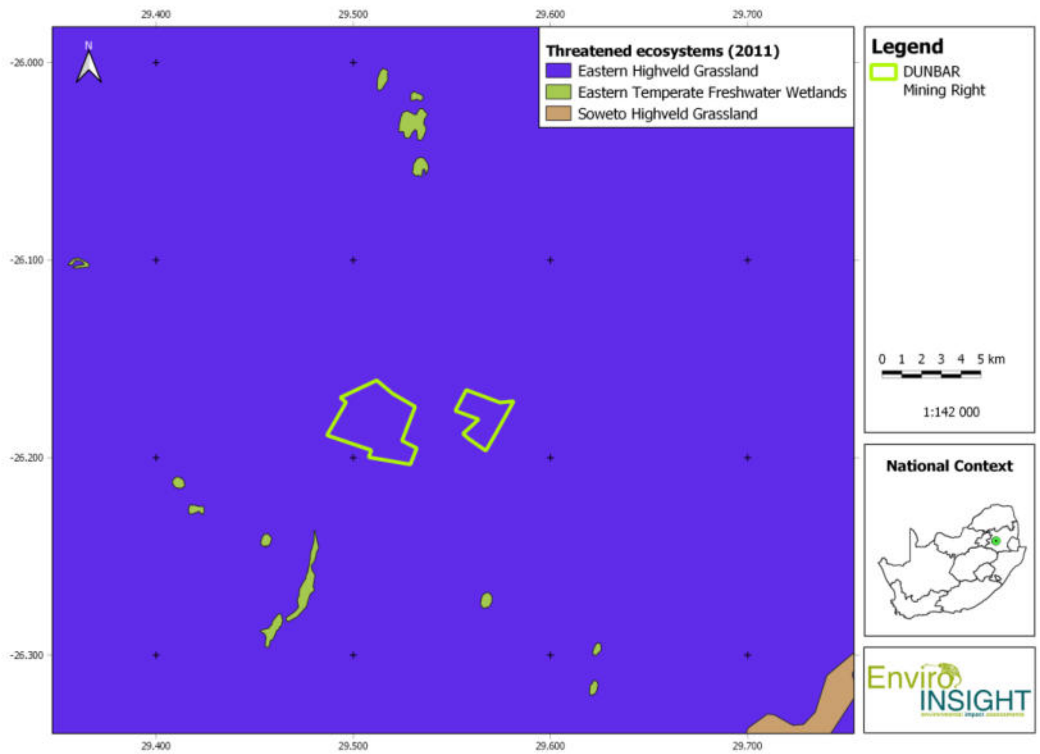


Figure 7-32: The study area in relation to threatened ecosystems.

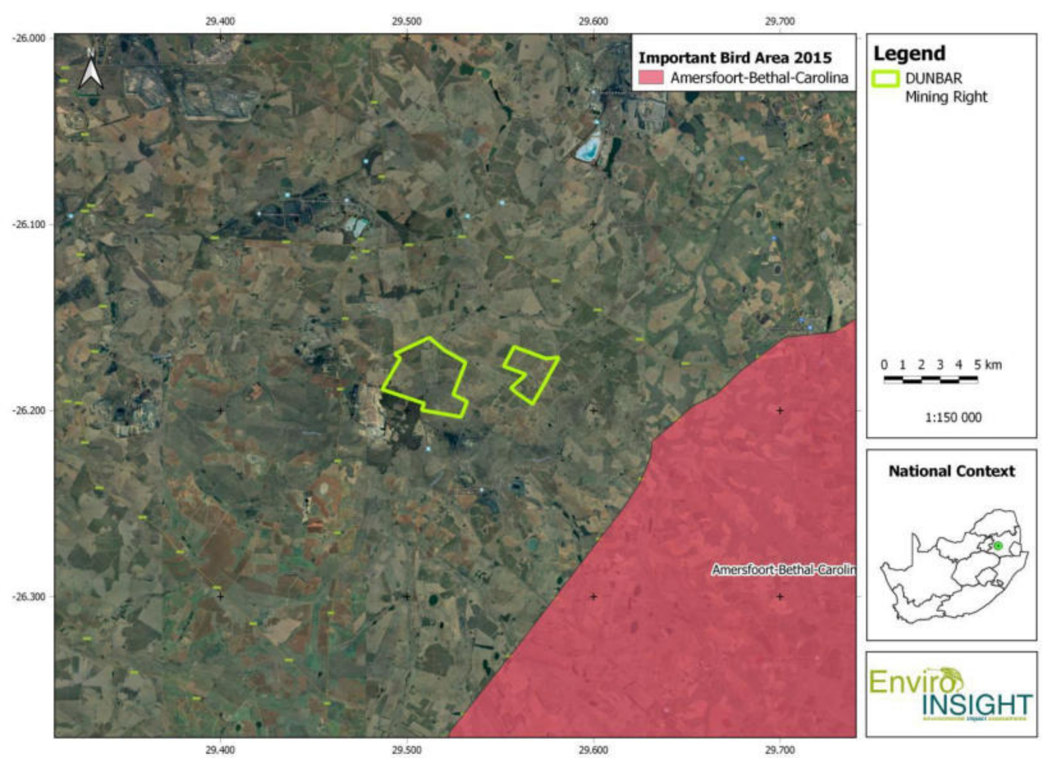


Figure 7-33: The study area in relation to Protected Areas and Important Bird Areas.

7.8.4 Mpumalanga Biodiversity Sector Plan (MBSP)

The Mpumalanga Biodiversity Sector Plan (MBSP) is a spatial tool with land-use guidelines that forms part of a broader set of national biodiversity planning tools and initiatives that are provided for in national legislation and policy. It comprises a set of maps of biodiversity priority areas accompanied by contextual information and land-use guidelines that make the most recent and best quality biodiversity information available for use in land-use and development planning, environmental assessment and regulation, and natural resource management.

Increasingly, people who do not necessarily have a background in biodiversity or conservation are being called upon to exercise decision-making powers in such a way that economic goals can be achieved whilst the health of ecosystems is maintained. People who make decisions about the use of Mpumalanga's natural resources should be aware of spatial biodiversity priorities within the Province. There is also a need for understanding the management requirements of different ecosystems and what land-uses are appropriate in different parts of the landscape. Well informed decision-makers will be in a better position to assess the relative merits and likely impacts of proposed land-use changes on the environment, taking cognisance of spatial biodiversity priorities to locate infrastructural developments and other land-uses wisely.

Recognising this, the Mpumalanga Tourism and Parks Agency (MTPA) and Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA), working with many partners, developed the MBSP as an important tool for addressing these needs. This plan is a key element of our landscape approach to biodiversity conservation, which includes working both within and beyond the boundaries of protected areas to manage a mosaic of land-uses that includes protection, restoration, production and subsistence use in order to deliver ecological, economic and social benefits.

The MBSP will help guide conservation activities (such as identifying priority sites for expansion of protected areas), and will be vital in feeding spatial biodiversity priorities into planning and decision-making in a wide range of cross-sectoral planning processes, such as the development of provincial and municipal integrated development plans and spatial development frameworks, land-use management schemes, environmental management frameworks and environmental management plans.

Mpumalanga Biodiversity Sector Plan (MBSP) terrestrial assessment is based on a systematic biodiversity planning approach to identify spatial priority areas that meet both national and provincial targets in the most efficient way possible, while trying to avoid conflict with other land-uses. It actively tries to build-in landscape resilience to a changing climate. These spatial priorities are used to inform sustainable development within Mpumalanga.

The study area is located in (Figure 7-34):

- Heavily modified
- Moderately modified (old lands)
- Other natural areas

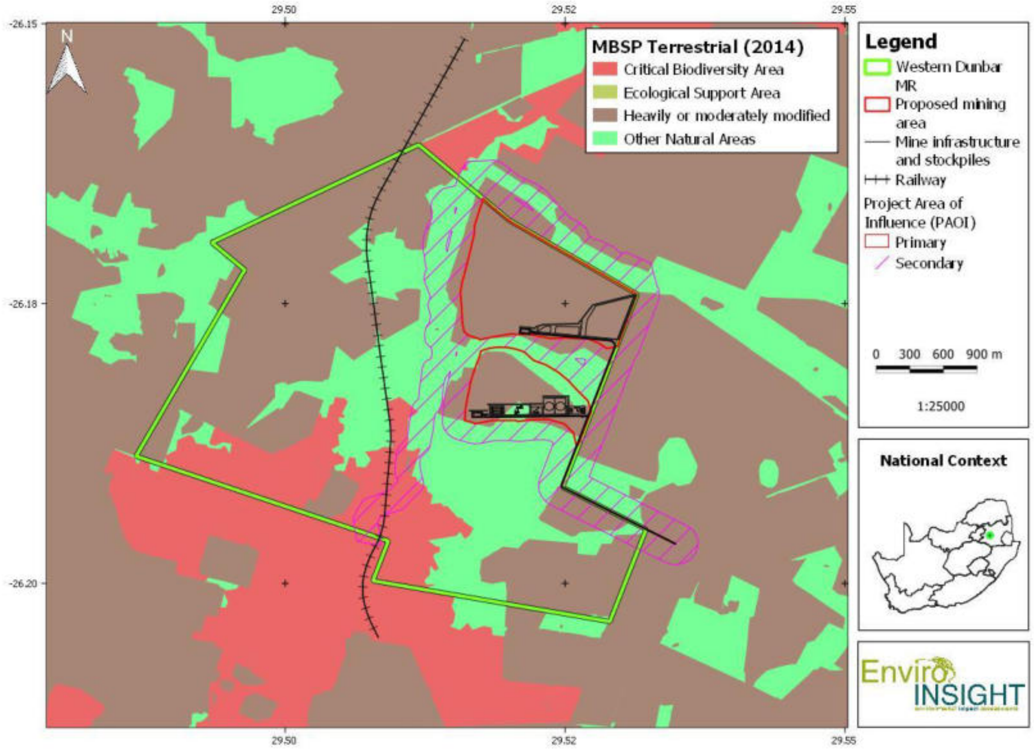


Figure 7-34: The study area in relation to MBSP Terrestrial (MBSP, 2014).

7.8.5 Mining and Biodiversity

In 2012, South African Mining and Biodiversity Forum in partnership with the Department of Environmental Affairs and the Department of Mineral Resources, and with technical input and coordination of South African National Biodiversity Institute (SANBI) produced a guideline to highlight areas of high biodiversity in relation to mining risk for South Africa: Mining and Biodiversity Guideline: Mainstreaming biodiversity into the mining sector (DEA *et al*. 2013; SANBI 2012). This study was very comprehensive at the time of publication but could not benefit from key datasets that were developed thereafter e.g. the updated National landcover (2013/2014) dataset. In addition, the updated North West Biodiversity sector plan was released in 2015. The Mining and Biodiversity Guideline (SANBI 2012) used "biodiversity priority areas" to develop their final dataset and defined these as follows:

- Protected areas;
- World heritage sites and their legally proclaimed buffers;
- Critically endangered and endangered ecosystems;
- Critical biodiversity areas;
- River and wetland freshwater ecosystem priority areas (FEPAs), and 1 km buffer of river and wetland FEPAs;
- RAMSAR sites;
- Protected area buffers;

- Transfrontier Conservation Areas (remaining areas outside of formally proclaimed PAs);
- High water yield areas;
- Coastal protection zone;
- Estuarine functional zones; and
- Ecological support areas.

The Mining and Biodiversity Guideline (SANBI 2012) shows that large sections of the study area is located in category B, C and D (refer to Table 7-21 for a description of each category), which indicate that there is a high to moderate risk from mining activities (Figure 7-35).

Table 7-21: Four categories of biodiversity priority areas in relation to their biodiversity importance and implications for mining.

Category	Biodiversity priority areas	Risk for mining	Implications for mining
A. Legally protected	• Protected areas (including National Parks, Nature Reserves, World Heritage Sites, Protected Environments, Nature Reserves) Areas declared under Section 49 of the Mineral and Petroleum Resources Development Act (No. 28 of 2002)	Mining prohibited	Mining projects cannot commence as mining is legally prohibited. Although mining is prohibited in Protected Areas, it may be allowed in Protected Environments if both the Minister of Mineral Resources and Minister of Environmental Affairs approve it. In cases where mining activities were conducted lawfully in protected areas before Section 48 of the Protected Areas Act (No. 57 of 2003) came into effect, the Minister of Environmental Affairs may, after consulting with the Minister of Mineral Resources, allow such mining activities to continue, subject to prescribed conditions that reduce environmental impacts.
B. Highest biodiversity importance	• Critically endangered and endangered ecosystems • Critical Biodiversity Areas (or equivalent areas) from provincial spatial biodiversity plans • River and wetland Freshwater Ecosystem Priority Areas (FEPAs) and a 1km buffer around these FEPAs • Ramsar Sites	Highest risk for mining	Environmental screening, environmental impact assessment (EIA) and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, and to provide site-specific basis on which to apply the mitigation hierarchy to inform regulatory decision-making for mining, water use licences, and enviromental authorisations. If they are confirmed, the likelihood of a fatal flaw for new mining projects is very high because of the significance of the biodiversity features in these areas and the associated ecosystem services. These areas are viewed as necessary to ensure protection of biodiversity, environmental sustainability, and human well-being. An EIA should include the strategic assessment of optimum, sustainable land use for a particular area and will determine the significance of the impact on biodiversity. This assessment should fully take into account the environmental sensitivity of the area, the overall environmental and socio-economic costs and benefits of mining, as well as the potential strategic importance of the minerals to the country. Authorisations may well not be granted. If granted, the authorisation may set limits on allowed activities and impacts, and may specify biodiversity offsets that would be written into licence agreements and/or authorisations.
C. High biodiversity importance	• Protected area buffers (including buffers around National Parks, World Heritage Sites* and Nature Reserves) • Transfrontier Conservation Areas (remaining areas outside of formally proclaimed protected areas) • Other identified priorities from provincial spatial biodiversity plans • High water yield areas • Coastal Protection Zone • Estuarine functional zone *Note that the status of buffer areas of World Heritage Sites is subject to a current intra-governmental process.	High risk for mining	These areas are important for conserving biodiversity, for supporting or buffering other biodiversity priority areas, and for maintaining important ecosystem services for particular communities or the country as a whole. An EIA should include an assessment of optimum, sustainable land use for a particular area and will determine the significance of the impact on biodiversity. Mining options may be limited in these areas, and limitations for mining projects are possible. Authorisations may set limits and specify biodiversity offsets that would be written into licence agreements and/or authorisations.
D. Moderate biodiversity importance	• Ecological support areas • Vulnerable ecosystems • Focus areas for protected area expansion (land-based and offshore protection)	Moderate risk for mining	These areas are of moderate biodiversity value. EIAs and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, identifying features (e.g. threatened species) not included in the existing datasets, and on providing site-specific information to guide the application of the mitigation hierarchy. Authorisations may set limits and specify biodiversity offsets that would be written into licence agreements and/or authorisations.

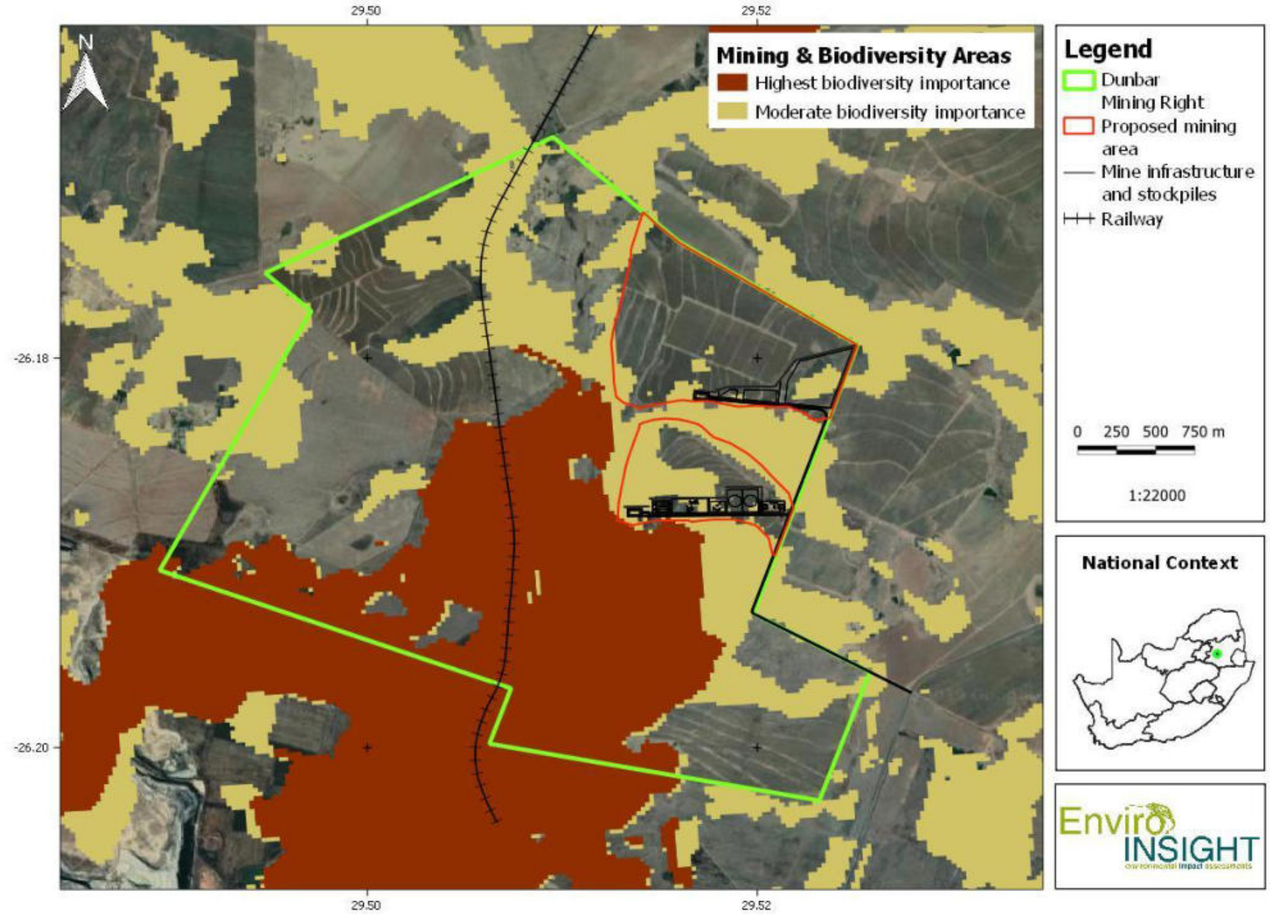


Figure 7-35: The study area in relation to Mining and Biodiversity Areas (SANBI, 2012).

7.8.6 Results

Habitats

Satellite imagery was manually classified into eight distinct and discernible habitat/land use types: Intact Grassland, Disturbed Grassland, Agriculture, Watercourses, Water-bodies, Infrastructure, Alien Trees and Mines which are discussed in detail below. Grassland was categorised by checking for signs of disturbance using historical satellite imagery. From this map it is clear that approximately half of the western portion of the MR application area is utilised for crop agriculture and the other half is grassland. Surface areas for each habitat type in the western portion of the MR application area are presented in Table 7-22. The habitat surrounding pans, wetlands and watercourses is predominantly Intact Grassland.

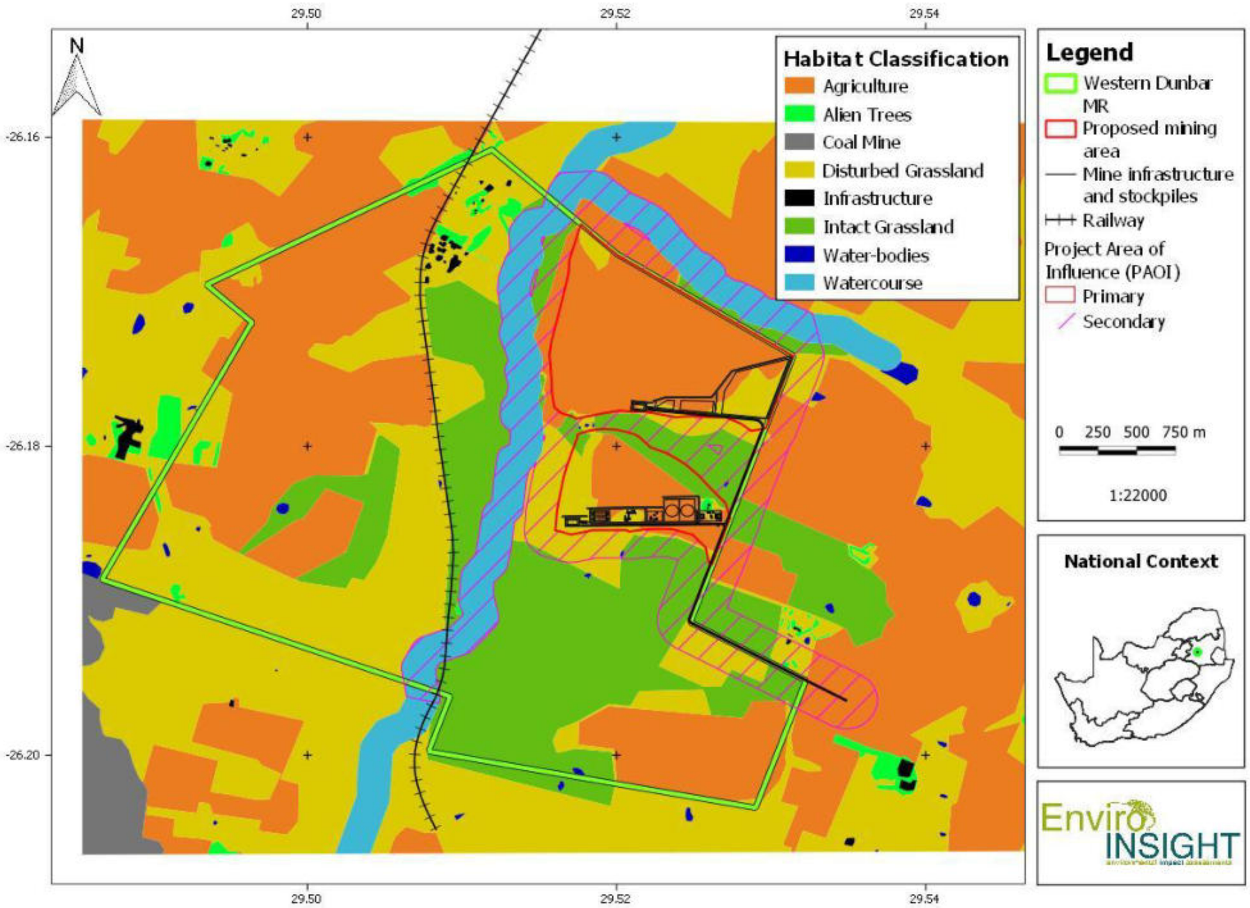


Figure 7-36: Habitats identified within the western portion of the MR application area and PAOI with layout and open cast pits indicated.

Table 7-22: Habitat types and their respective surface areas (ha) for the western portion of the MR application area.

Habitat	Area (ha)
Agriculture	489.02
Alien Trees	12.61
Grassland	783.51
Infrastructure	2.75
Water-bodies	7.83
Watercourses	6.03
Total	**1301.75**

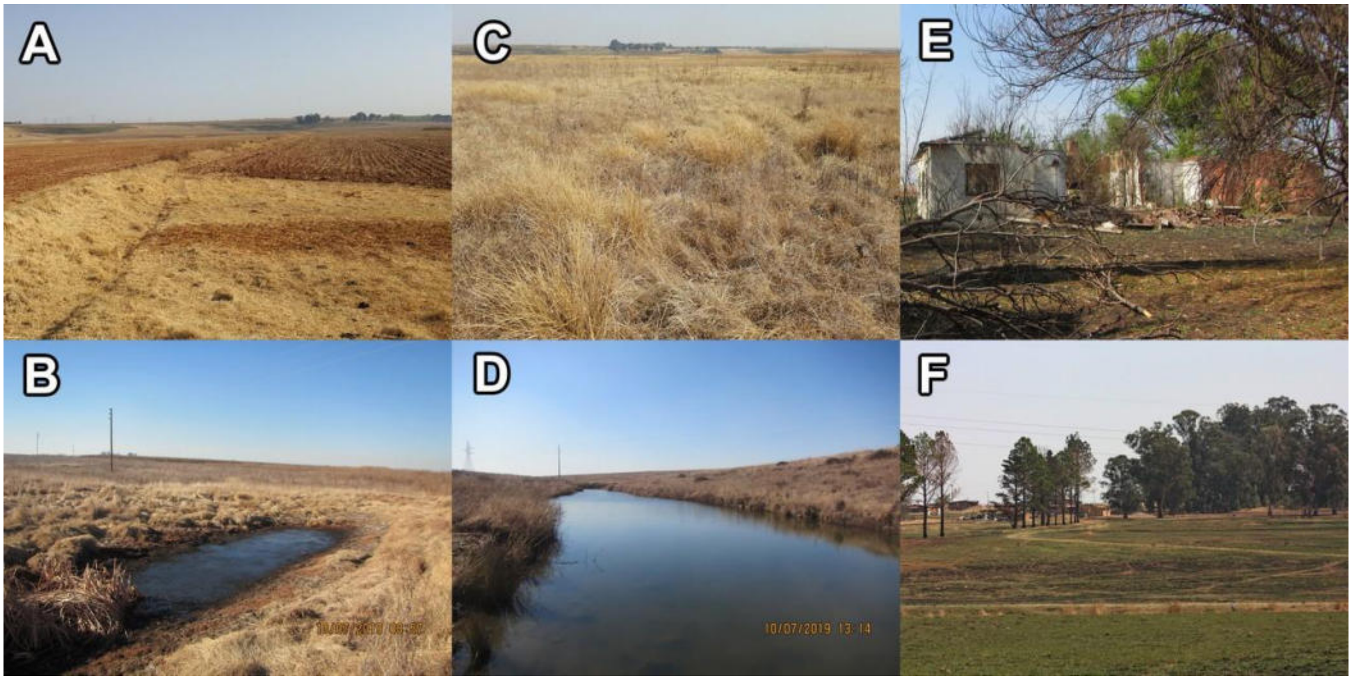


Figure 7-37: Photographs of the main habitat types identified in the PAOI taken prior to and during the dry season survey[13].

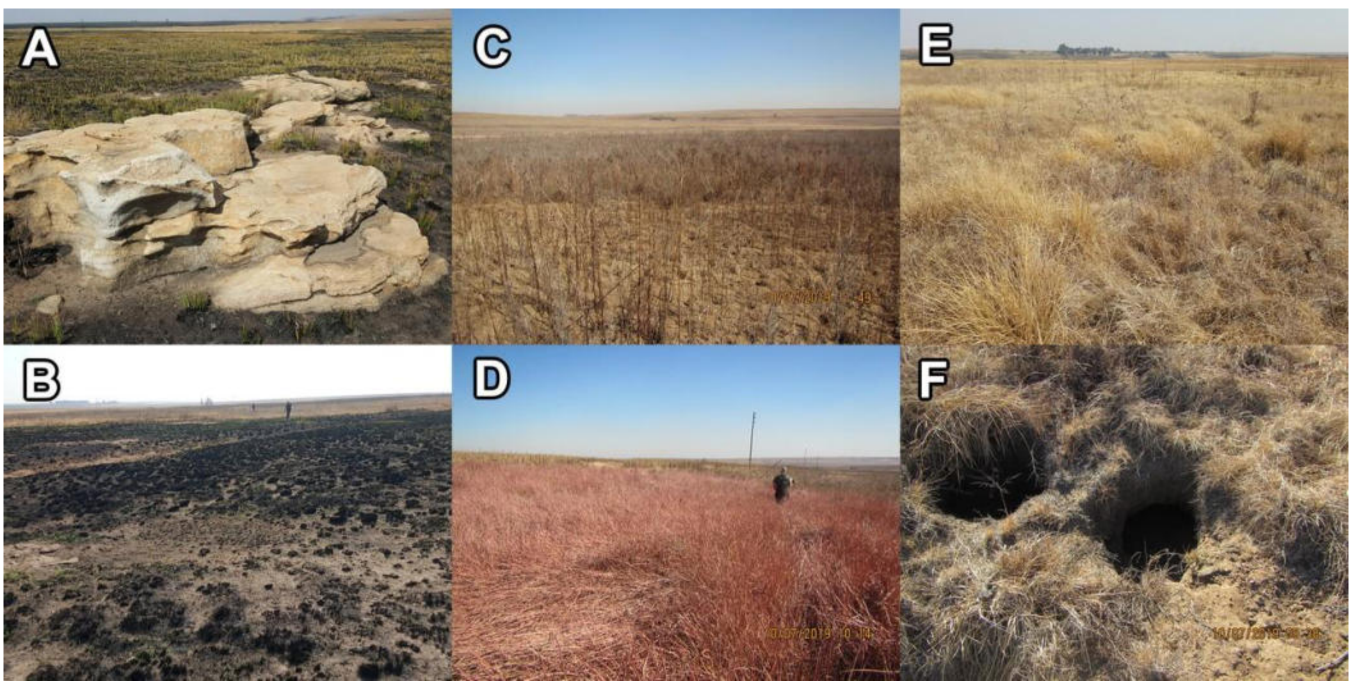


Figure 7-38: Habitat features of Grassland[14].

[13] A: Agriculture (Maize); B: Water-bodies; C: Disturbed Grassland; D: Watercourses; E: Infrastructure; F: Alien Trees

[14] A: Rocky outcrops; B: Burnt grassland; C: Overgrown area of *Bidens pilosa*; D: *Imperata cylindrica* patches; E: Typical grassy matrix; F: Abundance of rodent burrows

7.8.6.1 Intact Grassland

7.8.6.1.1 Flora specific analysis

Intact Grassland patches were found in-between Agriculture and Disturbed Grassland, and patches are located between the two mining pits and adjacent to the haul road. It is defined by having an intact grass assemblage and low intensity impacts, such as grazing and alien vegetation, and shows no evidence using satellite imagery of ploughing in the last 10 years.

A comprehensive list of flora species could not be compiled due to a combination of burnt grassland and dry season conditions. Sufficient rain had not fallen yet and grass identification is optimal in January-February. Nonetheless, despite these limitations and the current impacts, there was a moderate diversity of graminoids (grasses and sedges) and some forbs, particularly members of the Asteraceae family. Conspicuous grasses such as *Eragrostis* species dominated the area including species from the genera *Aristida*, *Hyparrhenia*, and the identifiable species *Cynodon dactylon, Schoenoplectus corymbosus* and *Themeda triandra.*

7.8.6.1.2 Avifauna specific analysis

The Grassland Habitats have been almost completely burnt through late dry season controlled fires which belies the fact that these habitats are excellent examples of complex grassland systems that exhibit sound forage and habitat potential. It is predicted that the potential small mammal density (and possibly diversity) will be very high providing excellent forage potential for carnivorous bird species (raptors and owls) while the good grass cover provides refugia for ground dwelling birds such as francolins and quails. Finally, large bodied species such as Blue Korhaan (*Eupodotis caerulescens*), Black Stork (*Ciconia* nigra), Southern Bald Ibis (*Geronticus calvus*) and Secretary Bird (*Sagittarius serpentarius*) are expected to occur/ forage within the habitat. Blue Korhaan were observed on-route to the PAOI (3 km).

7.8.6.1.3 Mammal specific analysis

These habitats provide excellent refugia and forage for small mammal species, which in turn form an important part of the basis for the trophic food chain. These areas comprise a large percentage of the overall habitat in the western portion of the MR application area and are extremely important breeding and foraging sites for mammal species. Threatened species such as serval, as well as other meso-predators are strongly represented within these areas. Recorded and predicted mammals within the grassland habitat include: Serval, brown hyaena, leopard, honey badger, black-backed jackal, aardwolf, striped polecat, caracal, yellow mongoose, slender mongoose, African wild cat, Cape fox, Common duiker, bushpig, warthog, Common mole-rat, Highveld golden mole, forest shrew, musk shrews, dwarf shrews, multiple rodent species, scrub hare, striped weasel, porcupine and South African hedgehog.

7.8.6.1.4 Herpetofauna specific analysis

These habitats generally have low densities of herpetofauna but provide excellent refugia and forage potential for snake species that prey on rodents, such as mole snakes. The rocky outcrops were sparsely distributed and barely protruded from the ground. No rupicolous[15] specialists were observed on the rocks, probably due to the lack of crevices and cracks for these species to utilise as refugia or breeding habitat. This habitat is not as important for herpetofauna as the aquatic habitats

[15] Rock-living

(watercourse and wetland pan habitats) but nevertheless represents a habitat of moderate overall sensitivity, especially when considering the limited patches of good quality grassland remaining in the region and their fragmented nature.

7.8.6.2 Disturbed Grassland

7.8.6.2.1 Flora specific analysis

Disturbed Grassland patches occur in a mosaic of agricultural fields throughout the western portion of the MR application area, and are intersected by the proposed development footprint. Previous agriculture activities such as ploughing, the invasion of alien plants and grazing by cattle has resulted in a disturbed grassland habitat.

A comprehensive list of flora species could not be compiled due to dry season conditions. Sufficient rain had not fallen yet and grass identification is optimal in January-February. Nonetheless, despite these limitations and the current impacts, areas that were left intact showed a moderate diversity of graminoids (grasses and sedges) and some forbs, particularly members of the Asteraceae family. Conspicuous grasses such as *Eragrostis* species were present in the area including species from the genera *Aristida*, *Hyparrhenia*, and *Themeda triandra.* Owing to disturbances and exposed bare areas within the habitat, an abundance of forbs, including alien species, were observed such as *Bidens pilosa*, *Datura ferox*, *Helichrysum* spp., *Tagetes minuta*, *Verbena aristigera* and *Verbena brasiliensis*.

7.8.6.2.2 Avifauna specific analysis

The Disturbed Grassland is predicted to have very high potential small mammal density, providing excellent forage potential for carnivorous bird species (raptors and owls) while the sparse grass cover provides some refugia for ground dwelling birds such as francolins and quails. Finally, large bodied species such as Blue Korhaan (*Eupodotis caerulescens*), Black Stork (*Ciconia* nigra), Southern Bald Ibis (*Geronticus calvus*) and Secretary Bird (*Sagittarius serpentarius*) are expected to forage within the habitat. Blue Korhaan were observed on-route to the PAOI (3 km).

7.8.6.2.3 Mammal specific analysis

These habitats provide excellent refugia and forage for small mammal species, which in turn form an important part of the basis for the trophic food chain. These areas comprise a large percentage of the overall habitat in the western portion of the MR application area and are extremely important breeding and foraging sites for mammal species. Threatened species such as serval, as well as other meso-predators are strongly represented within these areas. Recorded and predicted mammals within the grassland habitat include: Serval, brown hyaena, leopard, honey badger, black-backed jackal, aardwolf, striped polecat, caracal, yellow mongoose, slender mongoose, African wild cat, Cape fox, Common duiker, bushpig, warthog, Common mole-rat, Highveld golden mole, forest shrew, musk shrews, dwarf shrews, multiple rodent species, scrub hare, striped weasel, porcupine and South African hedgehog.

7.8.6.2.4 Herpetofauna specific analysis

These habitats generally have low densities of herpetofauna but provide excellent refugia and forage potential for snake species that prey on rodents, such as mole snakes. Indeed, the density of rodent burrows was remarkably high and two snakes were observed within a short space of time in this habitat (*Hemachatus haemachatus* and *Psammophylax* *rhombeatus*). The rocky outcrops were sparsely distributed and barely protruded from the ground. This habitat is not as important for herpetofauna as the aquatic habitats (watercourse and wetland pan habitats) but nevertheless represents a habitat of moderate overall sensitivity, especially when considering the limited patches of good quality grassland remaining in the region and their fragmented nature.

7.8.6.3 Watercourses

7.8.6.3.1 Flora specific analysis

The Watercourse consists of the non-perennial river Leeufonteinspruit which bisects the western block of the mining right application. Typical aquatic plants such as *Typha capensis* and *Cyperus* spp. are located in the watercourse, while the embankments are dominated by a grassland layer comprising species such as *and Cynodon dactylon, Imperata cylindrica* and *Themeda triandra* with the predominant alien *Datura ferox.* It should be noted that a comprehensive list of species could not be provided as the survey took place in the dry season when flowering conditions were not optimal.

7.8.6.3.2 Avifauna specific analysis

Depending on their surface area and available forage, the watercourse habitats often provide corridors and foraging habitat for wader and waterfowl species belonging to the Anatidae (ducks & geese), Podicipedidae (grebes), Ardeidae (herons), Phalacrocoracidae (cormorants), Threskiornithidae (ibises & spoonbills), Anhingidae (Darters) and lastly Palaearctic migrant waders (Scolopacidae). Red-chested Flufftail (*Sarothrura rufa*), the Near Threatened Half Collard Kingfisher (*Alcedo semitorquata)* and the Endangered Marsh Harrier (*Circus ranivorus*) are expected within this habitat type. The Watercourse habitat type includes the actual waterway as well as associated (reeds or moist grasslands) riparian vegetation. The associated vegetation is very diverse and structurally complex providing excellent forage and refugia habitat for a large diversity and density of avifaunal species, including nesting habitat for Passerines and piscivorous species such as kingfishers and darters.

7.8.6.3.3 Mammal specific analysis

Although the actual waterway habitats are very specific (excluding all species other than aquatic or semi-aquatic species), the associated riparian vegetation is very diverse and complex providing excellent forage and refugia habitat for mammal species. Recorded and predicted mammals for the watercourse habitat include: spotted-neck otter (transient), African clawless otter, serval, black-backed jackal, slender mongoose, porcupine, African wild cat, common duiker, bushpig, warthog, Highveld golden mole, forest shrew, musk shrews, dwarf shrews, water rat and multiple rodent species. The expected mammal diversity is expected to be high. However, due to the extensive burning and sub-optimal seasonality, it is currently not possible to determine the likelihood of occurrence until after the completion of the supplementary wet season survey.

7.8.6.3.4 Herpetofauna specific analysis

As with the other faunal groups, this habitat provides structural complexity and potential breeding/foraging habitat for a diverse assemblage of herpetofauna species and requires more detailed assessment prior to construction, after significant rainfall has occurred to initiate breeding activities. Furthermore, the linear nature of this habitat and its associated riparian vegetation provides important ecological corridors in the landscape and connects many different adjoining habitat types, an important aspect for the dispersal and migration of herpetofauna, which are generally poor dispersers. High densities of amphibian species (none of conservation concern) are expected along the shallow shores of the watercourse. This abundant and predictable food source attracts many predators (snakes, birds, mammals, fish) that rely heavily on this food source while the adjacent dense vegetation provides ample refugia potential. River frogs (*Amietia sp.*), Platannas (*Xenopus laevis*) and toads (*Sclerophrys sp.*) are expected to be the most abundant amphibians with Water Monitors (*Varanus niloticus*), Rinkhals (*Hemachatus haemachatus*), Herald snakes (*Crotaphopeltis hotamboeia*) and Brown water snakes (*Lycodonomorphus rufulus*) expected to be the most common reptilian predators, which in turn are important prey for mammals and bird species.

7.8.6.4 Water-bodies

7.8.6.4.1 Flora specific analysis

Several artificial dams were identified within the PAOI along the Leeufonteinspruit. These waterbodies have been subjected to various edge effects from the surrounding environment, including heavy trampling by cattle and the presence of alien species such as *Bidens pilosa, Datura ferox* and *Verbena brasiliensis.* The ecological integrity of most of these water bodies is in an acceptable condition as species such as *Imperata cylindrica* and *Themeda triandra* create favourable shoreline habitat for grass owls (*Tyto capensis*) and other small mammals, reptiles and birds. It should be noted that a comprehensive list of flora species could not be provided as the survey took place in the dry season when flowering conditions were not optimal.

7.8.6.4.2 Avifauna specific analysis

Wetlands and pans occur naturally and represent one of the more sensitive avifaunal habitats located within the PAOI. The diversity and density of avifauna within these habitats are extremely high due to the obvious forage and breeding potential as well as the structural complexity of the habitat (water associated trees, water, moist grassland, reeds etc.). Depending on their surface area and available forage, the habitats often provide foraging habitat for wader and waterfowl species belonging to the Alcedinidae (kingfishers), Anatidae (ducks & geese), Podicipedidae (grebes), Ardeidae (herons), Phalacrocoracidae (cormorants), Threskiornithidae (ibises & spoonbills), Anhingidae (Darters) and lastly Palaearctic migrant waders (Scolopacidae). The Endangered African Marsh Harrier and the African Grass Owl are predicted to occur within this habitat type while the Near Threatened Pallid Harrier (*Circus macrourus*) was observed. The supplementary wet season assessment will inform the level to which pans and wetlands with adequate coverage of tall reed beds or *Imperata cylindrical* may provide refuge, foraging habitat or breeding habitat for SCC.

7.8.6.4.3 Mammal specific analysis

Refer to watercourses (7.8.6.3.3).

7.8.6.4.4 Herpetofauna specific analysis

The majority of the water-bodies are artificial dams, of which the smaller ones are ephemeral (they dry out for a large portion of the year) and therefore may provide breeding habitat for the Giant Bullfrog. However, the larger dams along the Leeufonteinspruit have permanent water and are likely to have fish which would make them unsuitable breeding habitat for the Giant Bullfrog. This aspect alone raises the sensitivity of this habitat type to Very High as Giant Bullfrog are considered to be “Near Threatened” (Du Preez & Carruthers, 2017) but will likely undergo an escalation in conservation status soon as cryptic diversity within this species (revealed through genetic studies) will result in the splitting of *Pyxicephalus adspersus* into up to five new species, each with a much reduced geographical distribution range (Du Preez, pers comm.). Therefore, it is strongly advised that the precautionary approach is followed and that this species should be considered as a SCC. Furthermore, many other amphibian species preferentially breed in lentic (still) water systems such as pans and this seasonally reliable source of food for predators is of great importance.

7.8.6.5 Agriculture areas

7.8.6.5.1 Flora specific analysis

Agricultural crop production is the main land use within the PAOI, and consists mostly of maize crops. Several alien species and weeds such as *Bidens bipinnata, Conyza* spp., *Datura stramonium* and *Verbena brasiliensis* are present in this habitat type due to ongoing agricultural practices.

7.8.6.5.2 Avifauna specific analysis

This habitat type is widely distributed on the region and generally shows a low diversity (albeit high density) of bird species due to the monospecific nature of the basal layer. However, the tall structure (e.g. of maize fields) should allow for good foraging potential for terrestrial species (e.g. Blue Korhaan, Secretary bird and Francolins) as well as smaller Larks and Cisticola.

7.8.6.5.3 Mammal specific analysis

In many old agricultural land areas livestock and planted grasslands will be the prevailing landuse on previously disturbed areas in order to maximise the productivity potential of the land. Monospecific basal or vegetative layers serve to reduce overall habitat quality and foraging potential greatly. The soft substrate within the PAOI is however highly optimal for fossorial or burrowing species such as mole rats, mongooses, golden moles, Suids (pig species) and porcupines.

7.8.6.5.4 Herpetofauna specific analysis

Fallow and in-use agricultural fields provide limited habitat for herpetofauna as the majority of naturally occurring refugia (rocks, dense grass tufts) are removed. However, the soft substrate and food potential attracts rodents and therefore snake predators, especially Mole snakes (*Pseudaspis cana*) and Brown House Snakes (*Boaedon capensis*), which in turn attract avian predators. Consequently, a limited/reduced ecosystem is expected. Because the agricultural fields surround the potential breeding habitat of Giant Bullfrogs (wetland pans), many frogs migrate through and forage in these fields also.

7.8.6.6 Peripheral habitats (Alien Trees/Infrastructure/Mines)

The deserted infrastructure habitat within the PAOI may serve to act as either refugia and foraging habitat for some predatory avifauna (specifically owls), some mammal species (mostly small mammals) and certain herpetofauna (synanthropic skinks and geckos); or as a “roost” habitat for raptors (including Red-Listed species).

The existing mine is adjacent to the PAOI (to the Southwest) and therefore was not assessed in terms of terrestrial ecology.

7.8.7 Observed and Expected Fauna

7.8.7.1 Avifauna

The PAOI is surrounded by the 2605_2925, 2605_2930, 2610_2925 and 2610_2930 pentads (Figure 7-39). A photographic collage of some observed species is shown in Figure 7-40.

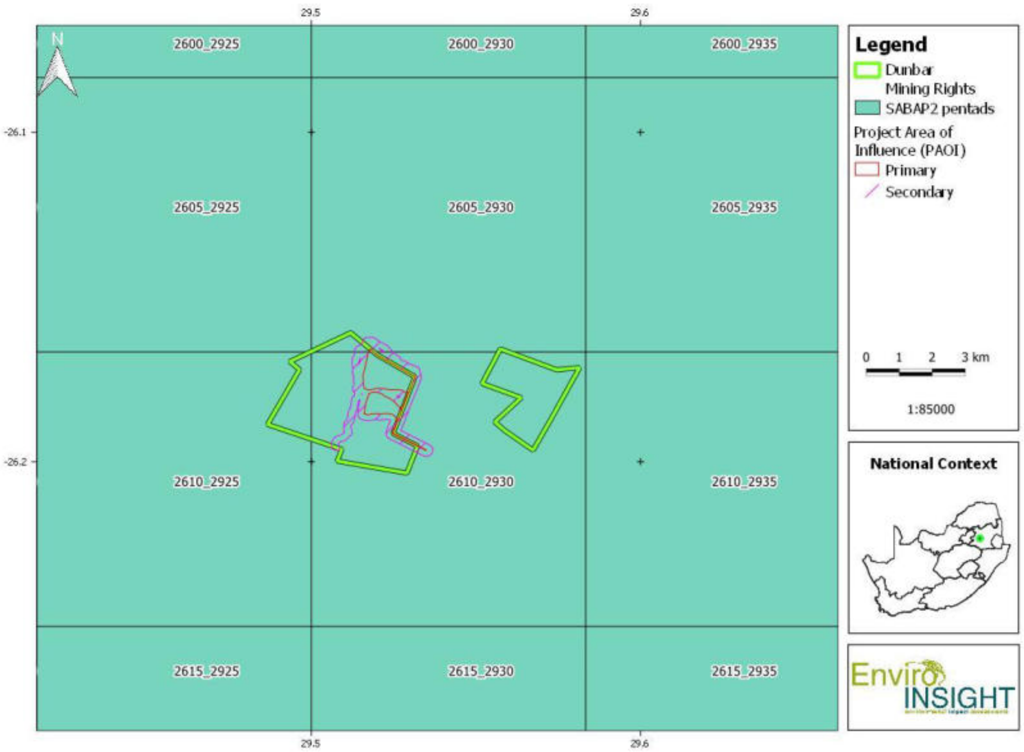


Figure 7-39: The MR areas and PAOI in relation to the SABAP2 pentads.

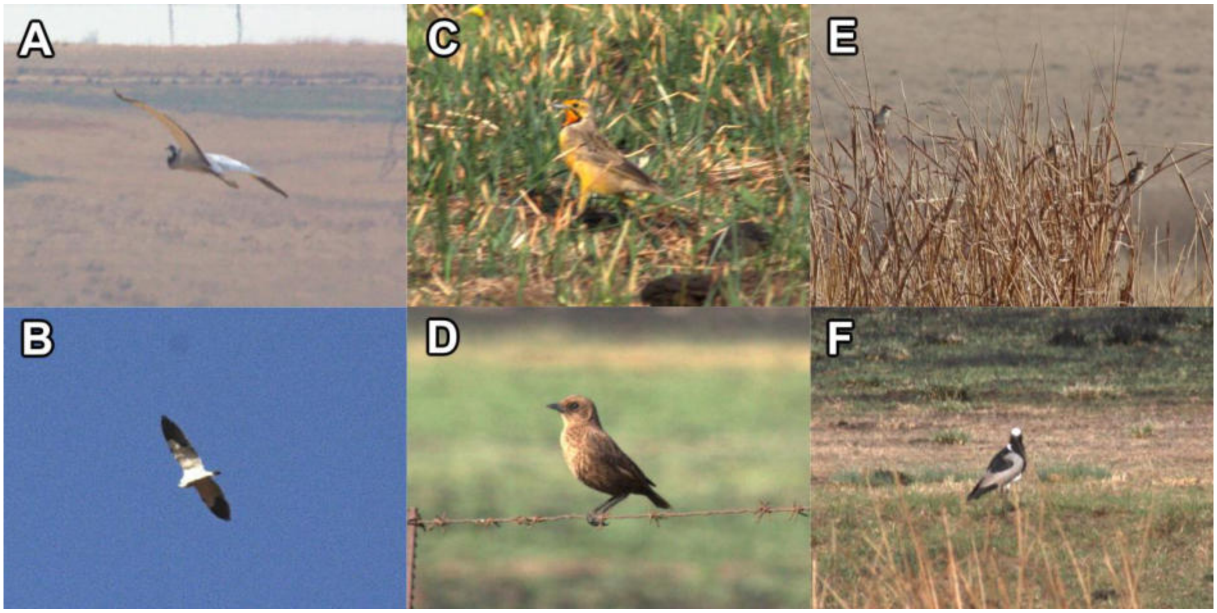


Figure 7-40: Photographic collage of some bird species recorded during the dry season survey[16].

7.8.7.2 Mammals

The PAOI resides on the 2629BA and is adjacent to 2629AB QDGC. These QDGCs along with adjacent cells were considered to represent similar habitats and therefore the predicted species list was derived from observation records from these QDGCs. Seven SCC are either confirmed or strongly expected to occur within the PAOI and are discussed in detail below.

Opportunistic diurnal sightings did not reveal many species due to the lack of available foraging or breeding habitat due to the extensive localised burning and the suboptimal seasonality of the assessment. Road kill potentially provides an alternative source of data but did not provide additional information during the dry season survey period either. However, within a road drainage area within 3 km of the PAOI, evidence of a leopard kill (porcupine) was recorded showing evidence of typical Highveld predator behaviour which implies periodic foraging by apex carnivores.

Given the fact that the vast majority of the surface area of the PAOI is dominated by agricultural activity, the number of mammal species observed and expected is low. The system within the PAOI is not conducive to a high mammal diversity, with the exception of the watercourse and wetland habitats on the periphery, combined with moist and primary grasslands. All SCC discussed in detail are assumed to be present on site (Precautionary Principle), with appropriate mitigation measures applied.

7.8.7.3 Herpetofauna

The PAOI resides on the 2629BA quarter degree grid cell (QDGC), and is adjacent to 2629AB. These QDGCs along with eight adjacent cells (2529CD, 2529DC, 2529DD, 2629BB, 2629BD, 2629BC, 2629AD, 2629AA) were considered to represent similar habitats and therefore the predicted species list was derived from observation records from these ten QDGC's (Figure 7-41). Expected species lists derived in this manner may therefore represent an overestimation of the diversity expected as

---

[16] A) Black-headed Heron (*Ardea melanocephala*); B) Pallid Harrier (*Circus macrourus*); C) Cape Longclaw (*Macronyx capensis*); D) Female Ant-eating Chat (*Myrmecocichla formicivora*); E) Red-billed Quelea (*Quelea quelea*); F) Blacksmith Lapwing (*Vanellus armatus*).

very specific habitat types may be required by a species which may be present in a QDGC but not necessarily on the study site within the QDGC. Conversely, many large areas in South Africa are poorly sampled for herpetofauna and expected species lists derived from a single QDGC may therefore underestimate the species diversity. Drawing expected species from surrounding QDGC's therefore increases the likelihood of obtaining a species list that suffers less from poor sampling in the area but it also artificially inflates the expected number of species because many different habitats in the surrounding QDGCs may not be present on the study site. To counteract this, all possible attempts were made to refine the expected species list based on species-specific habitat requirements and a good understanding of the habitat types and quality of the study site. Species that are unlikely to occur on the study site but that do occur in the surrounding QDGCs were kept in the expected species list but struck through and species with a high probability of occurrence on the study site were added to the list even if ReptileMAP and FrogMAP did not have a record for the selected QDGCs.

A total of 42 reptile and 20 amphibian species are expected to occur within the PAOI, representing relatively low herpetofauna diversity characteristic of the Highveld grassland habitats. Six reptile species were confirmed (4 snakes, 2 lizards; Figure 7-42) and no amphibians were observed during the dry season. One SCC could be expected to occur within the PAOI, namely the Giant Bull Frog (*Pyxicephalus adspersus*; Near Threatened). This species is discussed in detail below.

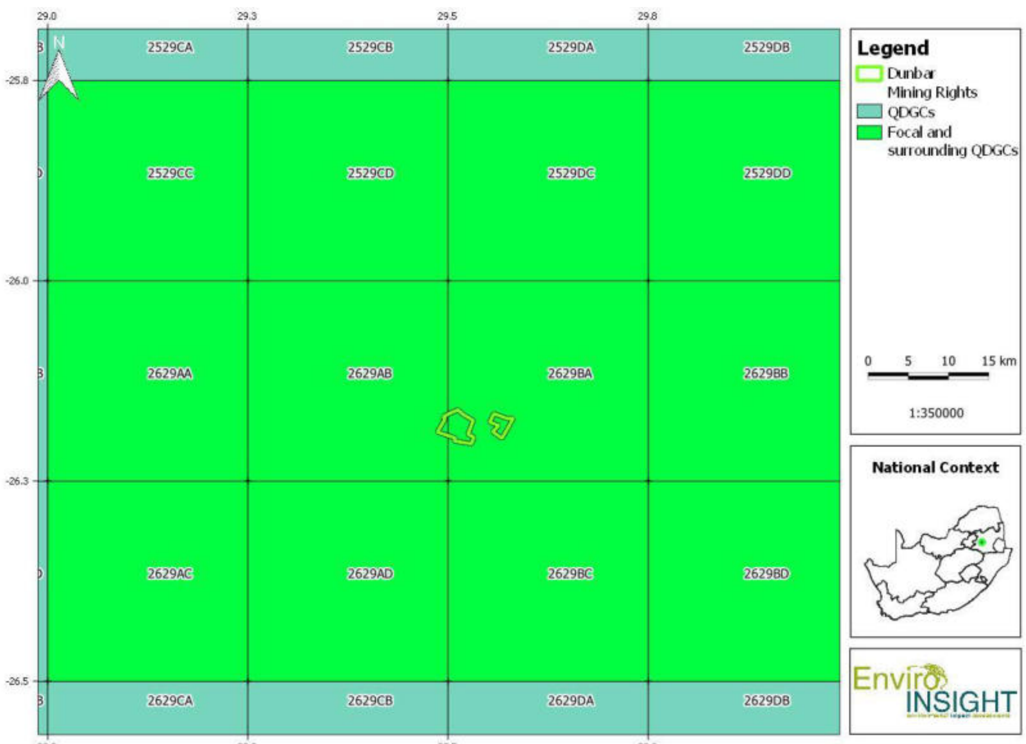


Figure 7-41: The MR areas and PAOI in relation to the quarter degree grid cells (QDGCs).

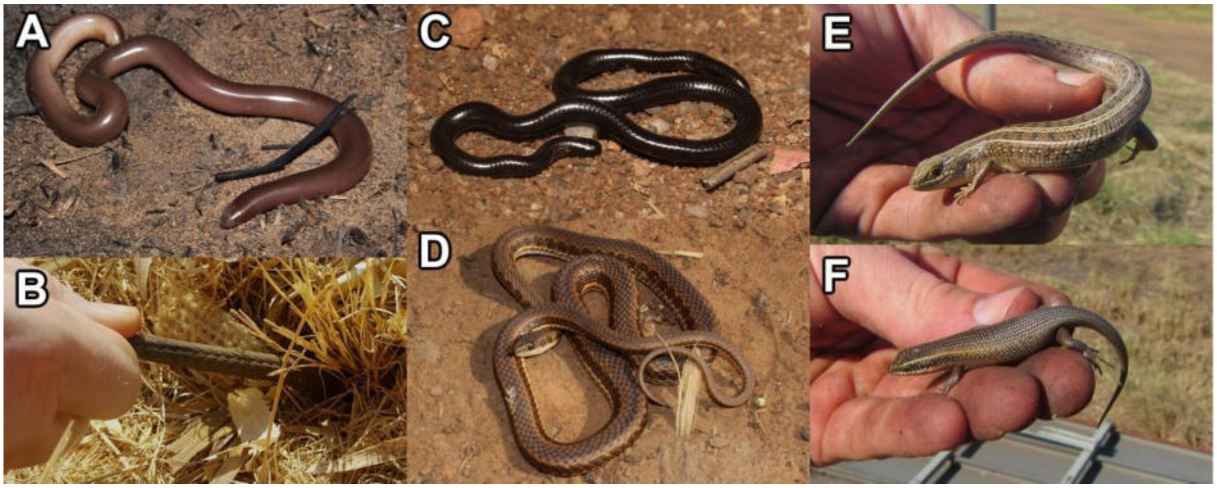


Figure 7-42: Photographic collage of the herpetofauna observed during the site surveys[17].

7.8.8 Floral SCC

No Flora SCC were recorded within the PAOI. A list of potential Flora SCC is indicated in Table 7-23 below. The presence of these species will be confirmed during the wet season survey.

Table 7-23: Potential Red and Orange Listed plant species

Species	Conservation Status	Habitat Description	Present on site
Aspidoglossum xanthosphaerum	Vulnerable - decline in habitat due to agriculture and trampling from livestock	Montane grassland and marshy sites at around 1800 m. (Flowering period: January-April)	Not recorded yet - Will be confirmed during the wet season survey
Gladiolus paludosus	Vulnerable - loss of habitat in Mpumalanga due to Agriculture and expansion of mines	Occurring in marsh and vlei habitats (Flowering period-October-November)	Not recorded yet - Will be confirmed during the wet season survey
Gladiolus robertsoniae	Near Threatened – Habitat degradation as a result of mining and overgrazing by livestock	Moist highveld grasslands, found in wet, rocky sites, mostly dolerite outcrops, wedged in rock crevices (Flowering period:October-November)	Not recorded yet - Will be confirmed during the wet season survey
Khadia carolinensis	Vulnerable - Threatened by current and future open cast mining in the distribution range	Well-drained, sandy loam soils among rocky quartzitic outcrops, or at the edges of sandstone sheets, Highveld Grassland, 1700 m. (Flowering period: October-March)	Not recorded yet - Will be confirmed during the wet season survey
Kniphofia typhoides	Near Threatened – extensive declining due to habitat loss to coal mining, overgrazing by cattle, urban expansion and crop	Low-lying wetlands and seasonally wet areas in climax Themeda triandra grasslands on heavy black clay soils, tends to disappear from degraded grasslands. (Flowering period: February - March)	Not recorded yet - Will be confirmed during the wet season survey

[17] A: *Afrotyphlops bibronii*; B: *Hemachatus haemachatus*; C: *Leptotyphlops conjunctus*; D: *Psammophylax rhombeatus*; E: *Trachylepis capensis*; F: *Trachylepis punctatissima*

	cultivation		
Nerine gracillis	Vulnerable - currently threatened by ongoing degradation and habitat loss due to overgrazing and urban development.	Undulating grasslands in damp, moist areas; the plants grow in full sun in damp depressions, near pans or on the edges of streams; grassland, riverbanks, vleis. (Flowering period: February - March)	Not recorded yet - Will be confirmed during the wet season survey

7.8.9 Faunal SCC

7.8.9.1 Avifauna

A list of avifauna SCC previously recorded in the pentads surrounding the PAOI is provided in Table 7-24. A total of nine SCC could occur on site, of which four are listed as nationally Near-Threatened and two species as nationally Vulnerable. Specific species are discussed in below.

Table 7-24: Avifauna SCC previously recorded in the PAOI pentads

Species	Common Name	Global Conservation Status*	National Conservation Status**	Average SABAP2 Reporting rate (n cards)	Preferred Habitat	Potential Likelihood of Occurrence on PAOI
Circus macrourus	Pallid Harrier	Near Threatened	Near Threatened	5.13%	Prefers dry to damp grasslands associated with open pans or floodplains.	Confirmed over grassland / agriculture fields.
Eupodotis caerulescens	Blue Korhaan (Bustard)	Near Threatened	Near Threatened	66.67%	Prefers extensive open short grassland and cultivated land.	A common foraging visitor to PAOI.
Geocolaptes olivaceus	Ground Woodpecker	Near Threatened	-	9.09 – 16.67%	Rocky slopes. Preferably very steep. Sometimes along water courses but rock imperative.	Unlikely to occur.
Glareola nordmanni	Black-winged Pratincole	Near Threatened	-	9.09%	Black-winged pratincoles are wetland migrants that may nest alongside non-perennial watercourses.	Unlikely to occur although may form nesting colonies from year to year.
Oxyura maccoa	Maccoa Duck	Near Threatened	Near Threatened	28.57%	Large saline pans and shallow impoundments.	Likely to occur within farm dams within the PAOI.

Phoenicopterus minor	Lesser Flamingo	Near Threatened	Near Threatened	33.33%	Open, eutrophic, shallow saline and alkaline wetlands.	Unlikely to occur.
Phoenicopterus ruber	Greater Flamingo	-	Near Threatened	21.70%	Restricted to large saline pans and other inland water bodies.	Unlikely to occur.
Sagittarius serpentarius	Secretarybird	Vulnerable	Vulnerable	38.67%	Prefers open grassland or lightly wooded habitat.	Regular to uncommon foraging visitor
Tyto capensis	African Grass-owl	-	Vulnerable	12.50 – 21.57%	Prefers rank moist grassland that borders drainage lines or wetlands.	Regular to Uncommon resident. Historical resident prior to the introduction of cattle/livestock. Likely present in areas where *Imperata* grass is present.

7.8.9.1.1 Pallid Harrier (*Circus macrourus*) Near-Threatened

The Pallid Harrier is a migratory raptor that will readily forage within the PAOI but is not considered dependent on the local habitats and at best, will be a temporary visitor. It does not represent a fatal flaw.

7.8.9.1.2 Maccoa Duck (*Oxyura maccoa*) Near-Threatened

The species is a permanent resident within the suitable dams within the area of influence of the study area, albeit in very small numbers. The species is in decline due to water pollution and loss of habitat, which is axiomatic to Highveld grasslands influenced by agriculture and mining. The species is not expected to occupy habitats immediately within the PAOI but will occur in adjacent suitable farm dams.

7.8.9.1.3 Secretarybird (*Sagittarius serpentarius*) Vulnerable

This species is often observed in open areas, including cultivated and old agricultural lands and has been frequently recorded by the specialist in areas surrounding the PAOI, albeit when conducting different surveys.

7.8.9.1.4 African Grass-owl (*Tyto capensis*) Vulnerable

The African Grass-owl is categorised as Vulnerable with the southern African population numbering less than 5 000 individuals. Suitable grass-owl habitat was searched for and was found within the PAOI. The presence of dense, tall *Imperata cylindrica* grassland is a requirement of this species and if the mine operations exclude the presence of cattle (and recolonisation takes place), this species may find sanctuary in the Grassland habitats. However, the extant of the suitability cannot be assessed until after the commencement of the November rains when regrowth of the burnt *Imperata* stands will occur. A more comprehensive analysis regarding impacts on this species will take place once the supplementary wet season study is complete.

7.8.9.2 Mammals

7.8.9.2.1 South African Hedgehog (*Atelerix frontalis*) Near-Threatened

Although hedgehogs were not recorded during the dry season survey, the species has been recorded by the specialist in nearby areas adjacent to the PAOI. Hedgehogs are listed as Near-Threatened and although the species is common in urban environments and is affected by development, it is also found on rural grasslands of varying degrees of quality, especially in the absence of dogs and other feral predators. With a loss of grassland habitat, it is likely that local hedgehog populations will be displaced or eradicated. The best course of action will be to mitigate against roadkills, to which this species is very susceptible as well as to allow for worker induction, which will report hedgehog presence and allow individuals to be safely relocated to more undisturbed areas (see mitigations).

7.8.9.2.2 Water Rat (*Dasymys incomtus*) Near-Threatened

This species may occur within the riparian zones but this was not confirmed during the dry season survey and must be confirmed by the specialist during the wet season supplementary survey. The species is not considered to be a fatal flaw given adequate avoidance and mitigation (especially of wetland environments).

7.8.9.2.3 Serval (*Leptailurus serval*) Near-Threatened

This meso-predator cat species has frequently been recorded by the specialist in nearby areas adjacent to the PAOI and the species has been confirmed through identifiable scats, defecated in the small unburnt patches of grassland. It is anticipated that a significant resident population persists within the PAOI, given the predicated high density of rodents and the suitable habitat. The species is a relatively common wetland associate in grassland areas and although the Near-Threatened status warrants due consideration, the species is not considered to be a fatal flaw given adequate avoidance and mitigation (especially of wetland environments).

7.8.9.2.4 Honey Badger (*Mellivora capensis*) TOPS Protected

Honey badgers will most likely persist on a permanent basis (based upon previous studies in the region by the specialist). The species is often associated with bushveld and primary grassland habitats although it is often subject to snaring and persecution due to its penchant for raiding commercial honey farms and chicken breeding facilities. The potential presence of honey badgers within the PAOI should be considered as a healthy ecological indicator. The NEMBA/TOPS protection does not represent a fatal flaw.

7.8.9.2.5 African Leopard (*Panthera pardus*) Vulnerable

Leopards will most likely not persist on a permanent basis (based upon previous studies in the region by the specialist) but will frequently utilise the PAOI as a foraging resource. The species is often associated with bushveld and primary grassland habitats although it is often subject to snaring and persecution due to its penchant for livestock killings. Although the species has been confirmed near the PAOI (during the survey period) and is listed as Vulnerable, it's extremely large home range size and propensity for avoiding areas of excessive disturbance precludes it from being considered as a fatal flaw.

7.8.9.2.6 Brown Hyaena (*Parahyaena brunnea*) Near-Threatened

Brown Hyaena is an essential component of the ecosystem and act as important scavengers in the region, clearing carcases that can potentially spread diseases to wild mammal populations. This species may use maize fields in the PAOI as migratory corridors however this is currently speculative. Although the species was confirmed through scats within the PAOI, it is unlikely to be resident.

7.8.9.2.7 Cape fox (*Vulpes chama*) TOPS Protected

Although this species is TOPS protected, its presence within the study is not considered to be of great concern due to the penchant for the species to colonise areas in association with humans.

7.8.9.2.8 African Clawless Otter (*Aonyx* capensis) and Spotted-Necked Otter (*Hydrictis maculicollis*) Near-Threatened

It was apparent that some potentially suitable migratory/dispersal habitat persists within the PAOI; especially within the watercourse habitat. However, most of the PAOI is sub-optimal for spotted-neck otters which prefer deep, clear pools which support large populations of fish. During the dry season survey, conditions within the PAOI were highly sub-optimal due to lack of water but the habitat may become far more conducive to supporting both species after the commencement of wet season rains. The areas of potential otter habitat are currently being highly affected by unrestrained cattle grazing which may cause temporary sedimentation, all but (locally) eliminating previously optimal spotted neck-otter habitat due to the fact that the species hunts fish by sight in clear deep pools. The conclusion for the spotted-neck otter (which the likelihood of occurrence is considered to be almost definite but transitory in all the relevant PAOI habitats exhibiting flowing water) requires mitigation measures through buffering of all flowing water courses from the development infrastructure and buffering of heavy cattle grazing in water courses. The Near-Threatened status of the spotted-necked otter does not warrant fatal flaw allocation. Concerning the African clawless otter, the species is much more terrestrial and the watercourse habitat is considered to be optimal. The species was confirmed through scats within the PAOI and the same buffering mitigations apply as for the spotted-neck otter.

7.8.9.2.9 Highveld Golden Mole (*Amblysomus septentrionalis*) Near-Threatened

The “turned” earth of much of the PAOI is ideal for burrowing. Its Near-Threatened status is not considered as a fatal flaw and mitigation of agricultural areas is considered to be unnecessary.

7.8.9.3 Herpetofauna

7.8.9.3.1 Giant Bullfrog (*Pyxicephalus adspersus*) – Least Concern/ Near-Threatened

The Giant Bullfrog is listed by Minter *et al*. (2004) as Near-Threatened. However, the IUCN (2019) considers this species to be of Least Concern across its global distribution, but as discussed above, this species will likely undergo an escalation in conservation status soon and must pre-emptively be considered to be of conservation importance. This species has been recorded in the QDGCs surrounding the PAOI (FrogMAP, 2019) and although the species is unlikely to breed in the dams along the Leeufonteinspruit drainage line, it may breed in the scattered smaller temporary pans and use the general area as foraging habitat or for dispersal. The proposed development can be expected to impact negatively on this species through destruction and alteration of potential foraging areas, dispersal corridors and breeding habitat and through direct mortality from excavations and particularly, vehicle traffic (e.g. road kill on haul roads). Mitigation of potential impacts will need to occur and will include appropriate education of staff for the detection and relocation of any excavated specimens, prevention of roadkills and avoidance of breeding habitats.

7.8.10 Current Impacts

Not all current impacts require highly detailed discussion although some of the more significant impacts must receive a contextual summary, as provided below. Photographic evidence of a selection of these impacts are shown in Figure 7-43.

The current impacts observed during the field survey were:

- Alien vegetation;
- Agriculture (commercial crops);
- Cattle grazing and trampling of wetlands;
- Damming of watercourse;
- Fires;
- Fences;
- Infrastructure (farmsteads);
- Local settlement (township);
- Overhead cables;
- Roads and railways (roadkill and disturbance).

The current impacts prevailing within the PAOI are ongoing in the absence of activities related to the proposed development and should therefore be described appropriately to make sure that impacts from the proposed development can be quantified separately as well as combined for a cumulative impact analysis. The following major obvious current impacts directly affect the faunal and floral assemblages and do not necessarily include all possible current impacts found within the PAOI:

Agriculture (commercial crops)

Large-scale production of monoculture maize and soya beans is the dominant landuse type in the area. Very few natural faunal species were present in these areas, especially given that the dry survey took place post-harvest, while the ground was bare and recently furrowed. These fields isolate sections of persisting natural grassland, which require natural corridors to ensure proper ecology functioning.

Cattle grazing and trampling of wetlands

Cattle were observed grazing in the PAOI, in addition to their effects on riparian communities. The edges of water-bodies are trampled by cattle, removing the riparian vegetation that provides refuge for many water-dependent species. In addition, defecation by cattle pollutes water (leading to eutrophication) and overgrazing can cause erosion, compaction and successional changes in the grassland community.

Fires

Although fire is a natural disturbance which the Highveld grassland community has evolved with, the unnatural regularity of this disturbance due to deliberate yearly burning (by farmers) and uncontrolled accidental burnings, leads to exclusion of many species from the community and ultimately a depauperate ecosystem consisting of low species diversity and abundance while favouring the proliferation of rapid colonizers such as weeds and alien invasive species.

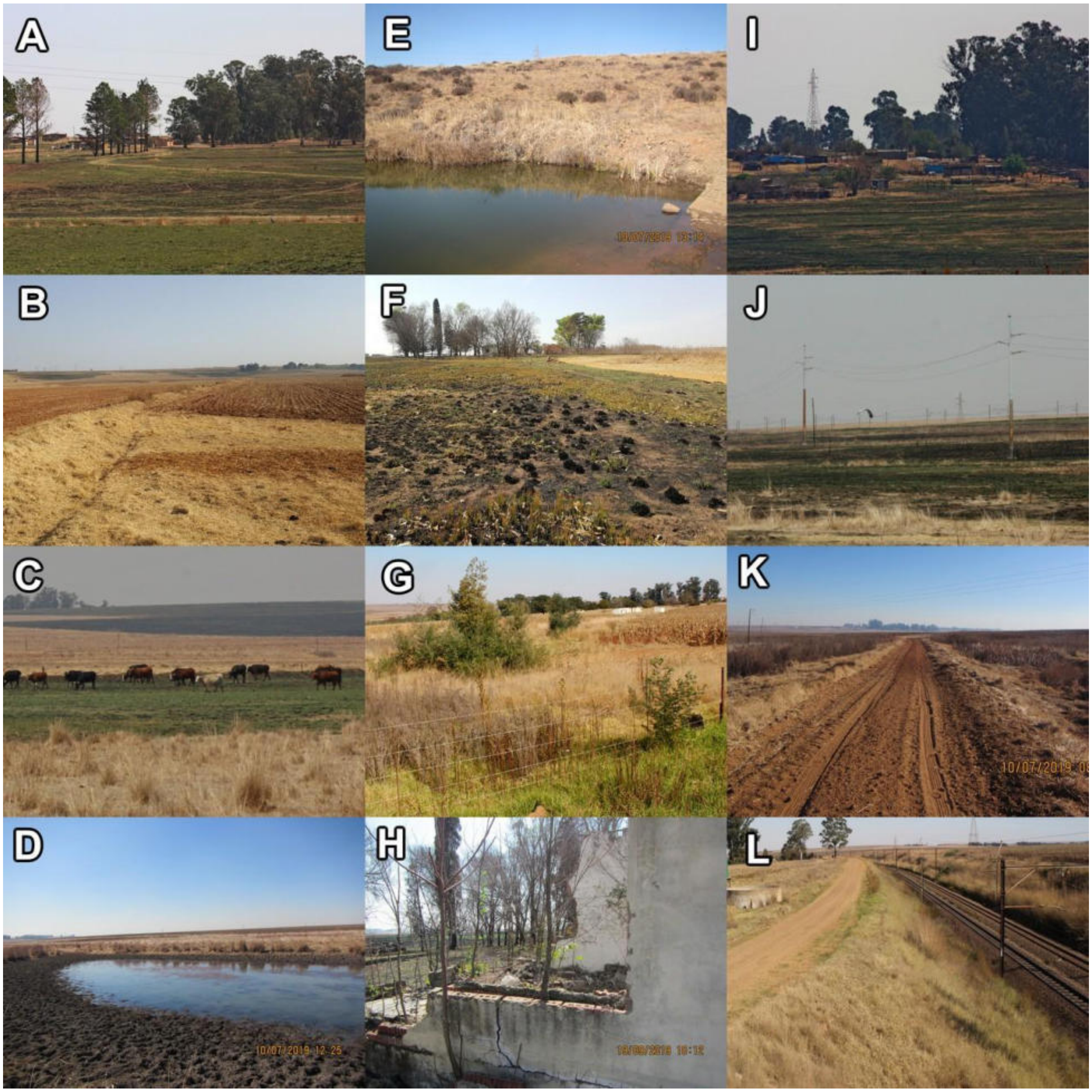


Figure 7-43: Photographic evidence of current impacts observed within the PAOI[18].

[18] A: Alien Trees; B: Agriculture; C: Cattle grazing; D: Trampled water-body by cattle; E: Damming of watercourse; F: Fire; G: Fencing; H: Infrastructure; I: Local settlement; J: Powerlines; K: Road; L: Railway

7.8.11 Habitat sensitivity

Based on the fauna and flora observations during the fieldwork as well as the current impacts described above, ecological sensitivity of each habitat type was identified (Table 7-25; Figure 7-44). This sensitivity is rated as either very low, low, medium, high or very high where low sensitivity is considered ideal for development and high sensitivity areas are to be avoided by the development. Based on the above, mostly agricultural fields, Intact Grassland and Disturbed Grassland would be affected by the proposed mining development, due to the proposed open cast mining blocks and mine infrastructure.

Table 7-25: Taxon specific and combined habitat sensitivity for the western portion of the MR area and PAOI.

Habitat	Taxon Group	Sensitivity	Justification	Overall Sensitivity
Agriculture	Avifauna	Very Low	Unsuitable for most species	Very Low
	Flora	Very Low	None	
	Herpetofauna	Very Low	Unsuitable for most species	
	Mammals	Very Low	Unsuitable for most species	
Alien Trees & Infrastructure	Avifauna	Low	Suitable for some LC species	Low
	Flora	Very Low	Unsuitable for most species	
	Herpetofauna	Low	Suitable for some LC species	
	Mammals	Low	Suitable for some LC species	
	Flora	Very Low	Unsuitable for most species	
	Herpetofauna	Very Low	Unsuitable for most species	
	Mammals	Very Low	Unsuitable for most species	
Disturbed Grassland	Avifauna	Moderate	Foraging SCC	Moderate
	Flora	Low	Unsuitable for some species	
	Herpetofauna	Moderate	No exclusive SCC	
	Mammals	Moderate	No exclusive SCC	
Intact Grassland	Avifauna	High	Foraging and breeding SCC	High
	Flora	Moderate	Expected SCC; Protection from soil erosion	
	Herpetofauna	Moderate	Suitable for many LC species	
	Mammals	Moderate	No exclusive SCC	
Water-bodies	Avifauna	Very High	Exclusive SCC	Very High
	Flora	Moderate	No exclusive SCC	
	Herpetofauna	Very High	Exclusive SCC	
	Mammals	Very High	Exclusive SCC	
Watercourse	Avifauna	Very High	Exclusive SCC	Very High
	Flora	Moderate	No exclusive SCC	
	Herpetofauna	High	Exclusive for many LC species	
	Mammals	Very High	Exclusive SCC	

Figure 7-44: Combined habitat sensitivity for the western portion of the MR area and PAOI in relation to mine infrastructure.

7.8.12 Summary and Recommendations

The mine is encompassed within the Eastern Highveld Grassland which has been listed as a threatened ecosystem with a status of Vulnerable. According to the MBSP, a Critical Biodiversity Area (CBA) falls within the western side of the mining right area, but not within the proposed mining infrastructure which is predominantly made up of 'Heavily or moderately modified' and 'Other Natural Areas'. No Protected Areas or Important Bird Areas (IBA) occur within close proximity to the mining right, with the closest IBA (The Amersfoort-Bethal-Carolina) approximately 11 km from the proposed mining infrastructure. According to the Mining and Biodiversity Guideline, although the proposed mining infrastructure falls mostly within areas of no biodiversity importance, a section of the PAOI is located in areas of Highest Biodiversity Importance and Moderate Biodiversity Importance which indicates that there is a high to moderate risk to biodiversity from mining activities.

No flora SCC have been observed within the PAOI which is predominately represented by large-scale agricultural fields (maize), Intact and Disturbed Grassland although this is subject to final assessment after sufficient rainfall, especially in relation to grassland patches and watercourses. A number of avifaunal SCC are predicted to occur with some of which will forage and possibly breed within the PAOI. However, the final assessment of the significance of the avifaunal assemblage is subject to a further assessment during the wet season supplementary survey (November). No mammal SCC (predicted or confirmed) are considered to represent a fatal flaw, although mitigations concerning road infrastructure (roadkill impacts) will have to be applied. Lastly, a single herpetofauna SCC is predicted to occur in the PAOI namely the Giant Bullfrog (*Pyxicephalus adspersus*). The Giant Bullfrog is unlikely to breed within the proposed mine layout due to the lack of temporary pans and the highly transformed nature of this area. However, it may utilise the area to forage/migrate and measures need to be taken to prevent individuals being trapped in excavations, excessive roadkill and unnecessary mortality during excavation.

Most anticipated flora and fauna impacts are low/medium to high/medium prior to implementation of mitigation measures. Following the application of mitigation measures, most impacts are reduced to low/medium or low, except for the effects of dust on watercourses. The proposed mining layout will remove agricultural land (the majority), some Intact and Disturbed Grassland (in the Northeast and Southeast) with unknown influences on adjacent grassland areas. Despite the predominantly disturbed nature of the grassland and the lack of CBA status, the area may provide foraging and nesting sites for avifaunal SCC, such as the Grass Owl and Secretary bird, which would need to be confirmed in the supplementary wet season survey. However, this is a relatively small patch of grassland and the mitigation measures provided should be sufficient to reduce impacts to acceptable levels. Nonetheless, the area should be rehabilitated to as close to its natural state as possible during the post-mining operations.

Incomplete baseline data for monitoring purposes was established, and a pre-construction survey during optimal seasonal and climatic conditions will be required as indicated above. Following such a survey, additional mitigation measures will be provided to reduce the anticipated impacts, where necessary. If additional SCC are recorded, the necessary mapping of suitable habitat and the appropriate buffer areas will be updated. As with camera trapping, it must be stated that due to logistical limitations and security concerns, as well as adequate results stemming from the utilisation of other methods (i.e. scat analysis and Mackinnon sampling), no Sherman Traps were deployed for the study. However, ongoing Sherman trap monitoring during both the construction and monitoring phases of the project is recommended when sufficient security has been established to ensure the low likelihood of trap theft.

Conclusion: It is unlikely that any severe and lasting impacts could occur from the mine activities if proper mitigation and monitoring takes place (as outlined in this report). The biggest concern is the effect of pollution/siltation on the Leeufonteinspruit watercourse and the importance of this habitat for the regional flora and fauna. It is therefore recommended that frequent monitoring must take place within this system to prevent and mitigate potential impacts, as well as to link impacts to specific events for adaptive management.

7.9 SOILS, LAND CAPABILITY, AND AGRICULTURAL POTENTIAL

The site falls into the Bb4 land type (Land Type Survey Staff, 1972 - 2006) with Figure 7-45 providing the land type distribution around the site. A detailed description and explanation of the characteristics of the specific land types is provided in sections 5.6 and 5.7. Ba land types denote areas dominated by plinthic soils with dominantly red apedal horizons overlying the plinthic horizons and Bb land types denote areas similar to the above but dominated by yellow and bleached soils. The current land use on the survey site consists of mix of dryland agriculture and grazing.

The topography of the site is predominantly flat undulating with a west-north-westerly aspect. A distinct watercourse and associated valley is evident in the western section.

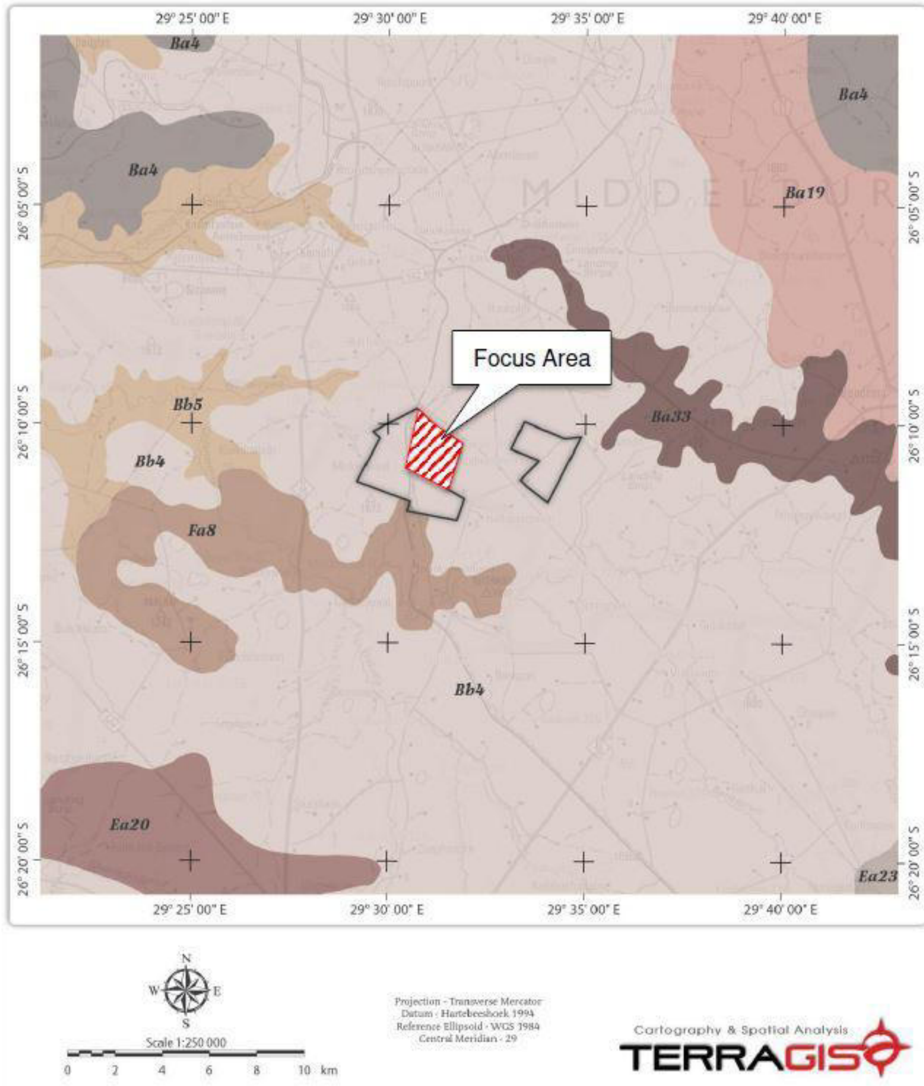


Figure 7-45: Land type map of the survey site and surrounding area.

7.9.1 Summary of Results

Land capability refers to the specific land use and agronomic practices that a given piece of land is capable of in the context of the original land capability categories published in the USA in the 1960's. The land capability concept is a bit broader than the "land suitability" approach expounded by the FAO (Food and Agriculture Organisation of the UN) where the latter aims to pronounce on the suitability of a specific area of land for a specific "land utilization type" (LUT). In the more recent South African case for "land capability" the then Department of Agriculture, Forestry and Fisheries (DAFF) established a requirement for the classification of land based on the criteria provided below. These categories are not significantly different from the original concept but have been amended for the South African context.

Table 7-26: Land capability classes for assessment of land for the South African context.

Land Capability Class	Definition	Conservation Need	Use suitability
I	No or few limitations. Very high arable potential. Very low erosion hazard.	Good agronomic practice.	Annual cropping.
II	Slight limitations. High arable potential. Low erosion hazard.	Adequate run-off control.	Annual cropping with special tillage or ley (25%)
III	Moderate limitations. Some erosion hazards.	Special conservation practice and tillage methods.	Rotation of crops and ley (50 %).
IV	Severe limitations. Low arable potential. High erosion hazard.	Intensive conservation practice.	Long term leys (75 %)
V	Watercourse and land with wetness limitations.	Protection and control of water table.	Improved pastures or Wildlife
VI	Limitations preclude cultivation. Suitable for perennial vegetation.	Protection measures for establishment eg. Sod-seeding	Veld and/or afforestation
VII	Very severe limitations. Suitable only for natural vegetation.	Adequate management for natural vegetation.	Natural veld grazing and afforestation
VIII	Extremely severe limitations. Not suitable for grazing or afforestation.	Total protection from agriculture.	Wildlife

7.9.2 Aerial Photograph Interpretation

The aerial photography interpretation yielded that the surface soil colour in the ploughed areas provides a clear soil mapping tool through the interpretation of surface soil colour variation as described by Van der Waals (2013). The land use of the site consists predominantly of dryland agriculture and grazing with depressions dominated by wetland conditions.

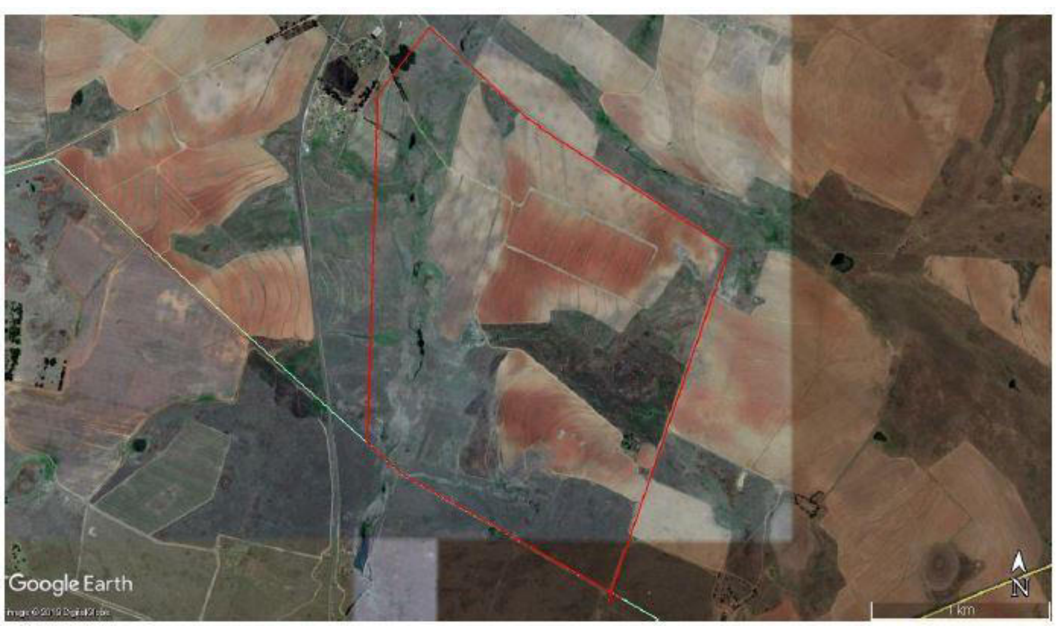


Figure 7-46: Google Earth image indicating land use and soil colour patterns.

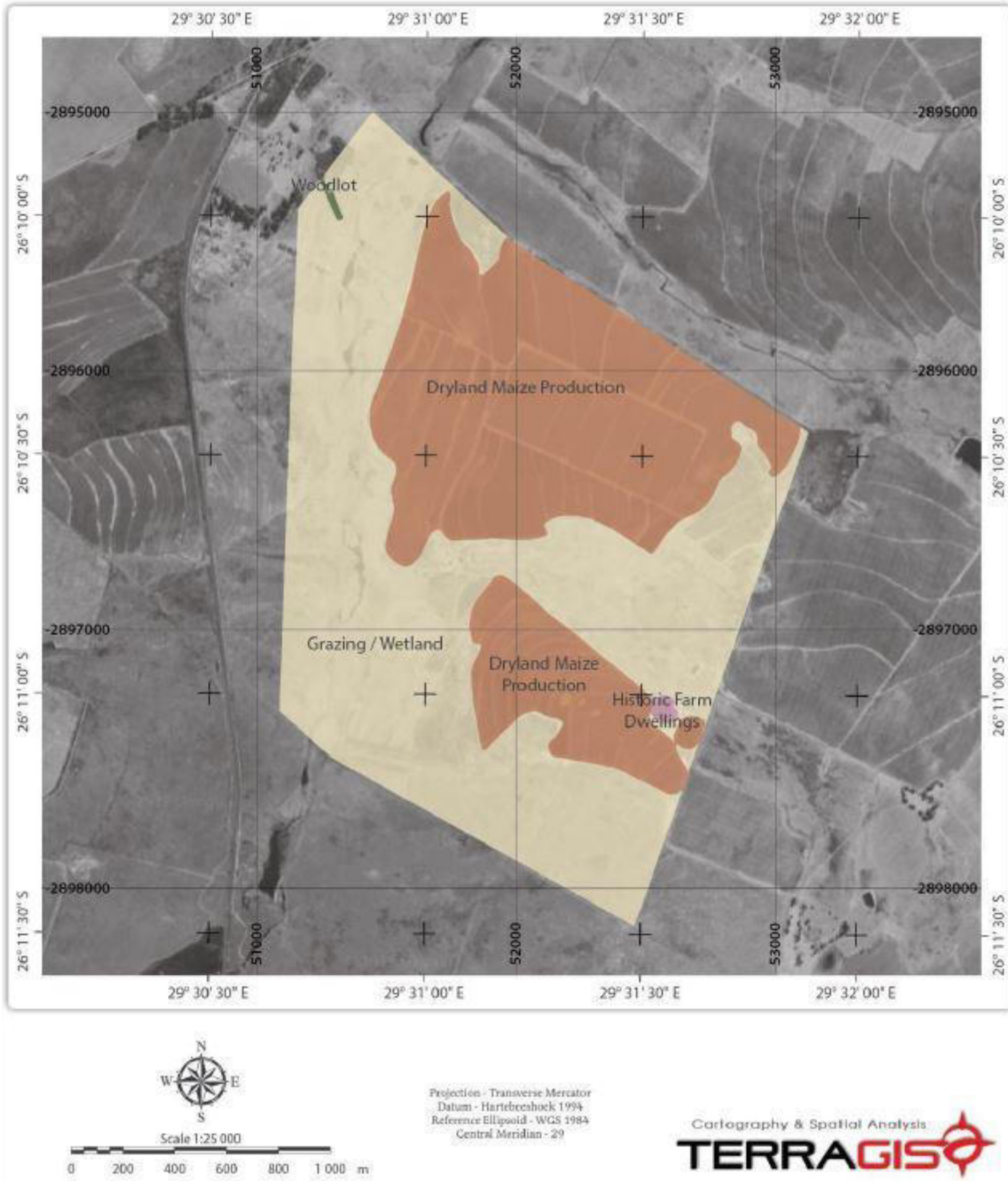


Figure 7-47: Land use map of the investigation site.

7.9.3 Terrain Unit Indicator

The contour data for the site as well as the surrounding area was used to generate a topographic wetness index (TWI). From extensive experience on the field of hydropedology it is evident that the TWI provides a very accurate indication of water flow paths and areas of water accumulation that are often correlated with wetlands – if soil and topographic conditions are conducive to the formation of redoximorphic features in the soils. This is a function of the topography of the site and ties in with the dominant water flow regime in the soils and the landscape. Areas in blue indicate concentration of water in flow paths with lighter shades of blue indicating areas of regular water flows in the soils and on the surface of the wetland / terrestrial zone interface.

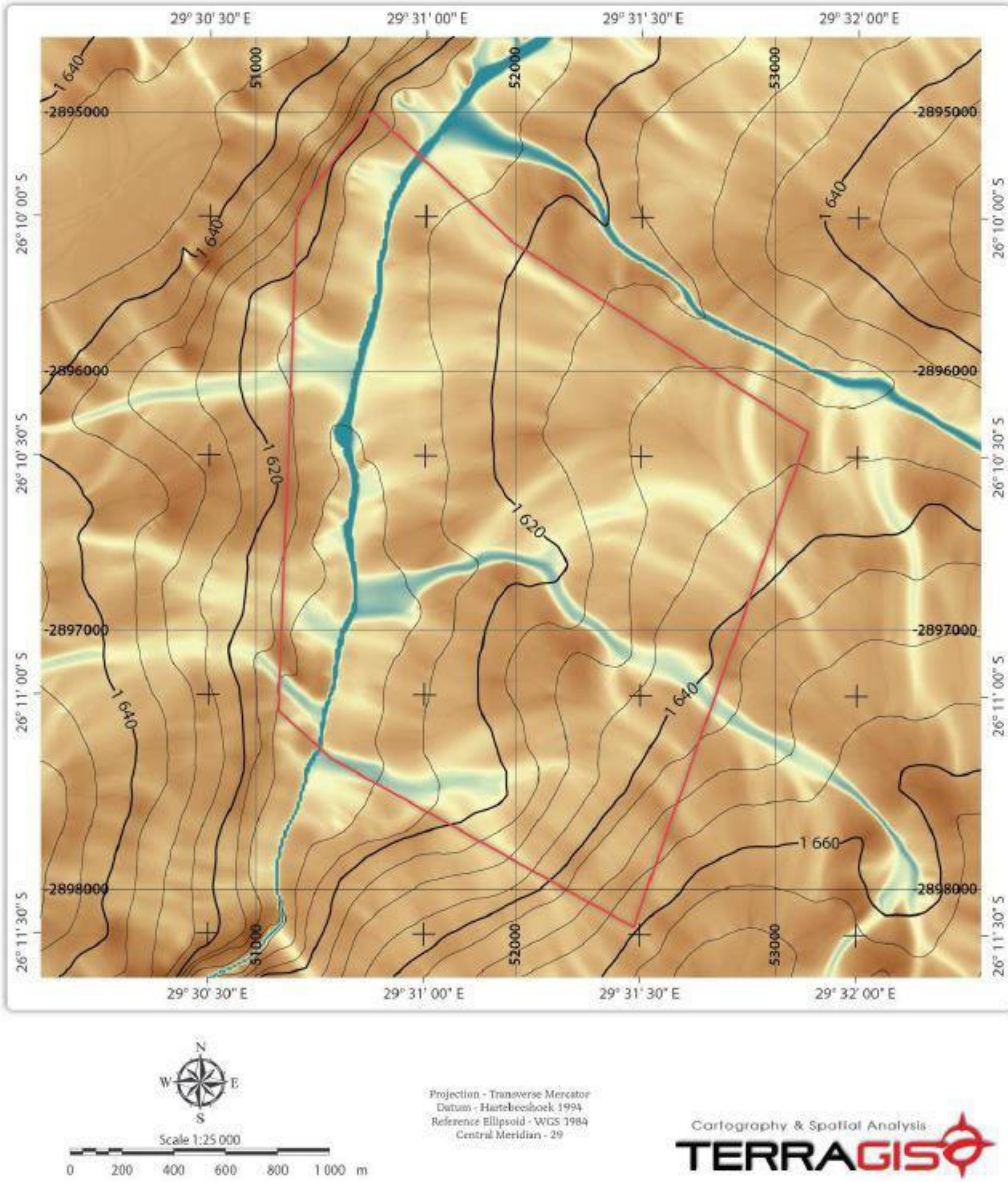


Figure 7-48: Topographic wetness index (TWI) of the survey site.

The terrain unit indicator provides a good correlation in terms of the surface water accumulation paths and the wetlands and grey soils on the site as identified in the aerial photograph interpretation section.

7.9.4 Soil Survey, Land capability and Agriculture potential

The reconnaissance soil survey yielded a generalised soil map for the site. The soils on the site have been divided into hydrological units. The land capability and agricultural potential map of the site are provided in

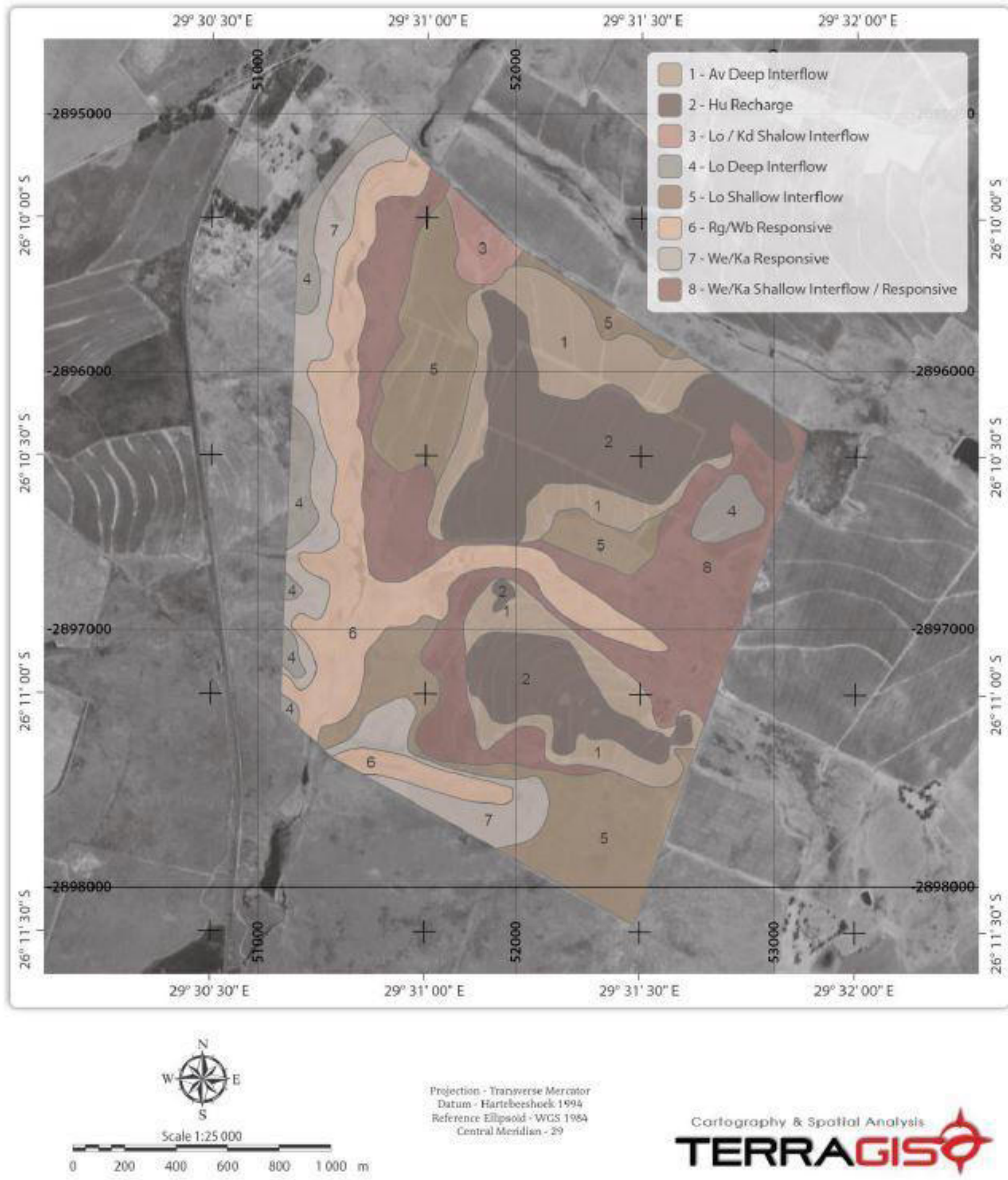


Figure 7-49: Generalised soil map for the investigation site.

7.9.5 Conceptual hydrological response

The conceptual hydrological response for the site is derived from the soils that were identified. The hydrological response is inferred from the soil properties. The hydrological functioning of the areas yield the following:

- Recharge Zones: The dryland crop production areas function as recharge zones with lateral flow of water occurring at depth in the soils. Surface runoff occurs during high intensity rainfall events that exceed the infiltration capacity. A significant intercept occurs during the growing season with crop water use.
- Deep Interflow Zones: Fractured rock and deep plinthic horizons represent interflow zones.
- Shallow Interflow Zones: E horizons underlain by higher clay content soil horizons represent shallow interflow zones

with intercept by wetland vegetation.

- Responsive Soil Zones: Soil with high clay content in low lying landscape positions represent response areas where interflow water approaches the land surface or flows out onto the land surface at times. These zones are characterised by seasonal and permanent wetland vegetation depending on the duration of later flow contributions from the landscape.

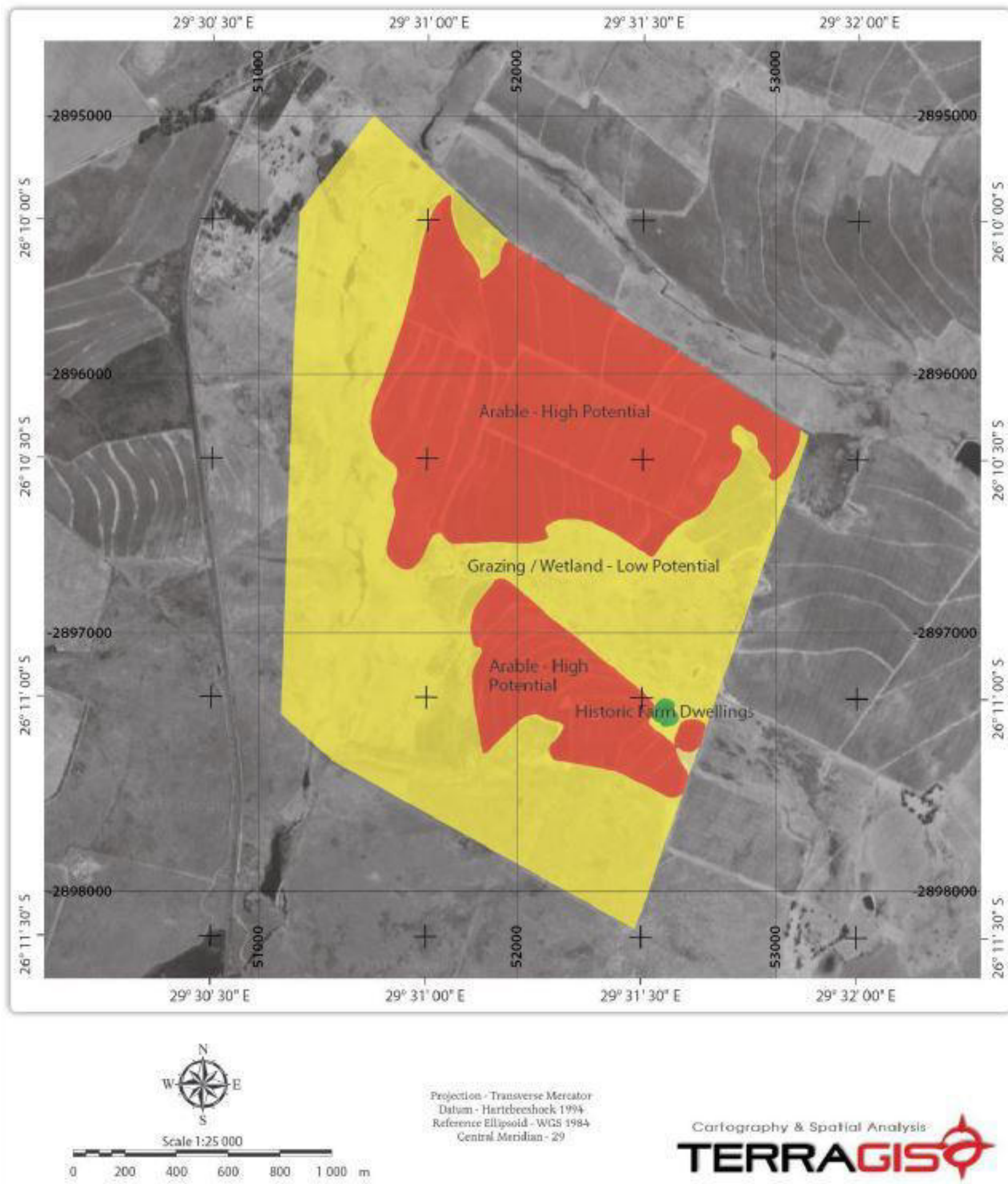


Figure 7-50: Land capability map of the investigation site.

7.9.6 Conceptual hydrological response – Implications for Open Cast Mining

The conceptual hydrological response for the site discussed above yields that the impacts of opencast mining, when viewed in the context of the discussion in the report will be as follows:

- Recharge Zones: If recharge zone soils are mined the implication will be a change in recharge characteristics of the landscape and severing of water flow paths feeding interflow (both shallow and deep) and responsive soil areas. The nett effect will be a removal of water from the system until the mine pit fills up and starts decanting. This will yield a variation in flow regime and a degradation of water quality due to acid mine drainage (AMD). The duration of the impact will depend on a range of factors that can only be modelled in the geohydrological investigation.
- Deep Interflow Zones: The opencast mining of deep interflow zones will have a similar impact as discussed under point 1 above. Mining of these areas implies that the recharge areas are also mined and it is therefore seen as a cumulative impact.
- Shallow Interflow Zones: The opencast mining of shallow interflow zones will have a similar effect to the discussion under point 1 above. Mining of these areas implies that the recharge areas are also mined and it is therefore seen as a cumulative impact.
- Responsive Soil Zones: Responsive soil areas are often not mined as these occur within wetlands and watercourses with associated buffers and floodlines precluding mining developments. However, with the water feed for the response having been severed through mining of the recharge and interflow soils the responsive areas cease exhibiting the natural background condition response.

The practical implications of the above impacts are the following:

- Arbitrary buffers on responsive areas soils (read “wetlands” and “watercourses”) do not have any effect on the protection of the water resource. This aspect renders the concept of a buffer moot since it has no practical application or benefit in opencast coal mining areas.
- The protection of flow parameters in landscapes that undergo opencast coal mining is also a moot point as the flow is drastically altered through the severing of all the flow paths and recharge and storage characteristics of the landscape. The re-establishment of flow can only happen during the rehabilitation phase – if properly planned. However, during this phase the implementation of plans to deal with AMD and altered flow regimes and water quality is critical in order to regain some of the original flow and water dynamics in the landscape.

7.10 SOCIO-ECONOMIC IMPACTS

The Socio-Economic Assessment undertaken during the EIA Phase is attached as Appendix F5.

7.10.1 Regional Study Area

The secondary area relates to the district and local municipality within Mpumalanga Province, as well as the ward in which the study area is located. As this provides a general background of the area and its population, it will be disucssed prior to the primary study area.

The Project includes sections of the Nkangala and Gert Sibande District Municipalities, with the relevant local municipalities being Steve Tshwete and Govan Mbeki. The major towns in Govan Mbeki include Bethal, Embalenhle, eMzinoni, Lebogang, Secunda and Evander. The towns with the highest population within Msukaligwa include Ermelo, Phumula and Wesselton. Within Steve Tshwete, the towns with the highest populations include Middelburg, Mhluzi and KwaZamokuhle; Hendrina has a small population but is quite strategic to Steve Tshwete.

The mining sector within Gert Sibande has declined from 36.1% in 1996 to 23.9% in 2012 while the mining sector has increased significantly in Nkangala from 49.1% in 1996 to 69.4% in 2012. Mining is an important economic activity within Nkangala. The mining sector is the largest sector within the NDM, contributing approximately 40.9% of the total Gross Value Add (GVA) (Nkangala District Municipality, 2017). Mining activities occur towards the southern regions of Nkangala, however, within the southern regions, crop farming especially maize and vegetables, is encouraged while cattle and game farming is encouraged in the northern regions (Nkangala District Municipality, 2017). Nkangala has significant mining potential which has the potential to contribute towards employment opportunities. This however, may result in sporadic urban settlement patterns and increased influx of labourers into the area resulting in mushrooming of informal settlements.

Steve Tshwete is situated centrally within Nkangala and consists of many industries and companies such as Columbus Steel, power stations, local mines and many strong agricultural areas. Steve Tshwete has one of the largest economies within Nkangala and is dominated by the mining sector following behind the manufacturing of steel (Nkangala District Municipality, 2017).

The mining sector within the Gert Sibande specifically within Govan Mbeki contributes largely towards Mpumalanga's GVA. Products that are mined in Gert Sibande are gold and coal. Gert Sibande contains four operational coal-fired power stations, situated within close proximity to the coal mines. Leading sectors within Gert Sibande include trade, community, mining and agriculture. Over the years, there has been a decrease in the role that the agricultural and trade sectors have played and the community and mining sectors have increased in terms of employment opportunities (Nkangala District Municipality, 2017). Similarly to Nkangala, the increase in mining activities attracts an influx of labourers, placing pressure on the receiving environment and resources.

7.10.2 Steve Tshwete Local Municipality

The regional study area is defined as Ward 4 of the Steve Tshwete Local Municipality (STLM) within the Nkangala District Municipality (NDM), Mpumalanga Province, in which the proposed Project is located.

Ward 4 comprises the rural areas along the southern parts of STLM. The Ward borders Emalahleni District Municipality to the east and Gert Sibande District Municipality to the north. The town of Komati as well as Komati Power Station is located in this Ward as well as coal mines including Koornfontein and Goedehoop Colliery. Population densities for the local municipality are generally low in Ward 4. In 2011 the Ward had a total population of 9 409 or 4.1% of the STLM population. This population comprise of 3 640 households which equates to an average household size of about 2.6 members.

The demographics, households, economics, education and service delivery aspects for Ward 4 and STLM are discussed below to provide a background of the area and insights for the socio-economic assessment. The information was obtained from Statistics South Africa (Census, 2011).

Demographics

The total population of STLM accounts for about 19.3% (one-fifth) of the NDM. The total population of STLM and Ward 4 in 2011 was 278 749 and 9 409, respectively. The age median for STLM is 27, with 31% of the population being under 18, and 65% of the population between 18-64 years of age. 96.4% of the population is South African residents.

The majority of the population group according to the Community Survey (2016) in STLM is black (82%) followed by white (14%). The most prominent language spoken within Ward 4 is IsiZulu (25%), followed by Afrikaans (15%) and IsiXhosa (14%).

Households

The average household size is indicative of the quality of life in any given study area. The type of dwellings for the Mpumalanga province, NDM, STLM (Community Survey 2016) and Ward 4 (Census 2011) are indicated below. Most of the people stay in formal dwellings followed by informal dwellings (shacks), most notably a higher amount of people not staying in a house or brick/concrete block structure compared to the rest of the province. Specifically, Ward 4 has more informal dwellings (24.8%) compared to the statistics for STLM (14.4%) and NDM (15%).

Table 7-27: Type of dwelling Mpumalanga, NDM, STLM (Community Survey 2016) and Ward 4 (Census 2011).

	Mpumalanga	NDM	STLM	Ward 4
Caravan/tent	0%	0%	0.2%	0.4%
Cluster house in complex	0.4%	0.6%	0.3%	0.4%
Flat or apartment in a block of flats	1.1%	1.5%	4.3%	0.4%
House/flat/room in backyard	6%	6.2%	9%	1.3%
House or brick/concrete block structure on a separate stand or yard or on a farm	75.3%	70.6%	64.8%	59.6%
Informal dwelling (shack; in backyard)	4.2%	5.3%	6.6%	1.8%
Informal dwelling (shack; not in backyard; e.g. in an informal/squatter settlement or on a farm)	6.7%	9.8%	7.8%	23%
Other	1.2%	1%	1.4%	2.6%
Room/ flat-let on a property or larger dwelling/servants quarters/granny flat	1%	0.9%	1.1%	1.1%
Semi-detached house	0.6%	0.8%	1.6%	0.7%
Townhouse (semi-detached house in a complex)	0.5%	0.9%	0.9%	0%
Traditional dwelling/hut/structure made of traditional materials	3.2%	2.3%	2.1%	1.3%
Unspecified	0%	0%	0%	0.6%

More than 50% of households in Ward 4 are rented, with only 13% fully owned or being paid off. This is less compared to STLM (41%), NDM (57.4%) and the province (58%). Men dominate as the head of the household (81%), which is exceptionally high compared to NDM (64%) and Mpumalanga (60%). Only 6 Households have heads under the age of 18 years old.

The average annual household income is R57 300 (range R40 000 - R75 000) for 22.6% of the household, which is higher compared to NDM (15.8%) and Mpumalanga (13.3%). This could be mainly due to the higher employment rates from the existing coal mines, the Komati Power Station and the agricultural sector.

The goods available by household are indicated below.

Table 7-28: Goods available by household for Mpumalanga, NDM, STLM and Ward 4. Goods that are significantly lower for Ward 4 compared to the rest of the province is indicated in bold.

	Mpumalanga	NDM	STLM	Ward 4
Cell phone	90.7%	91.8%	93.3%	92.1%
Computer	16.1%	18.8%	25.3%	12.1%
DVD player	59.8%	58.8%	64.7%	**42.2%**
Electric/gas stove	74.5%	76.3%	81.5%	**55.6%**
Landline/telephone	6.3%	7.2%	12.2%	4.2%
Motor-car	26%	30.4%	39.5%	25.7%
Radio	68.4%	71.8%	75.4%	67.4%
Refrigerator	70.1%	70.8%	72.5%	**46.2%**
Satellite television	24.4%	22.3%	27.5%	**12%**
Television	74.4%	75.5%	80.4%	**55.4%**
Vacuum cleaner	11.5%	14.7%	22.9%	13.3%
Washing machine	26.6%	36.3%	46.5%	20.1%

Education

In terms of education, the majority of the population of the municipality has some form of education with only 14.4% of the population having no schooling as depicted in the diagram below (Census 2011). According to the 2016 Community Survey, the population in STLM aged >20 completed grade 12, increased from 73 793 in 2011 to 97 943 (increase of 24 150) in 2016 which translate to an increase of 32.7% in the relevant period. The grade 12 pass rate improved from 74.4% in 2011 to 86.3% in 2015 and became the 2nd highest in the Province (IDP 2018).

Economics

The Middelburg Central Business District and Hendrina Central Business District are the primary economic activity nodes within the STLM. Retail development, offices, government buildings and municipal offices are located in this node.

Furthermore, the STLM is aligned to many economic developments in the province like the Maputo Corridor, Phase 3 development of Middelburg mall, mining development and implementation of SLPs, Industrial Park adjacent to Mhluzi (possible job creation and SMME Development).

The coal mines in the area are the main employers of local labour. The mining operations supply coal to Eskom for power generation. It is forecast that these mines have a lifespan of 25-35 years. Thus, mining will continue to dominate the local economy according to the IDP (2018). According to the STLM, it is however, necessary to begin to consider and plan for the resultant impact of downscaling and the possible closure of mines and the possible decommissioning of power stations as these impacts on the employment levels and capacity of residents to pay for services. If the local coal is not taken up by Eskom for power generation, then the municipality would need to consider whether there is the necessary infrastructure in place for local coal to be exported to other markets. Consideration must be made on the environmental impacts of mining especially the air pollution arising from the current mining operations and the power generation stations. Of strategic importance is rehabilitation plans for mining land, with the view to unlocking the value of land and for planning the uses of land in the future post mining.

There have already been retrenchments with the closures of mines and power plants. In this respect, the Social and Labour Plans (SLPs) of mines need to be linked more intrinsically to the overall growth and development of the municipal area and ensure the re-skilling of workers for new economic activity.

The only significant manufacturer within the STLM is Columbus Steel, a manufacturer of stainless steel and the 2nd biggest employer in the municipality. To diversify the economy, the value chain on manufacturing arising from mining by-products needs to be explored for additional opportunities. The existence of a steel incubation programme and the current skills base indicates an opportunity to create a steel hub. A clustering approach based on diversification would be needed. To support innovation the linking up of different economic activities both production and services to research activities would be needed. This would have the potential to bring the manufacturing, education, trade and service sectors into one consolidated umbrella (DP 2018).

Employment

The unemployment rate of Steve Tshwete decreased slightly from 19.7% in 2011 to 16.4% in 2015 and was the lowest among all the municipal areas of Mpumalanga. For females the unemployment rate is 21.8% and that of males 12.9%. Youth unemployment rate is about 27.1%; a challenge with especially very high youth unemployment rate of females.

Mining, trade and manufacturing are the major leading employment drivers in STLM.

Table 7-29: Population by employment status.

Indicators	South Africa	Mpumalanga	Nkangala DM	Steve Tshwete LM	Ward 4
Discouraged work-seeker	3.5%	3.7%	3.3%	2.2%	2.9%
Employed	25.5%	24%	27.2%	37.4%	44.7%
Not applicable	34.5%	35.9%	33.5%	29.3%	20.8%
Other not economically active	25.7%	25.3%	24.4%	21.9%	21.3%
Unemployed	10.8%	11.1%	11.6%	9.2%	10.3%
Unspecified	0%	0%	0%	0%	0%

Service Delivery

Steve Tshwete Local Municipality has made great strides in providing this basic service to its communities:

- 94.1% of the population are getting water from a regional or local service provider
- 87% have access to electricity
- 81.7% have access to flush or chemical toilets

- 81.1% are getting refuse disposal from a local authority, private company or community members

Even though Access to water and sanitation remains fairly high in STLM, due to households increase between 2011 and 2016, the percentage of households with water and sanitation has decreased. The 2016 Community survey reveals that, 81.9 of households had access to potable water (household connections and communal stands) and 85.4% had flush and chemical toilets. In 2014, the Blue Drop Certified Systems awarded STLM a blue drop score of 97.1% (ranked 1st in the province, noting that the municipality continues to manage drinking water within their area of jurisdiction with distinction. STLM was ranked second in terms of waste water services in the Green Drop Report which was at 61.9% (IDP 2018).

Census 2016 shows that the municipality continues to improve expanding the access to refuse removal. About 85% households had access to refuse removal on a regular basis. The municipal service extends to all the municipal towns but exclude the mining towns and rural areas which are self serviced.

Social Infra-structure

Poor road infrastructure exists within Nkangala and Steve Tshwete as heavy vehicles transporting coal travel along routes which are not designed to accommodate heavy vehicles, thus deteriorating the conditions of the roads (Nkangala District Municipality, 2017). Similar road conditions are experienced within Gert Sibande where many of the roads are utilised by coal trucks and result in damage to road infrastructure. Accidents that occur as a result of coal trucks also result in loss of life and livestock, affecting farmer's livelihoods (Gert Sibande District Municipality, 2017). Additionally, the poor conditions of the roads used by coal trucks result in high maintenance costs.

Health

When examining issues of health, statistics show that the number of people with HIV has begun to increase since 2010. HIV/AIDS has a devastating effect on the social and economic development of Steve Tshwete's population and Council will, therefore, persist with its efforts in this area. The Council has adopted an HIV/AIDS Strategy which is in line with the National and Provincial Framework.

HIV and AIDS is one of the biggest challenges the country is facing. The rate of infection is rapidly increasing and more and more people are getting ill and dying from AIDS. According to the 2013 Antenatal Care Survey, HIV prevalence rate has decreased from 52%- 43%. This positive change can be attributed to the active Aids Council, vigorous HCT campaigns and community awareness. HIV/AIDS has a devastating effect on the social and economic development of Steve Tshwete's population and the Council in collaboration with various stakeholder will continue to maximize its efforts in this area, in order to ensure that prevalence rates decreases (IDP 2018).

The social and economic consequences of the disease are far reaching and affect every facet of life in South Africa. HIV/AIDS affects economic growth and poverty via various impact channels. At the household level, a wide range of factors influence poverty; these include vulnerability from deteriorating livelihoods, heightened stigmatism, fragmentation of social networks, and lower investments in human capital and nutrition. Moreover, while households are directly affected by HIV/AIDS, there are also broader implications for the economy as a whole.

According to the 2011 Census, Influenza and pneumonia, accidental injury and Tuberculosis are the top major causes of death within the STLM. HIV and diabetes constitutes a lesser in the municipality's death rate.

7.10.3 Local Study area

This section focuses on the characteristics of the primary study area, the area likely to experience impacts related to the physical intrusion of Project infrastructure and project-related activities. This study area is defined as the extent of the mining right area: Portion of Portion 1, Portion 2 and the remaining extent of the Farm Dunbar 189 IS, Portion 1 of the Farm Middelkraal 50 IS and Portion 6 of the Farm Halfgewonnen 190 IS. The following aspects of the study area are described:

- Land ownership;
- Socio-economic characteristics of the population residing in the vicinity of the study area; and
- Stakeholder perceptions and attitudes.

Agricultural practices such as the planting of maize and soya crops are the dominant land features in the mining right area (Figure 7-51). Cattle grazing occurs to a lesser extent, and is mostly subsistence farming and are traditionally linked rather from a commercial perspective.

.

Figure 7-51: Agricultural activities on the proposed project study area.

7.10.4 Economic

Several indicators exist that can describe the economy of a region or an area. The most common variables that are used for the analysis include production and Gross Domestic Product per Region (GDP-R) or Gross Value Added (GVA). The GDP-R represents the total value of sales of goods and services, or the turnover of all economic agents in a region; while the GVA, using the output approach, represents the sum of value added created by all residents within a certain period, which is typically a year. The trend at which the GDP-R has been changing in the past is also referred to as an economic growth indicator. It is a measure of both the performance of an area and the well-being of the citizens of an area.

Mpumalanga's economy is dominated by mining, mostly coal for the Eskom power plants that are also located in the province. Mpumalanga also has extensive heavy industry, which forms part of the long-standing Highveld complex, and a strong commercial agricultural sector. These industries have driven its growth since 2011. The strength of Mpumalanga's major sectors has meant the province has been mainly at, or above, the national average for employment levels and remuneration.

While Mpumalanga, with 4 335 963 residents, accounted for about 10% of South Africa's population in 2016, it contributed 7% of the GDP. In 2014, the real economy (represented by agriculture, mining, trade, manufacturing and construction) made up 40% of Mpumalanga's output. The real-economy sector was dominated by mining, at 22% of the provincial economy, followed by manufacturing at 12%, construction at 3%, and agriculture at 3%. Mpumalanga contributed 22% of national mining, 8% of national manufacturing, 9% of agriculture and 6% of construction.

Mpumalanga accounted for 6% of South African manufacturing employment. The top five manufacturing industries in Mpumalanga, in terms of employment, were basic iron and steel plus metal products; chemicals and plastic; food and beverages; glass and non-metallic minerals; and clothing, textiles and footwear. The province accounted for 9% of employment in basic iron and steel and metal products, its largest manufacturing industry. Its manufacturing was closely integrated into the Gauteng industrial sector.

Coal dominated mining employment in Mpumalanga, producing mainly to supply Eskom as well as for export. Generally, gold mining saw job losses during commodity explosions, while platinum mining, coal and iron ore created employment.

It should be noted that an in-depth economic assessment was not undertaken and according property valuations were not done in this report.

7.10.5 Stakeholder Engagement Plan

Social impacts already start in the planning phase of a project and as such it is imperative to start with stakeholder engagement as early in the process as possible. A Stakeholder Engagement Plan will assist Vandabyte to outline their approach towards communicating in the most efficient way possible with stakeholders throughout the life of the project. Such a plan cannot be considered a once off activity and should be updated on a yearly basis to ensure that it stays relevant and to capture new information. Stakeholders must provide input in the Stakeholder Engagement Plan.

The Stakeholder Engagement Plan should have the following objectives:

- To identify and assess the processes and/or mechanisms that will improve the communication between local communities, the secondary community and Dunbar.
- To improve relations between Dunbar staff, the surrounding landowners and the people living in the local communities.
- To provide a guideline for the dissemination of information crucial to the local communities in a timely, respectful and efficient manner.
- To provide a format for the timely recollection of information from the local communities in such a way that the communities are included in the decision making process.

The Stakeholder Engagement Plan should be compiled in line with International Finance Corporation (IFC) Guidelines and should consist of the following components:

- **Stakeholder Identification and Analysis** – time should be invested in identifying and prioritising stakeholders and assessing their interests and concerns.

- **Information Disclosure** – information must be communicated to stakeholders early in the decision-making process in ways that are meaningful and accessible, and this communication should be continued throughout the life of the project.
- **Stakeholder Consultation** – each consultation process should be planned out, consultation should be inclusive, the process should be documented and follow-up should be communicated.
- **Negotiation and Partnerships** – add value to mitigation or project benefits by forming strategic partnerships and for controversial and complex issues, enter into good faith negotiations that satisfy the interest of all parties.
- **Grievance Management** – accessible and responsive means for stakeholders to raise concerns and grievances about the project must be established throughout the life of the project.
- **Stakeholder Involvement in Project Monitoring** – directly affected stakeholders must be involved in monitoring project impacts, mitigation and benefits. External monitors must be involved where they can enhance transparency and credibility.
- **Reporting to Stakeholders** – report back to stakeholders on environmental, social and economic performance, both those consulted and those with more general interests in the project and parent company.
- **Management Functions** – sufficient capacity within the company must be built and maintained to manage processes of stakeholder engagement, track commitments and report on progress.

7.10.6 Proposed Grievance Mechanism

In accordance with international good practice the proposed Dunbar Coal Mine should establish a specific mechanism for dealing with grievances. A grievance is a complaint or concern raised by an individual or organisation that judges that they have been adversely affected by the project during any stage of its development. Grievances may take the form of specific complaints for actual damages or injury, general concerns about project activities, incidents and impacts, or perceived impacts. The IFC standards require Grievance Mechanisms to provide a structured way of receiving and resolving grievances. Complaints should be addressed promptly using an understandable and transparent process that is culturally appropriate and readily acceptable to all segments of affected communities, and is at no cost and without retribution. The mechanism should be appropriate to the scale of impacts and risks presented by a project and beneficial for both the company and stakeholders. The mechanism must not impede access to other judicial or administrative remedies.

The grievance mechanism should be based on the following principles:

- Transparency and fairness;
- Accessibility and cultural appropriateness;
- Openness and communication regularity;
- Written records;
- Dialogue and site visits; and
- Timely resolution.

Based on the principles described above, the grievance mechanism process involves four stages:

- Receiving and recording the grievance;

- Acknowledgement and registration;
- Site inspection and investigation; and
- Timely Response.

7.10.7 Stakeholder Perceptions

Stakeholder perceptions of a proposed development are critical inputs into the socio-economic process. A thorough understanding of the origin of stakeholder perceptions is therefore required, not only to put impacts into perspective, but also to identify mitigation measures that will address potential social risks to the proposed project.

In addition to the stakeholders interviewed for the SIA study, the SIA also takes into account the stakeholder issues and concerns raised during the public participation process for the scoping and EIA study, which is still on-going. The public participation process has already consulted key stakeholders and government departments at the regional level, as well as landowners and other local-level stakeholders. Consultations for the SIA focused on potentially affected parties in the project area.

The main 'social' issues and concerns raised these respondents are summarised below:

- In general landowners are not very resistant to the project. Limited interaction during the process including providing no comments on the draft scoping report, not attending public meetings or completing the questionnaires attest to this;
- Loss of agricultural land which has implications for food security regionally and nationally;
- Coal dust will affect grazing capacity of land as well as crop yield of maize and soya;
- Loss of temporary seasonal farm employees. They do not necessarily have the skills to work on a coal mine or do not necessarily want to, and they and their dependants could be affected negatively;
- Loss of sense of place, mostly as a result of potential air, noise and visual pollution, population influx, increased traffic and perceived increase in crime;
- Concerned about the groundwater of the area, as most farmers and people within the community are dependent on boreholes for water supply. Dewatering of mining pits could impact on the catchment area;
- Pollution of ground and surface water. It is strongly believed that the proposed mine could pollute water sources, especially boreholes and the Leeufonteinspruit;
- Health problems associated with dust and other particles that emanate from the mining activities;
- Neighbouring property owners adjacent the mine, which will not be bought out by the mine, are concerned that the mine will ultimately result in a devaluation of their property or impact the viability of their farming operations;
- Damage incurred by blasting will result in damage to agricultural land;
- Uncertainties to whether compensation for land will be sufficient;
- People that have no work are hoping for the mine to establish in order to apply for jobs;
- That the proposed coal mine is not sustainable, and will be detrimental to the environment.

7.10.8 Summary and recommendations

The proposed Dunbar Coal Mine is situated in an area with complex social dynamics. The secondary study area is already exposed to a number of social and environmental impacts (both positive and negative) from different sources, including existing coal mines and Eskom Power Plants.

The impact rating pre-mitigation during the **construction** phase indicated one very high and one high negative impact, seven medium-high negative impacts, three medium-high positive impacts and one medium-low positive impact. After mitigation measures have been applied, one high negative impact exists, one medium-high negative impacts and three medium-low negative impacts. Most positive impacts after mitigation are medium-high due to the short time period of the construction phase, and most mitigation measures for positive impacts remain unchanged. Exceptional intervention and implementation is required to increase positive impacts to high. It must be considered that there will also be positive social impacts, such as skills development, CSI projects and SLP projects. Should the proposed Dunbar Coal Mine not be allowed, these impacts will fall away.

The impact rating pre-mitigation during the **operational** phase indicated two high and two medium-high negative impacts. The positive impacts indicated five as high and one as medium-high. After mitigation measures have been applied, negative impacts were reduced to medium-high or medium-low and most positive impacts as high. As already mentioned, social impacts are complex and multi-facet, making rating of these impacts difficult.

Even after mitigation measures have been applied, some high negative impacts are still perceived as medium, as the perception of the community regarding the mine and the authorities to deal with their issues affectively are negative. Furthermore, stakeholders who are directly affected by the proposed mine perceptions are not favourable. The mine would have to strictly adhere to the proposed mitigation measures as well as proactive measures and management of issues in order to ensure social aspects of the mine could be brought to low, which is not impossible. Continuous consultation with the community and landowners are vital, as well as with the local municipalities to resolve issues optimally.

If approved, the Dunbar Coal Mine will need to maintain relationships with the community and surrounding landowners during the construction and operational phase. This is not always an easy task, due to possible mistrust and division in the community, which could make it incredibly hard to engage with them. However, if good relationships are not maintained, it may come at a great cost to the mine later on.

Many of the issues faced by the community have historic roots and include the failure of government to fulfil their mandate in terms of services and the current dire socio-economic conditions in South Africa. Therefore cumulative impacts are high for the secondary study area, where the proposed Dunbar Coal Mine could be responsible for either alleviating some of these issues or exacerbate them. The SLP should be used as a tool in order to alleviate current social and economic issues within the primary study area.

The environmental and health impact of coal is undeniable, and some negative impacts of coal mines can be seen in surrounding areas where rehabilitation and mine closure have not taken place. However, without the mine the socio-economic conditions for many residents impacted on by poverty in the local community could deteriorate further.

7.11 PALAEONTOLOGICAL

The Desktop Palaeontological Assessment undertaken during the EIA Phase is attached as Appendix F6.

A Phase 2 (or site visit) Palaeontological Impact Assessment was requested for the proposed Mining Rights Application. To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a site visit was made on 5-7 August 2019, and the results to follow.

7.11.1 Project location and geological context

The site, Portion of Portion 1, Portion 2 and the remaining extent of the Farm Dunbar 189 IS, Portion 1 of the Farm Middelkraal 50 IS and Portion 6 of the Farm Halfgewonnen 190 IS, lies in the heart of the Witbank coalfield that is in the north eastern part of the Main Karoo Basin. Mudstones, siltstones, sandstones and coal seams have filled in the uneven topography of the basin during the Permian and Triassic periods. Jurassic dolerite dykes have cut through these sediments, mostly to the south and west of this area, and are associated with the Drakensberg basalt outpourings. To the south of the site are several small exposures of the much older Selons River Formation that are part of the Rooiberg Group, Transvaal Supergroup. These porphyritic rhyolites (volcanic rocks) are now called the Kwaggasnek and Schrikkloof Formations (Rooiberg Group; Buchanan, 2006) and are dated between 2061 to 2052 Ma. Since they are ancient rocks and of volcanic origin so do not preserve fossils of any kind, they will not be considered further.

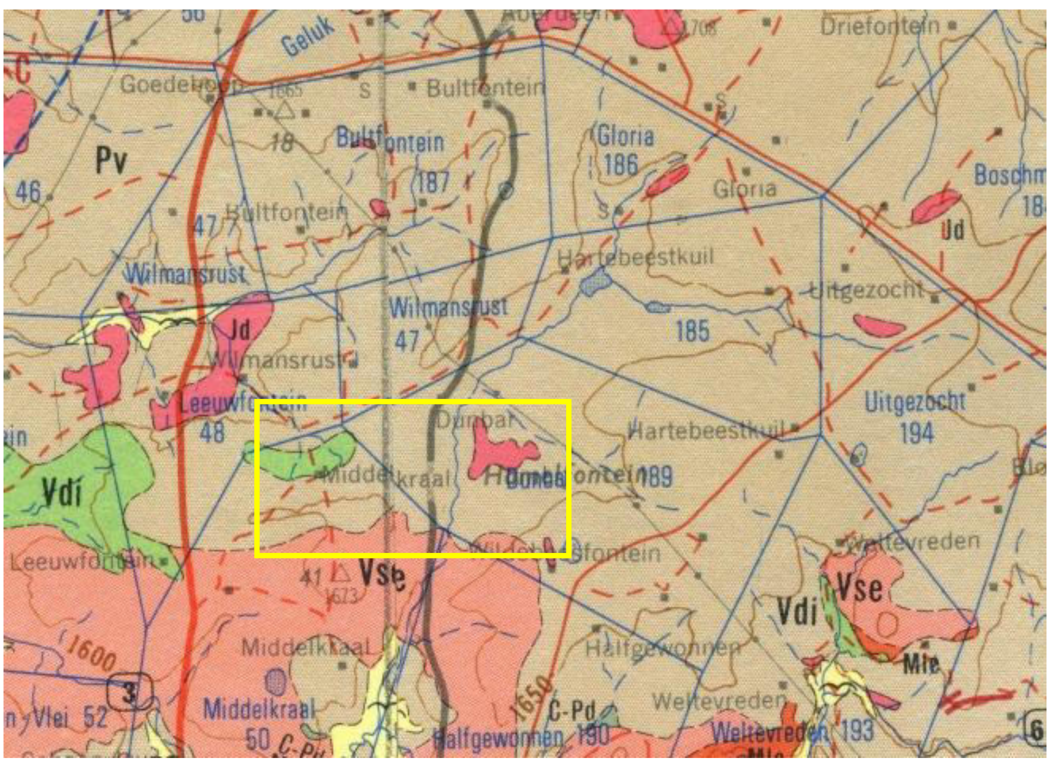


Figure 7-52: Geological map of the area around the farm Dunbar 189, west of Hendrina. The location of the proposed project is indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2628 East Rand.

Table 7-30: Explanation of symbols for the geological map and approximate ages (Buchanan, 2006. Johnson et al.). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Pv	Vryheid Fm, Ecca Group, Karoo SG	Shales, sandstone, coal	Early Permian, Middle Ecca
Vdi	Diabase		
Vse	Selons River Fm, Rooiberg Group, Transvaal SG	Porphyritic rhyolite with interbedded mudstone and sandstone	Ca 2061-2052 Ma

7.11.2 Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 7-53. The site for mining is in the Vryheid Formation and it contains up to six coal seams. Although coal is formed from the extreme compression and heat alteration of peats and peats are formed from buried accumulations of plant material growing in swampy environments, coal itself does not contain any recognisable fossil plant material. The shales and mudstones associated with the coals, however, are likely to preserve impressions of plants from the *Glossopteris* flora, for example *Glossopteris* leaves, reproductive structures, lycopods, sphenophytes, ferns, cordaitaleans and early gymnosperms. A few terrestrial vertebrates had evolved by the early Permian but bones are very seldom preserved together with fossil plants because they require different conditions for preservation. No fossils vertebrates are likely to occur in the Vryheid Formation.

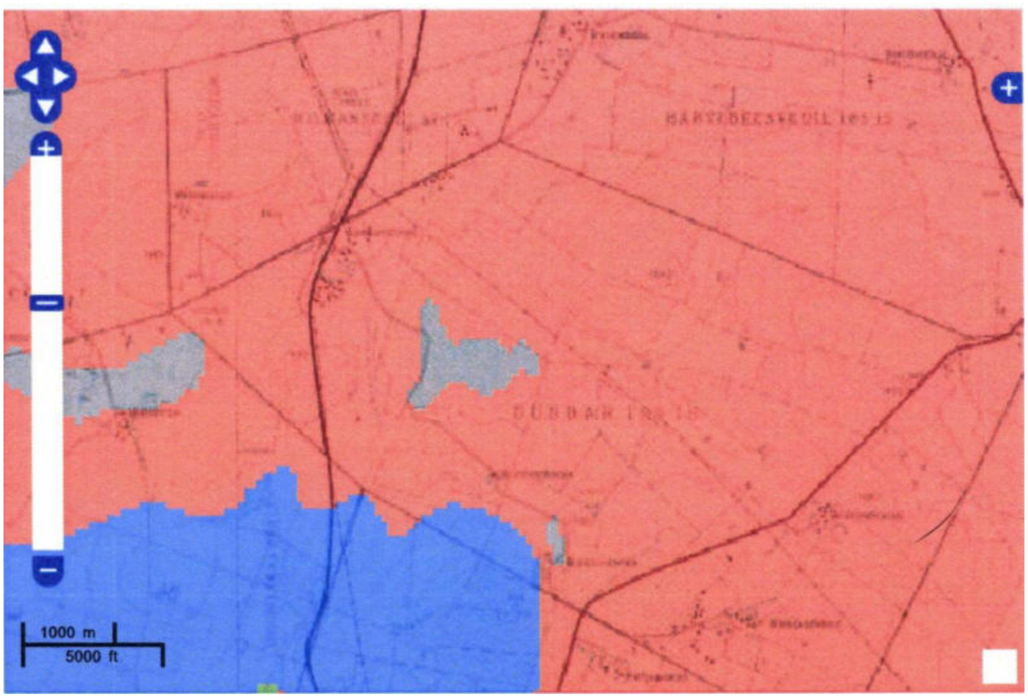


Figure 7-53: SAHRIS palaeo-sensitivity map for the site for the proposed coal mine on Farm Dunbar 189 shown within the yellow rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

Geotechnical cores have been drilled throughout the coalfields and for the Hendrina area the uppermost coal seam is about 18m below the surface soils. The soils are 10-14m deep and they overlie shales and mudstones that overlie the coal (Snyman, 1998). Fossils will not occur in the soils or coal but can occur in the shales and mudstones.

7.11.3 Findings and Recommendations

From the SAHRIS map above the area is indicated as both insignificant (grey) and very highly sensitive (red) so a site visit was conducted (as this is required) and the observations are shown below.

Table 7-31: Observations at each site with GPS coordinates and corresponding photograph taken at or near the point by Rick Tolchard, 5-7 August 2019.

Location	Observations	Figure
Point 1 - S26°10.144', E29°30.847' (1387m)	Abandoned field, deep soils and no rocks or shales exposed	4
Point 2 - S26°10.272', E29°30.833' (1619m)	Depression with some water and showing the deep, dark soils in the abandoned/fallow fields. No rocks or shales exposed	5
Point 3 - S26°11.015' E29°31.530' (1648m)	Old farmhouse in the distance; deep soils and no rocks or shales exposed	6
Point 4 - S26°11.071', E29°31.538' (1657m)	Example of the rare rocks with leaves and cobs of the maize crop; no fossils	7
Point 5 - S26°11.134' E29°31.322' (1639m)	Rare rock, no fossils	8
Point 6 - S26°10.948' E29°31.105' (1632m)	Grasses on deep soils; no rocks or fossils	No photo
Point 7 - S26°10.702', E29°30.900' (1631m)	Lateritic rock visible from fence, not in the farm area	9
Point 8 - S26°10.053', E29°31.210' (1628m)	Abandoned/fallow field; deep soils and no rocks or fossils	10
Point 9 - S26°10.562', E29°31.679' (1641m)	Recently ploughed field showing deep dark soils	11

Based on survey and observations during the site visit, it is clear that there are no fossils present in the soils. There is a very small chance that fossils may occur in the shales and mudstones associated with the coal seams. In this area the soils are about 10-14m deep so there is a chance that fossils occur below this depth. Their occurrence in the Vryheid Formation (Ecca Group) is sporadic and unpredictable. A Fossil Find Protocol should be added to the EMPr: if fossils are found once mining has commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample.

Figure 7-54: Point 1 of site visit – abandoned field and no rocks or shales visible

Figure 7-55: Point 2 – depression with water showing deep soils.

Figure 7-56: Point 3 – Old farmhouse in the distance; abandoned or fallow field on deep soils.

Figure 7-57: Point 4 – only rock in the area.

Figure 7-58: Point 5 - sandstone with no fossil impressions.

Figure 7-59: Point 7 - Lateritic rock seen on the other side of the fence; no fossils.

Figure 7-60: Point 8 – abandoned or fallow field on deep soil; no rocks or shales or fossils.

Figure 7-61: Point 9 – ploughed field showing deep soil; no rocks or fossils.

7.12 HERITAGE

The Heritage Impact Assessment (HIA) undertaken during the EIA Phase is attached as Appendix F7.

During the survey no archaeological features were recorded, but the ruins of a farmstead with associated buildings and a stone cairn were recorded. General site conditions and features on sites were recorded by means of photographs, GPS locations, and site descriptions. Possible impacts were identified and mitigation measures are proposed in the following report. SAHRA as a commenting authority under section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) requires all environmental documents, complied in support of an Environmental Authorisation application as defined by NEMA EIA Regs section 40 (1) and (2), to be submitted to SAHRA. As such the EIA report and its appendices must be submitted to the case as well as the EMPr, once it is completed by the Environmental Assessment Practitioner (EAP).

7.12.1 Archaeology of the area

The Stone Age is divided in Early; Middle and Late Stone Age and refers to the earliest people of South Africa who mainly relied on stone for their tools.

Very few Early Stone Age sites are on record for Mpumalanga and no sites dating to this period are expected for the study area. An example in Mpumalanga is Maleoskop on the farm Rietkloof where ESA tools have been found. This is one of only a handful of such sites in Mpumalanga.

The MSA has not been extensively studied in Mpumalanga but evidence of this period has been excavated at Bushman Rock Shelter, a well-known site on the farm Klipfonteinhoek in the Ohrigstad district. This cave was excavated twice in the 1960's by Louw and later by Eloff. The MSA layers show that the cave was repeatedly visited over a long period. Lower layers have been dated to over 40 000 BP (Before Present) while the top layers date to approximately 27 000 BP (Esterhuizen & Smith in Delius, 2007; Bergh, 1998). Some isolated finds were recorded close to Witbank as well by Huffman (1999) on the farm Rietfontein.

The Later phases of the Stone Age began at around 20 000 years BP. This period was marked by numerous technological innovations and social transformations within these early hunter-gatherer societies. These people may be regarded as the first modern inhabitants of Mpumalanga, known as the San or Bushmen. They were a nomadic people who lived together in small family groups and relied on hunting and gathering of food for survival. Evidence of their existence is to be found in numerous rock shelters throughout the Eastern Mpumalanga where some of their rock paintings are still visible. A number of these shelters have been documented throughout the Province (Bornman, 1995; Schoonraad in Barnard, 1975; Delius, 2007). These include areas such as Witbank, Ermelo, Barberton, Nelspruit, White River, Lydenburg and Ohrigstad.

Three late Stone Age sites are on record in the greater area. The sites are Welgelegen Skuiling close to Ermelo, Chrissiesmeer (also known for rock art) and lastly Groenvlei close to Carolina, this area is also known for rock art (Bergh 1999).

The Iron Age as a whole represents the spread of Bantu speaking people and includes both the pre-Historic and Historic periods. It can be divided into three distinct periods:

- The Early Iron Age: Most of the first millennium AD.
- The Middle Iron Age: 10th to 13th centuries AD
- The Late Iron Age: 14th century to colonial period.

The Iron Age is characterised by the ability of these early people to manipulate and work Iron ore into implements that assisted them in creating a favourable environment to make a better living. No Early Iron Age sites are on record in the greater region. Around 220 Late Iron Age stone walled sites are on record to the east of the study area (Bergh 1999) and is also associated with numerous pre-*difaqane* and *difaqane* wars that took place during the last quarter of the 18th century and during the first three decades of the 19th century. The sites are located close to Bethal. The study area was most probably inhabited by the Phuting group (Berg 1999). Around the study area the Phuting moved south due to the Ndebele migration (Difaqane). These wars led to the displacement of large numbers of Tswana clans on the Highveld where Mzilikazi's Ndebele caused chaos and havoc.

Late Iron Age settlements are characterised by extensive dry stonewalls and dates back to the 17th century. Late Iron Age communities who contributed to this stone walled architecture were the Sotho, Pedi, Ndebele and Swazi. The stone building tradition that these indigenous groups established many decades before the first colonial settlers arrived, may have influenced the colonial farmers to utilize these same resources as building material for the first farmsteads which arose on the Eastern Highveld (Pistorius 2006).

7.12.2 Historical Background

Sites dating to the historic period occur sporadically in the study area. These are mostly farming related, although some mining sites also occur. The farming related sites are usually farmsteads and farm cemeteries, either belonging to the landowners or their labourers. Mining related sites are for example the old Albion Colliery, dating to the 1940's

7.12.3 The Anglo-Boer War (1899-1902)

The Anglo-Boer War, which took place between 1899 and 1902 in South Africa, was one of the most turbulent times in South Africa's history. Even before the outbreak of war in October 1899 British politicians, including Sir Alfred Milner and Mr. Chamberlain, had declared that should Britain's differences with the Z.A.R. result in violence, it would mean the end of republican independence. This decision was not immediately publicized, and as a consequence republican leader based their assessment of British intentions on the more moderate public utterances of British leaders. Consequently, in March 1900, they asked Lord Salisbury to agree to peace on the basis of the status quo ante bellum. Salisbury's reply was, however, a clear statement of British war aims (Du Preez 1977).

During the Anglo-Boer War, a number of battles took place in the region. The one closest to the study area took place on the farm Wilmansrust, some distance to the east, in June 1901. During this clash, more than 50 British troops were killed.

7.12.4 Cultural Landscape

The cultural landscape form part of the agricultural and mining landscape of the greater area. The area under investigation is located about four kilometres to the south of Meerlus and about 17 kilometres to the west of Hendrina in Mpumalanga Province.

7.12.5 Findings of the Survey

It is important to note that the entire farm was not surveyed. Only the footprint of the development was surveyed on foot and by vehicle. The study area is divided into a Northern section, a Southern section as well as a planned route for a future access road linking with an unnamed road towards the South East of the study area. The study area consists mostly of ploughed fields that have been extensively farmed for a number of years. The only areas not altered by agriculture are located on the boundaries of the ploughed fields and these areas are highly overgrown.

During the survey three features were recorded consisting of a stone cairn (Feature 1), ruins of a farmstead younger than 60 years (Feature 2) and the remains of a rectangular brick structure (Feature 3), and is described below.

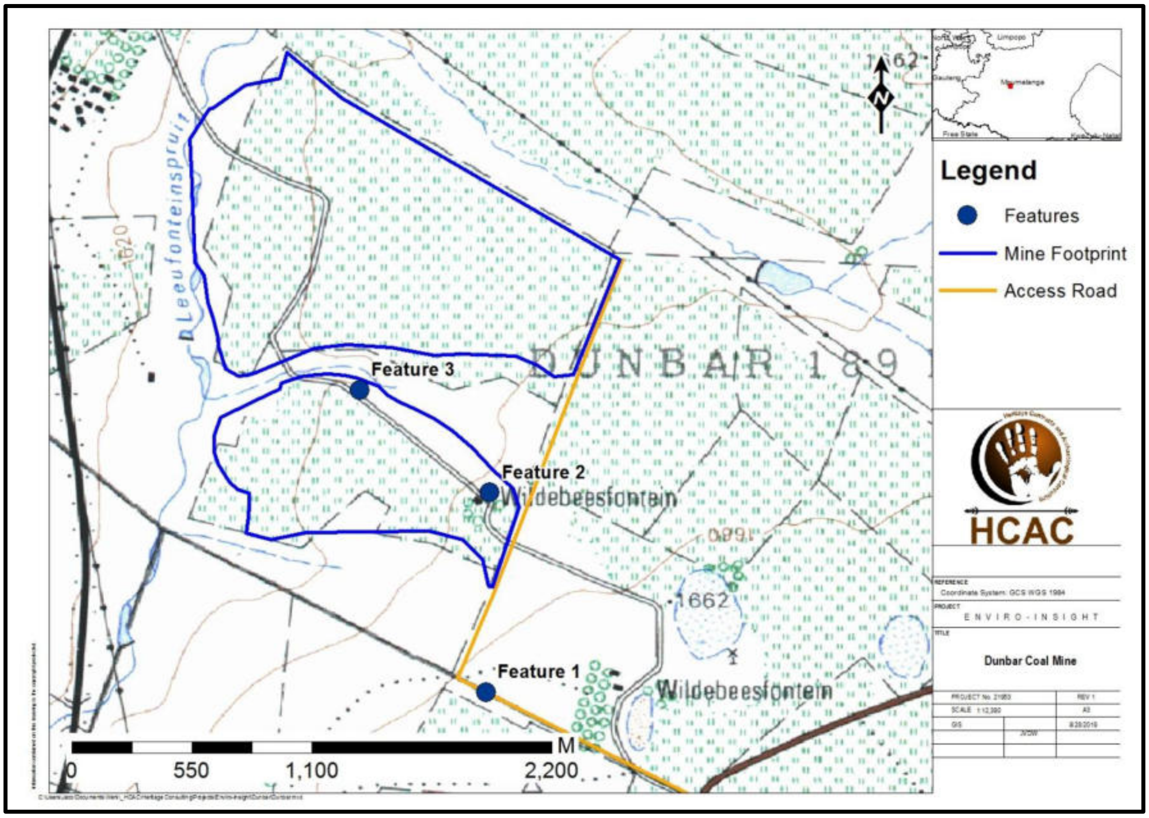


***Figure 7-62**: Site distribution map.*

Table 7-32: Features recorded during the assessment.

LABEL	LONGITUDE	LATITUDE	DESCRIPTION	IMPACT	SIGNIFICANCE
Feature 1	29° 31' 33.2617" E	26° 11' 31.2755" S	Stone Cairn	Direct	If confirmed to be a grave the feature is of high social significance. If not, the feature is of no heritage significance
Feature 2	29° 31' 33.8233" E	26° 11' 01.6188" S	Ruins of farm stead	Direct	No heritage significance
Feature 3	29° 31' 14.4417" E	26° 10' 46.3826" S	Ruin of rectangular brick structure	Direct	No heritage Significance

7.12.5.1 Built Environment (Section 34 of the NHRA)

Feature 2 consists of the ruins of the Wildebeesfontein farmstead that is located in the eastern corner of the southern section of the study area. This site consists of multiple buildings including a house, garage, outbuilding and a cement water reservoir. This site seems to be a modern farmstead that was abandoned within the last couple of decades. Based on historical maps this feature dates to between 1965 and 1984 and is therefore not older than 60 years and of no heritage significance.

Figure 7-63: Red brick structure viewed from the north

Figure 7-64: Red brick structure viewed from the west

Figure 7-65: Main dwelling viewed from the north east

Figure 7-66: Main dwelling viewed from the west

Feature 3 consists of the remains of a rectangular brick structure, possibly a pump house. This structure is not indicated on historical maps and is not considered to be of heritage significance.

Figure 7-67. Remains of Feature 3.

Field Rating – GP C: Heritage Significance – Low

7.12.5.2 Archaeological resources (Section 35 of the NHRA)

The cultural landscape of the greater study area is characterised by mining and agricultural developments and the project will not impact on significant viewscapes. The study area is located outside of the known distribution of Iron Age settlements in Mpumalanga and in the unlikely event that settlements did occur in the study area, the extensive ploughing of the study area would have destroyed surface indicators of such sites if they ever existed. The lack of Stone Age sites or artefacts can be a result of the local geology. The lithology of the study area consists of fine to coarse-grained sandstone, shale and coal seams with a small section in the centre with dolerite and minor ultrabasic rocks (1.25000 Geological Map) and no raw material suitable for knapping were noted in the study area and no archaeological sites were identified during the survey.

7.12.5.3 Burial Grounds and Graves (Section 36 of the NHRA)

Several sandstone outcrops occur within the ploughed fields but do not represent stone packed grave dressings (Figure 19). A stone cairn (Feature 1) of unknown purpose was recorded along the proposed access route (Figure 13) that could mark a possible grave although it is more likely that the pile consists of cleared stones for agricultural purposes. The stone cairn is located under a fence, measures approximately 1.2 meter wide by 2 meter long and is aligned east to west (Figure 20 – 21). If any graves are located in future they should ideally be preserved *in-situ* or alternatively relocated according to existing legislation.

Figure 7-68: Sandstone outcrop in agricultural field.

Figure 7-69: General view of Feature 1.

Figure 7-70: Stone cairn at Feature 1.

Figure 7-71: Stone cairn at feature 1.

Field Rating – GP A (if confirmed to be a grave)
Significance – High Social Significance (if confirmed to be a grave)

7.12.5.4 Battlefields or concentration camps

No Battlefield sites were identified in the project site.

7.12.5.5 Recommendations

The study area was assessed both on desktop level and by a field survey by archaeologists and palaeontologists. The study is applicable to the mine footprint and not to the mining right area. If the mine footprint changes from the current layout as assessed in this HIA the changes will have to be subjected to a walk down.

The study area consists mostly of ploughed fields that have been extensively farmed for a number of years. The study area is divided into a Northern section, a Southern section as well as a future access road linking with an unnamed road towards the South East of the study area. The only areas not altered by agriculture are located on the boundaries of the ploughed fields. These open areas on the sides of the fields also seem to have been worked in the past but is highly overgrown with weeds.

The study area is located outside of the known distribution of Iron Age settlements in Mpumalanga and in the unlikely event that settlements did occur in the study area, the extensive ploughing of the study area would have destroyed surface indicators of such sites if they ever existed. The lack of Stone Age sites or artefacts can be a result of the local geology. The lithology of the study area consists of fine to coarse-grained sandstone, shale and coal seams with a small section in the centre with dolerite and minor ultrabasic rocks and no raw material suitable for knapping were noted in the study area, and no archaeological sites were identified during the survey. Three features were however recorded namely a stone cairn (Feature 1), ruins of a farmstead younger than 60 years (Feature 2) and the remains of a rectangular brick structure (Feature 3).

Feature 1 is a stone cairn of unknown purpose that is located along the proposed access route and could mark a possible grave although it is more likely that the pile consists of cleared stones for agricultural purposes. The stone cairn is located under a fence, measures approximately 1.2 meter wide by 2 meter long and is aligned east to west. If Feature 1 is a grave it is oh high social significance.

Feature 2 consists of the ruins of the Wildebeesfontein farmstead that is located in the eastern corner of the southern section of the study area. This site consists of multiple buildings including a house, garage, outbuilding and a cement water reservoir. This site seems to be a modern farmstead that was abandoned within the last couple of decades. Based on historical maps this feature dates to between 1965 and 1984 and is therefore not older than 60 years and of no heritage significance (Figure 9 & 10). Feature 3 consists of the remains of a rectangular brick structure, possibly a pump house. This structure is not indicated on historical maps and is not considered to be of heritage significance.

In terms of the palaeontology an independent paleontological study was conducted (Bamford 2019) that concluded that the study area is located on the shales, mudstones, sandstones and coals of the Vryheid Formation, lower Ecca Group, Karoo Supergroup. During the site visit conducted by the palaeontologists no fossils and no shales were observed only deep soils, ploughed fields and fallow fields and concluded that until excavations and mining commence it is unlikely that any fossils would be observed and no further palaeontological site visits are required until fossils are found by the geologist or responsible person. However, since fossils plants of the Glossopteris flora will be associated with the shales close to the coal seams a Fossil Chance Find Protocol is recommended.

The impact of the proposed project on heritage resources is considered to be low with the correct mitigation measures in place and it is recommended that the proposed project can commence based on the following recommendations included as a condition of authorisation in the EMPr:

- It is recommended that the Stone Cairn (Feature 1) should be avoided by the development with a 15 meter buffer. If this is not possible, it should be confirmed whether the Stone Cairn represents a grave through a social consultation process. If it is indeed a grave, Feature 1 should preferably be avoided and retained *in situ.* If the feature is not a grave no mitigation is required. If any graves are located in future they should ideally be preserved in-situ or alternatively relocated according to existing legislation.
- The implementation of a chance finds procedure during the pre-construction and construction phase of the project as outlined in the HIA report.

7.13 TRAFFIC

The Traffic Impact Assessment (TIA) undertaken during the EIA Phase is attached as Appendix F8.

7.13.1 Surrounding Road Network

Considering the expected number of vehicle trips to be generated as a result of the proposed activities, as well as the expected distribution of these trips on the surrounding road network, the following existing roads were deemed relevant for the purpose of this study:

- **Road D622**: This road can be classified as a Class 3 road (minor arterial road) and fall under the jurisdiction of the provincial roads authority. Access to the Dunbar Coal Mine is proposed directly off this road.
- **Road R541 (P182/1):** This road can be classified as a Class 2 (major arterial road) and also fall under the jurisdiction of the provincial roads authority. This road links Road R38 (to Hendrina) with the R35 (to Komati), and
- **R35:** This road can also be classified as a Class 3 road (minor arterial road) and fall under the jurisdiction of the South African National Roads Authority Limited (SANRAL). This road links Komati to Bethal

7.13.2 Existing Traffic Flows

To determine the existing traffic demand on the surrounding road network, 13-hour manual traffic surveys were conducted on Wednesday 18 September 2019 at key intersections. From these surveys it was determined that the common peak traffic hours occurred between 06h15-07h15 for the AM peak hour and between 16h15-17h15 for the PM peak hour, with the PM peak hour slightly being the critical peak. The surveys also indicated the following relevant information:

- The R542 / Road D622 intersection is currently exposed to an estimated Average Daily Traffic (ADT) volume of approximately 2 900 vehicles per day;
- The R35 / R542 intersection is currently exposed to an estimated Average Daily Traffic (ADT) volume of approximately 5 400 vehicles per day, and
- The heavy vehicle proportion of the traffic on the surrounding road network is approximately 40%.

7.13.3 Baseline Operating Conditions

The baseline operating conditions for the key intersections are summarized in Table7-33. These operating conditions are based on the existing 2019 peak hour traffic volumes, as well as the existing intersections layout design and traffic control as per Drawing RUD001 in the TIA report.

The Level of Service (LOS) parameter is determined by the V/C ratio (ratio between the traffic volume and traffic capacity per movement, both measured in veh/h) and delay (time delay experienced, measured in seconds) values. LOS values can vary between “A” and “F”, with “F” being the worst operating condition. A LOS of “D” or better is deemed acceptable, with a LOS of “E” acceptable for right-turn traffic movements if adequate lengths of storage lanes are provided.

These baseline operating conditions tabulated below indicate that good traffic operating conditions are currently experienced at the key study intersections. These conditions would be influenced by the following variables:

- Traffic volumes;

- Intersection geometry, and
- Intersection traffic control.

7.13.4 Non-motorised and Public Transport

A public transportation and non-motorised transport assessment were carried out as part of this study.

Public transport in the study area is mainly provided by minibus taxis and busses. Taxis and busses were observed travelling along Road D622, Road R542 as well as Road R35.

The proposed development is expected to generate a considerable demand for non-motorised and public transport, but due to the remote location of the study site no new facilities are recommended. It is however recommended that transport be provided to and from the site during both the construction and operational phases of the project.

Table 7-33: Baseline operating conditions.

Intersection & approach definitions	Peak hour	Analysis parameters	Intersection capacity analysis results								
			Approach 1			Approach 2			Approach 3		
			L	T	R	L	T	R	L	T	R
R542 / Road D622 App 1: R542 SE App 2: R542 NW App 3: Road D622 SW	Week AM	V/C	0.02	0.06	-	-	0.07	0.07	0.04	-	0.04
		Delay (s)	6	0	-	-	1	7	7	-	9
		LOS	A	A	-	-	A	A	A	-	A
	Week PM	V/C	0.01	0.06	-	-	0.05	0.05	0.12	-	0.12
		Delay (s)	6	0	-	-	1	7	7	-	9
		LOS	A	A	-	-	A	A	A	-	A
R35 / R542 App 1: R35 S App 2: R542 E App 3: R35 N	Week AM	V/C	-	0.07	0.07	0.22	-	0.22	0.07	0.09	-
		Delay (s)	-	1	8	11	-	15	6	0	-
		LOS	-	A	A	B	-	C	A	A	-
	Week PM	V/C	-	0.09	0.09	0.29	-	0.29	0.06	0.08	-
		Delay (s)	-	0	8	11	-	17	6	0	-
		LOS	-	A	A	B	-	C	A	A	-

7.13.5 Impact during Construction Phase

To determine the traffic impact during construction, the following construction activity assumptions are made:

- A maximum of 300 construction workers will be on site;
- 80% of the construction workers will make use of public transport or transport provided by the contractor;
- The remaining 20% will make use of private transport, which is assumed to have a vehicle occupancy of 1.5 occupants per vehicle during the peak traffic hours, and
- An in: out traffic split of 80%:20% and 20%:80% is assumed for the AM and PM peak traffic hours respectively.

Based on the assumptions above the construction phase is expected to generate peak hour traffic volumes. Figure 7-72 presents the expected peak hour traffic volumes at the key study intersections during the construction phase.

Table 7-34: Expected traffic to be generated during the construction phase.

Peak Hour	Vehicle Trips Generated (Vehicles / hour)		
	In	Out	Total
AM	40	10	50
PM	10	40	50

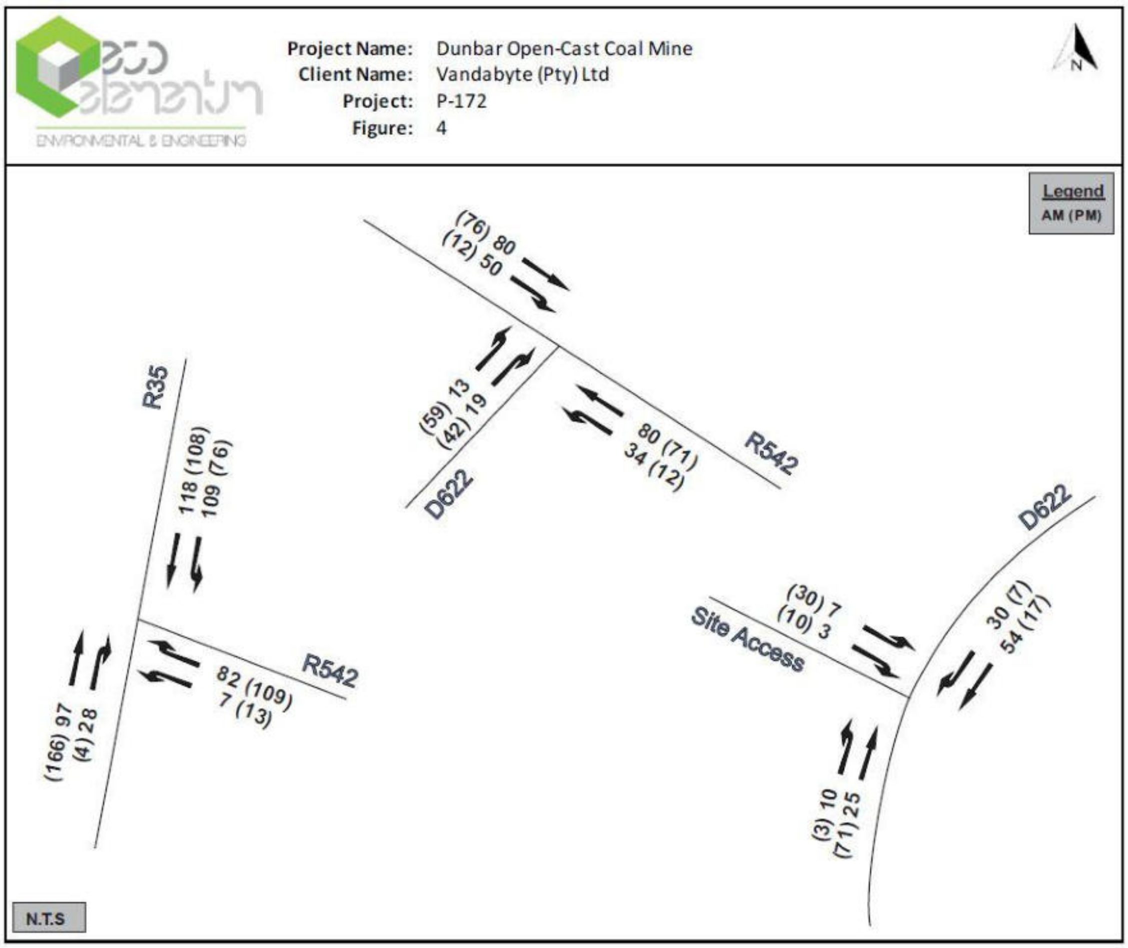


Figure 7-72: Expected peak hour traffic volumes at the key intersections during the construction phase.

The operating conditions for the key intersections during the construction phase are summarized above. These operation conditions are based on the expected peak hour traffic volumes during construction as per Figure 7-72, as well as the intersection layout designs and traffic control as per Drawing RUD001 in the TIA report.

7.13.6 Impact during Operational Phase

According to the TMH 17 Volume 1, South African Trip Data Manual South African Trip Data Manual (3), mining activities generates an insignificant number of vehicle trips on the external (i.e. public) road network (a maximum of 1 trip per 100 employees during peak traffic hours). To determine more site-specific trip generation data, information regarding the operational characteristics of the mine was obtained from the Applicant.

Table 7-35: Construction phase operating conditions.

Intersection & approach definitions	Peak hour	Analysis parameters	Intersection capacity analysis results								
			Approach 1			Approach 2			Approach 3		
			L	T	R	L	T	R	L	T	R
Site Access / Road D622 App 1: Road D622 NE App 2: Site Access NW App 3: Road D622 SW	Week AM	V/C	-	0.06	0.06	0.01	-	0.01	0.02	0.02	-
		Delay (s)	-	1	6	10	-	10	6	0	-
		LOS	-	A	A	A	-	B	A	A	-
	Week PM	V/C	-	0.02	0.02	0.04	-	0.04	0.05	0.05	-
		Delay (s)	-	1	6	10	-	9	6	0	-
		LOS	-	A	A	B	-	A	A	A	-
R542 / Road D622 App 1: R542 SE App 2: R542 NW App 3: Road D622 SW	Week AM	V/C	0.03	0.06	-	-	0.08	0.08	0.06	-	0.06
		Delay (s)	6	0	-	-	1	7	7	-	10
		LOS	A	A	-	-	A	A	A	-	A
	Week PM	V/C	0.01	0.06	-	-	0.05	0.05	0.16	-	0.16
		Delay (s)	6	0	-	-	1	7	7	-	9
		LOS	A	A	-	-	A	A	A	-	A
R35 / R542 App 1: R35 S App 2: R542 E App 3: R35 N	Week AM	V/C	-	0.08	0.08	0.23	-	0.23	0.09	0.09	-
		Delay (s)	-	1	8	11	-	16	6	0	-
		LOS	-	A	A	B	-	C	A	A	-
	Week PM	V/C	-	0.09	0.09	0.33	-	0.33	0.06	0.08	-
		Delay (s)	-	1	8	12	-	18	6	0	-
		LOS	-	A	A	B	-	C	A	A	-

Notes: L=left, T=through, R=right, V/C=volume/capacity, LOS=Level of Service, red text indicates unacceptable performance

To determine the traffic impact during future operations, the following assumptions are made:

- 150 employees will be employed on site during the operational phase;
- 50% of the employees will make use of transport provided by the employer (busses or shuttles);
- The remaining 50% will make use of private transport, which is assumed to have a vehicle occupancy of 1.2 occupants per vehicle during the peak traffic hours;

- 80% of the workers will commute to and from the site during the AM and PM peak traffic hours;
- An in: out traffic split of 80%:20%, and 20%:80% is assumed for the AM and PM peak traffic hours, respectively;
- 5 000 t of coal will be transported by road from the mine per day with a peaking factor of 0.15; and
- Coal will mainly be transported to Komati.

Based on the assumptions above, the future operational phase is expected to generate peak hour traffic volumes as below. Figure 7-73 below presents the expected peak hour traffic volumes at the key study intersections during the future operational phase.

Table 7-36: Expected traffic to be generated during the operational phase.

Peak Hour	Vehicle Trips Generated (Vehicles / hour)		
	In	Out	Total
AM	54	14	68
PM	14	54	68

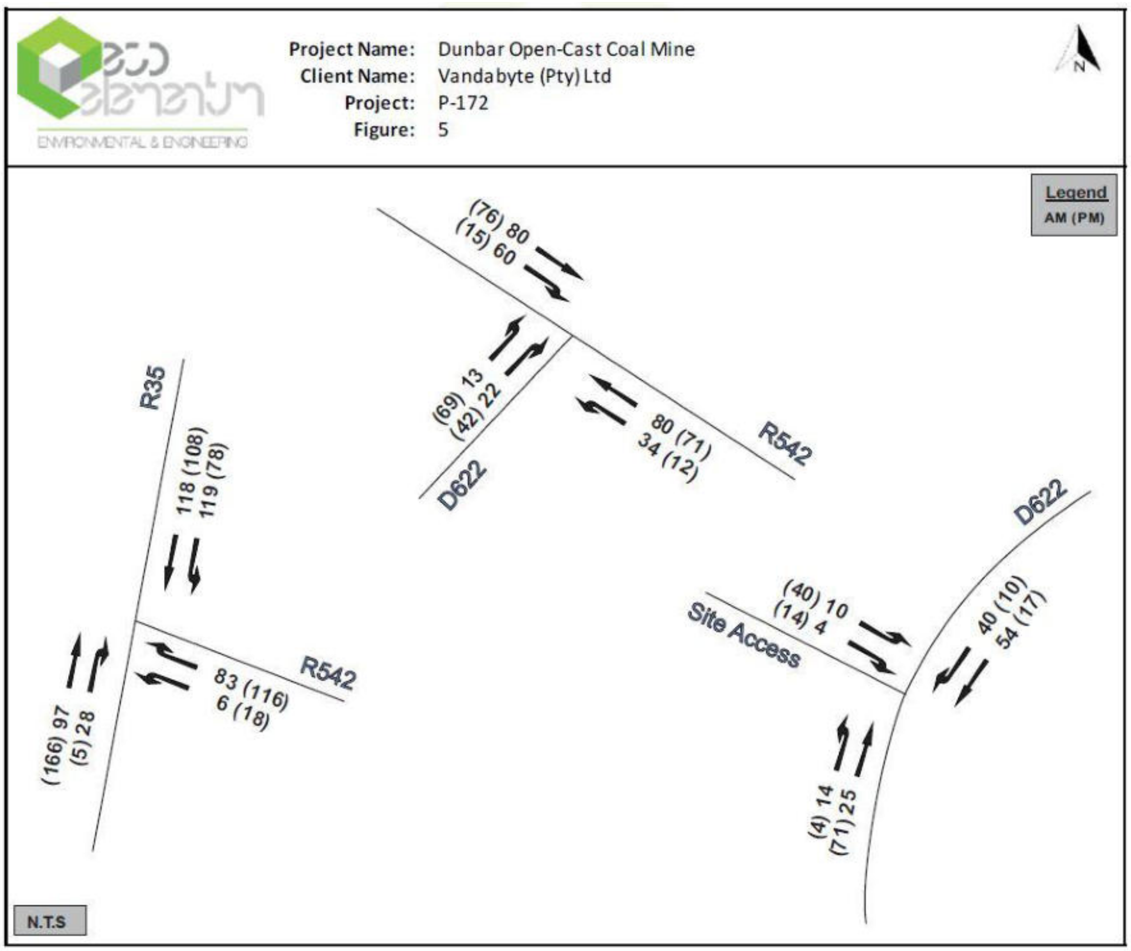


Figure 7-73: Expected peak hour traffic volumes at the key intersections during the future operational phase.

The operating conditions for the key intersections during the future operational phase are summarized below. These operating conditions are based on the expected peak hour traffic volumes during future operations as per Figure 7-73, as well as the existing intersections layout design and traffic control as per Drawing RUD001.

Table 7-37: Future operational phase operating conditions.

Intersection & approach definitions	Peak hour	Analysis parameters	Intersection capacity analysis results								
			Approach 1			Approach 2			Approach 3		
			L	T	R	L	T	R	L	T	R
Site Access / Road D622 App 1: Road D622 NE App 2: Site Access NW App 3: Road D622 SW	Week AM	V/C	-	0.07	0.07	0.01	-	0.01	0.03	0.03	-
		Delay (s)	-	1	6	10	-	10	6	0	-
		LOS	-	A	A	A	-	B	A	A	-
	Week PM	V/C	-	0.02	0.02	0.06	-	0.06	0.05	0.05	-
		Delay (s)	-	1	6	10	-	10	6	0	-
		LOS	-	A	A	B	-	A	A	A	-
R542 / Road D622 App 1: R542 SE App 2: R542 NW App 3: Road D622 SW	Week AM	V/C	0.03	0.06	-	-	0.09	0.09	0.07	-	0.07
		Delay (s)	6	0	-	-	1	7	7	-	10
		LOS	A	A	-	-	A	A	A	-	B
	Week PM	V/C	0.01	0.06	-	-	0.06	0.06	0.18	-	0.18
		Delay (s)	6	0	-	-	1	7	7	-	9
		LOS	A	A	-	-	A	A	A	-	A
R35 / R542 App 1: R35 S App 2: R542 E App 3: R35 N	Week AM	V/C	-	0.08	0.08	0.24	-	0.24	0.09	0.09	-
		Delay (s)	-	1	8	11	-	16	6	0	-
		LOS	-	A	A	B	-	C	A	A	-
	Week PM	V/C	-	0.09	0.09	0.36	-	0.36	0.06	0.08	-
		Delay (s)	-	1	8	12	-	18	6	0	-
		LOS	-	A	A	B	-	C	A	A	-

Notes: L=left, T=through, R=right, V/C=volume/capacity, LOS=Level of Service, red text indicates unacceptable performance

7.13.7 Comparing Operating Conditions with the Baseline

By comparing the expected operating conditions during the project's construction and operational phases with the baseline, it can be stated that an insignificant traffic impact is expected for both these project phases.

Based on the above, the severity of the traffic impact can be described as "very low" for both the project phases, and a rating of 1 can thus be adopted.

7.13.8 Summary and recommendations

In summary and based on the content of this document, the following key conclusions are made regarding the proposed Dunbar Coal Mine to be situated between Hendrina and Komati in the Mpumalanga Province, South Africa:

- This report forms part of the environmental authorisation process required for the proposed project;
- The purpose of this report is to investigate the traffic impact that the proposed project will have on the surrounding road network and, if necessary, propose possible measures to mitigate such impact;
- The study area (receiving environment) was defined based on the extent and type of the project activities, and the characteristics of the traffic expected to be generated as a result. Based on this, the boundaries of the study area are limited to the location of the following key intersections:
    - Road D622 / Proposed Access to Dunbar Coal Mine;;
    - Road D622 / Road R542 (P182/1), and
    - Road R542 / R35.
- No vulnerabilities or sensitivities currently exists in the defined study area;
- To determine the existing traffic demand on the nearby road network, a classified 13-hour manual traffic survey was conducted on Wednesday 18 September 2019 at the key study intersections;
- By using the data collected, traffic operating conditions were determined by means of traffic engineer software, name SIDRA INERSECTION 8. Operating conditions were determined and compared for the following three scenarios:
    - Baseline;
    - Project construction phase; and
    - Project operational phase
- By comparing the operating conditions for the different scenarios, it is concluded that the proposed project will have an insignificant traffic impact on the surrounding road network;
- Seeing as no traffic problems or congestion are expected as a result of the project activities, providing that the issues discussed in the TIA report be considered, no mitigation measures are required; and
- Traffic impact significance scores of 63 and 72 are calculated for the construction and operational phases of the proposed project, respectively, which implies that the project can be authorized from a traffic engineering viewpoint

7.14 VISUAL

The Visual Impact Assessment (VIA) undertaken during the EIA Phase is attached as Appendix F9.

Location

The project area is situated in predominant agriculture area with dispersed home steads in the immediate vicinity of the proposed project area. Scattered mining areas can also be found in the area. The sensitive receptors as shown above was captured using a desktop study, it may thus differ from actual conditions.

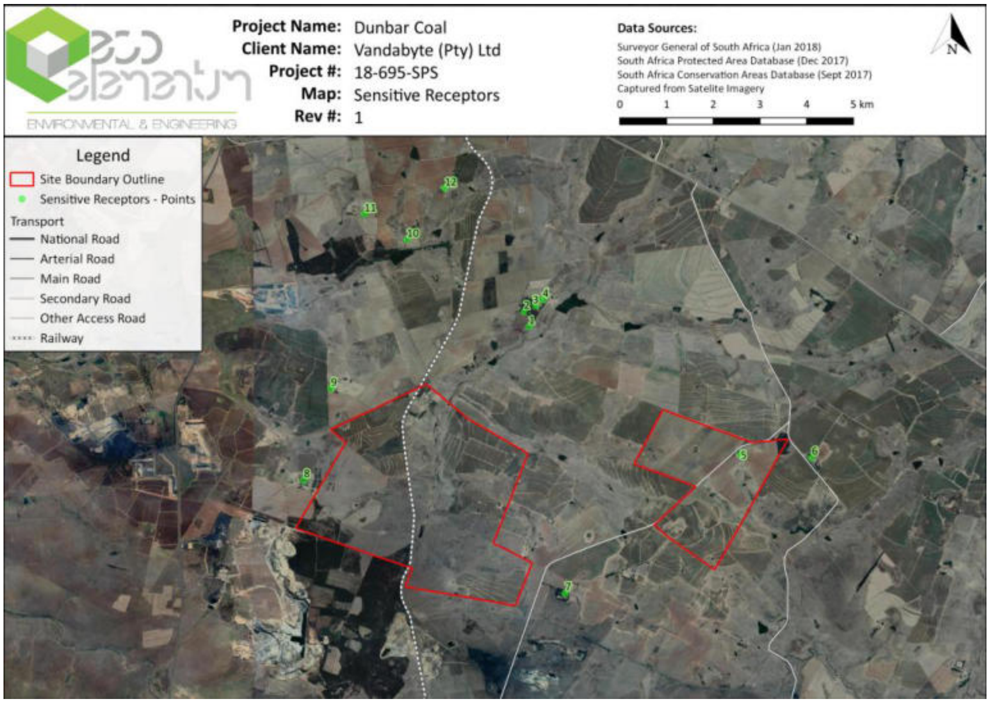


Figure 7-74: Population areas within close proximity of the proposed Dunbar Coal project.

New infrastructure

The proposed Dunbar Coal project will comprise of various newly built structures. Some of the highest structures are included in this report. It must be noted that no complete detail of the exact structures were available at the time of this report and general height and location assumptions were made where applicable.

Table 7-38: Maximum Height of the Relevant Proposed Structures.

Description	Height (m)
Stockpile - ROM	15
Stockpile – ROM Washed	10
Stockpile - Topsoil	15
Stockpile - OVB	30
Opencast Pit	3
Haul Roads	1
Offices	3
PCD	3
Plant Area	10
Workshop	6
Opencast Pit	3

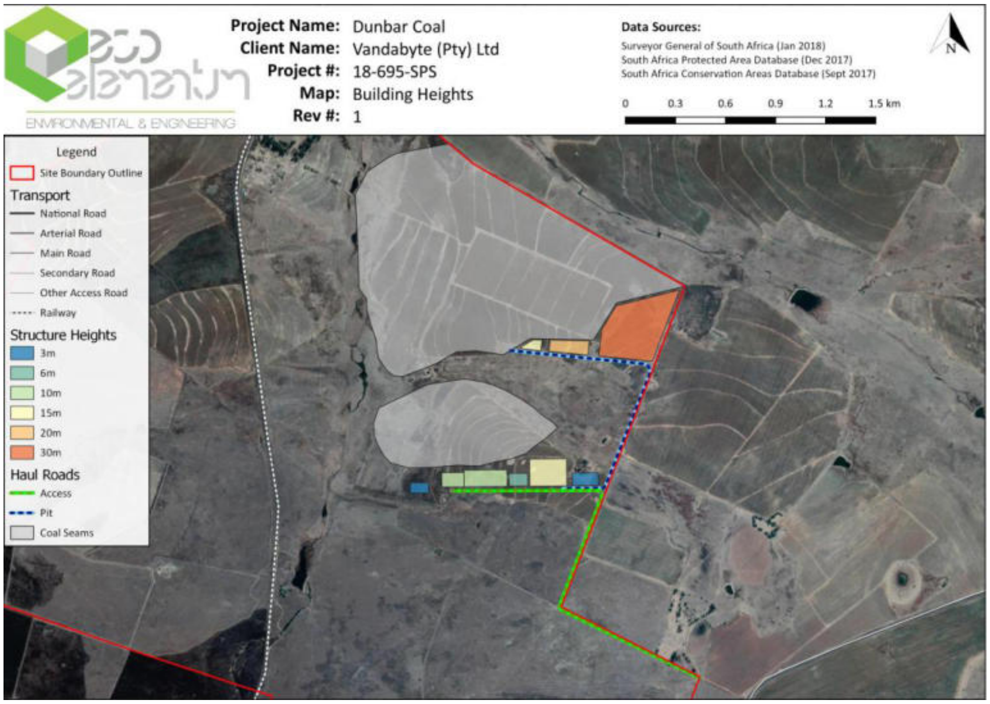


Figure 7-75: Infrastructure surface heights for the proposed Dunbar Coal Mine.

Topography

The proposed Dunbar Coal project area is situated in an area with undulating hills (Figure 7-76).

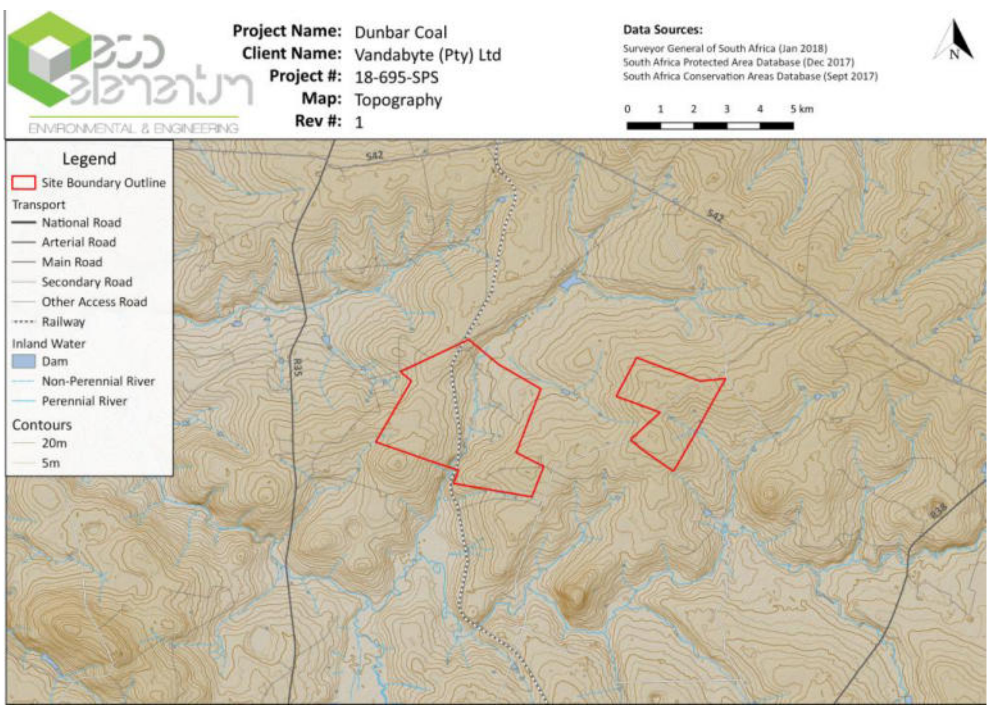


Figure 7-76: Topography surrounding the proposed Dunbar Coal project.

Slope

Slope angle is determined from the Digital Terrain Model (DTM) and the location of the proposed structures given a ranking depending on the steepness of the slope. Structures built on steep slopes are assumed to be more visible and exposed than those on flat surfaces (Figure 7-77).

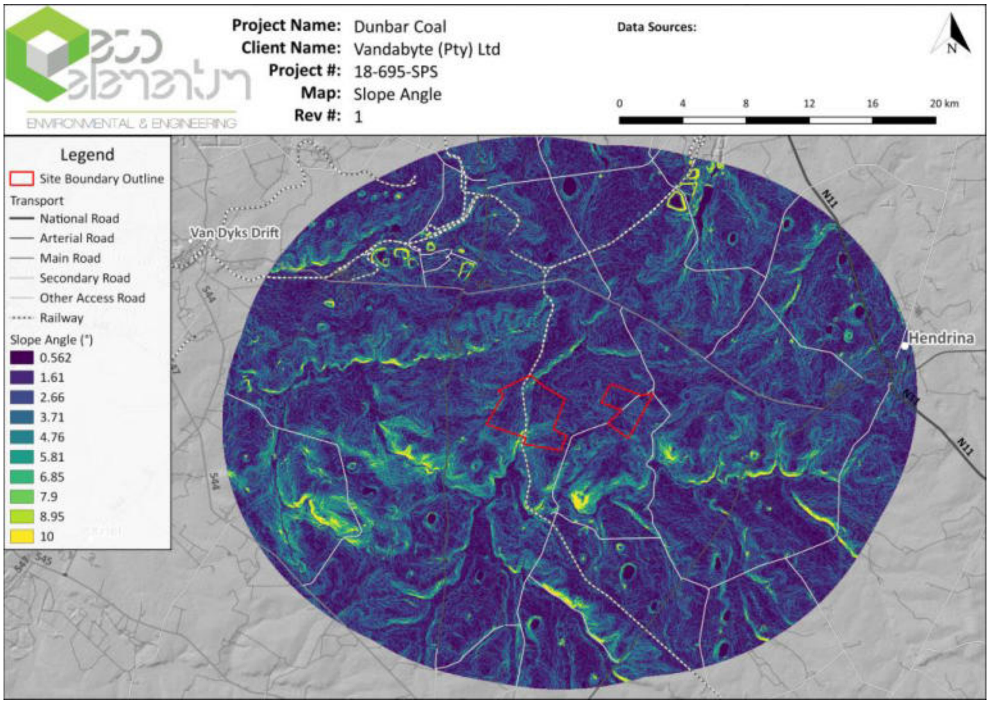


Figure 7-77: Slope angles of the terrain in the 15 km buffer area surrounding the proposed Dunbar Coal Mine project.

Aspect

Structures on flat surface are illuminated by the sun the whole day and thus visible from all directions. In the southern hemisphere structures on North facing slopes are less visible from the south, structures on East and West facing slopes are only illuminated during half of the day thus less visible where structures on the southern slopes are mostly in the shade (Figure 7-78).

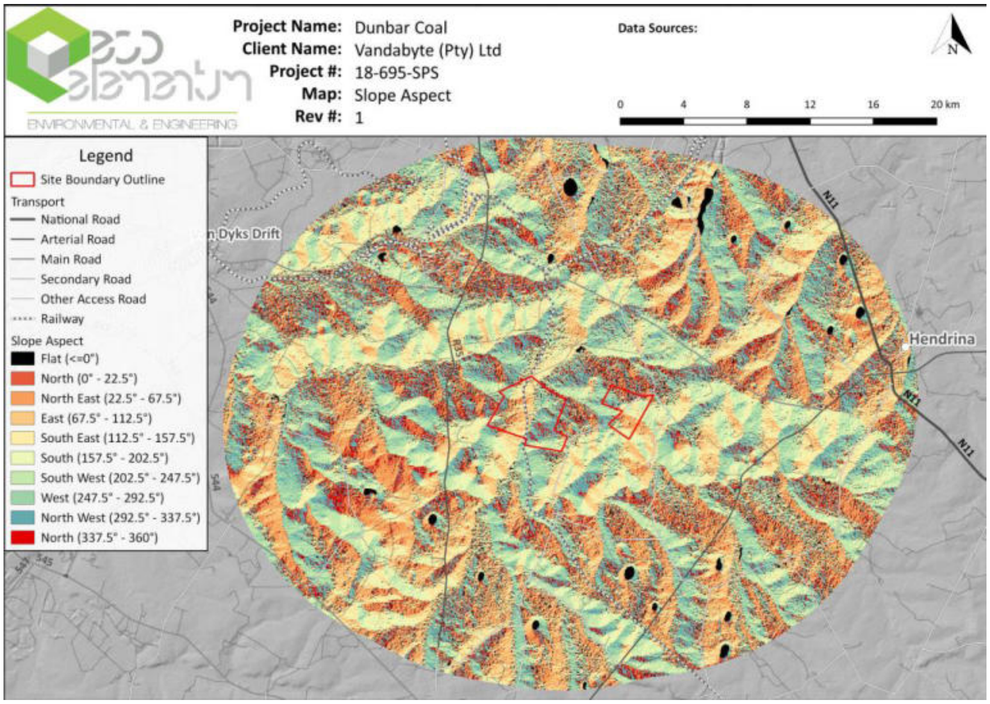


Figure 7-78: Aspect direction of the terrain in a 15 km buffer area surrounding the proposed Dunbar Coal Mine project.

Terrain Ruggedness

The terrain ruggedness is determined from the DEM and given a ranking based on the homogeneousness of the terrain. Rugged terrain has a tendency to increase the visual absorption characteristics of the terrain (Figure 7-79).

Relative Elevation

Using the DEM the elevation of the proposed structure relative to the surrounding elevation is determined and ranked according to the difference in height of the surrounding areas. Structures built on higher ground are more visible than those built in low lying areas (Figure 7-80).

Landform

Landform of the location of the proposed structures are determined from the DTM and ranked according to the type of landform. Structures built on certain landforms, e.g. ridges, will be more visible than structures built in valleys. The study area is mainly classified as Open Slopes with Canyons or Deeply incised Streams (Figure 7-81).

Slope Position

Using GIS analysis, the position of the proposed structure is determined and ranked according to the position on the slope the structure is to be built (Figure 7-82).

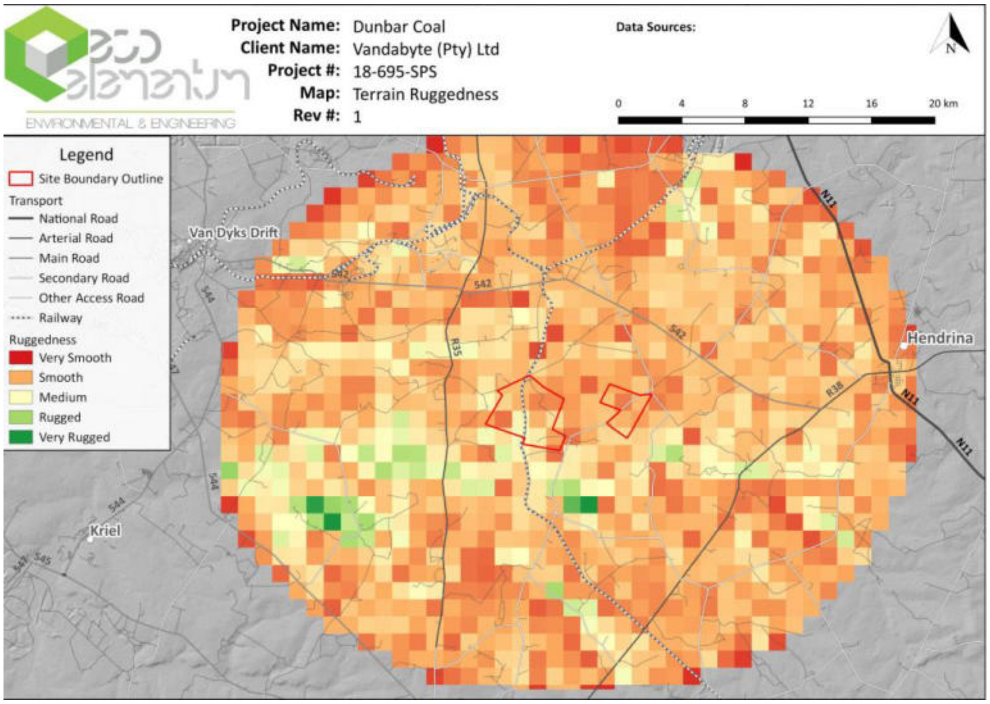


Figure 7-79: Terrain ruggedness in a 15 km buffer area surrounding the proposed Dunbar Coal Mine project.

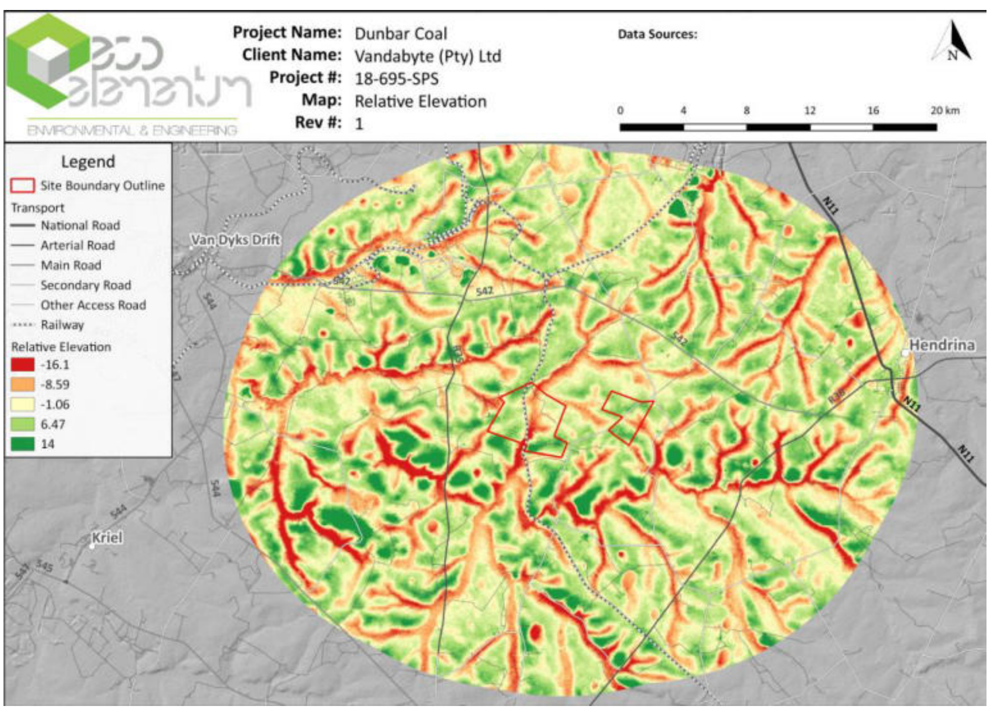


Figure 7-80: Relative Elevation of terrain in a 15 km buffer area surrounding the proposed Dunbar Coal Mine project.

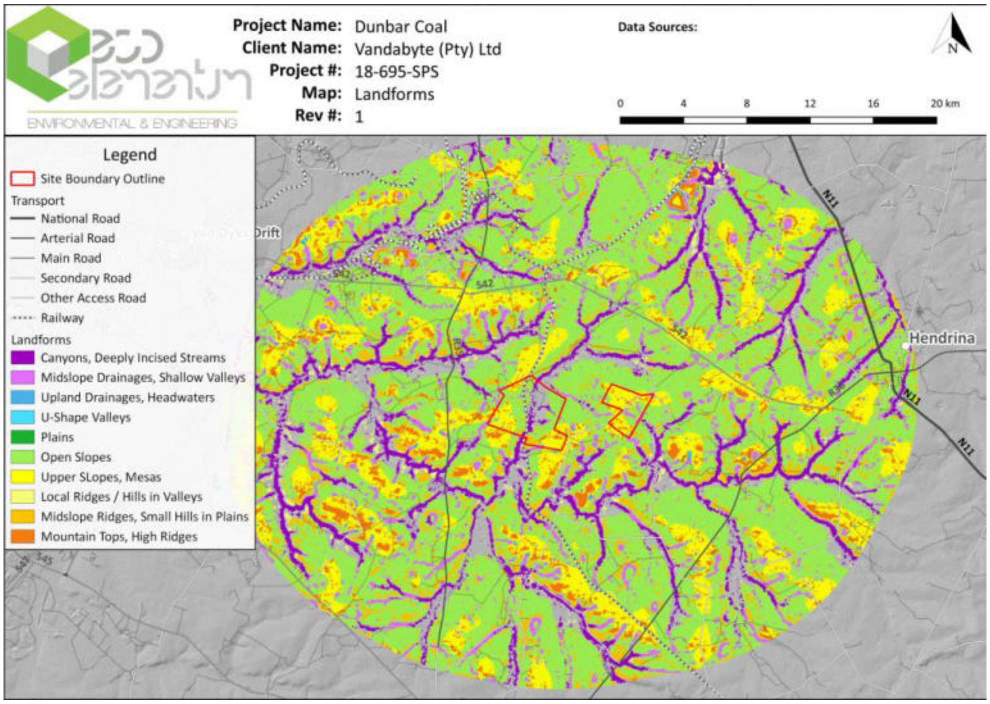


Figure 7-81: Landforms in a 15 km buffer area surrounding the proposed Dunbar Coal Mine project.

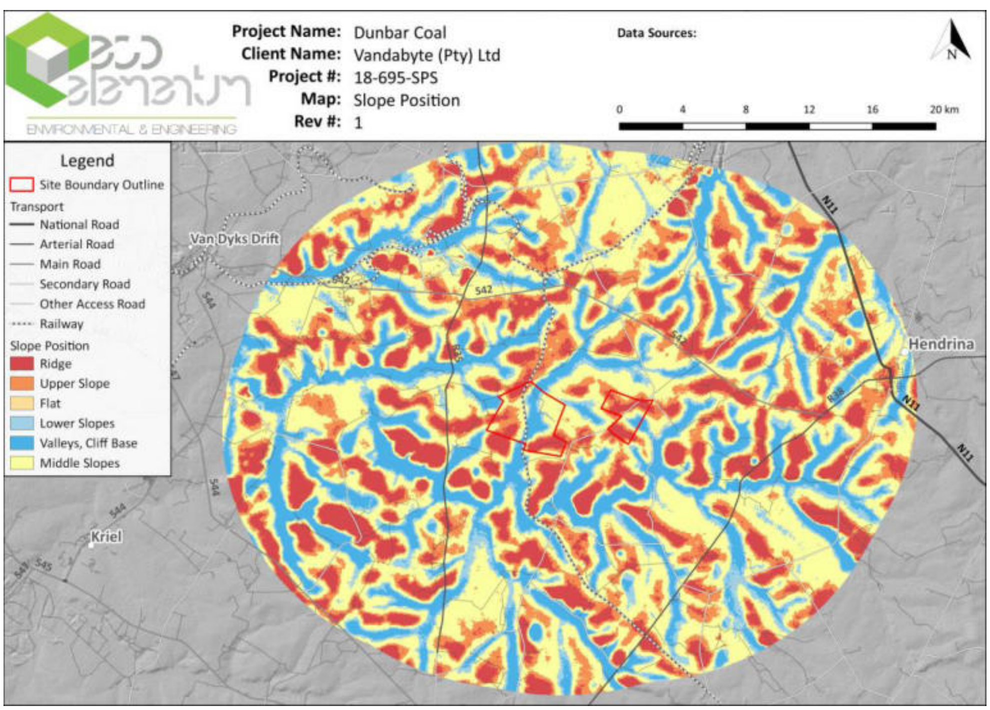


Figure 7-82: Slope Positions in a 15 km buffer area surrounding the proposed Dunbar Coal project.

Visual Absorption Capacity of the landscape

The VAC is the capacity of the receiving environment to absorb the potential visual impact of the proposed facility. The VAC is primarily a function of the vegetation, and will be high if the vegetation is tall, dense and continuous. Conversely, low growing, sparse and patchy vegetation will have a low VAC. Topography and built forms have the capacity to 'absorb' visual impact.

The digital terrain model utilised in the calculation of the visual exposure of the facility does not incorporate potential visual absorption capacity (VAC). It is therefore necessary to determine the VAC by means of the interpretation of the vegetation cover, topography and structures. Land cover is used in the ranking of the VAC.

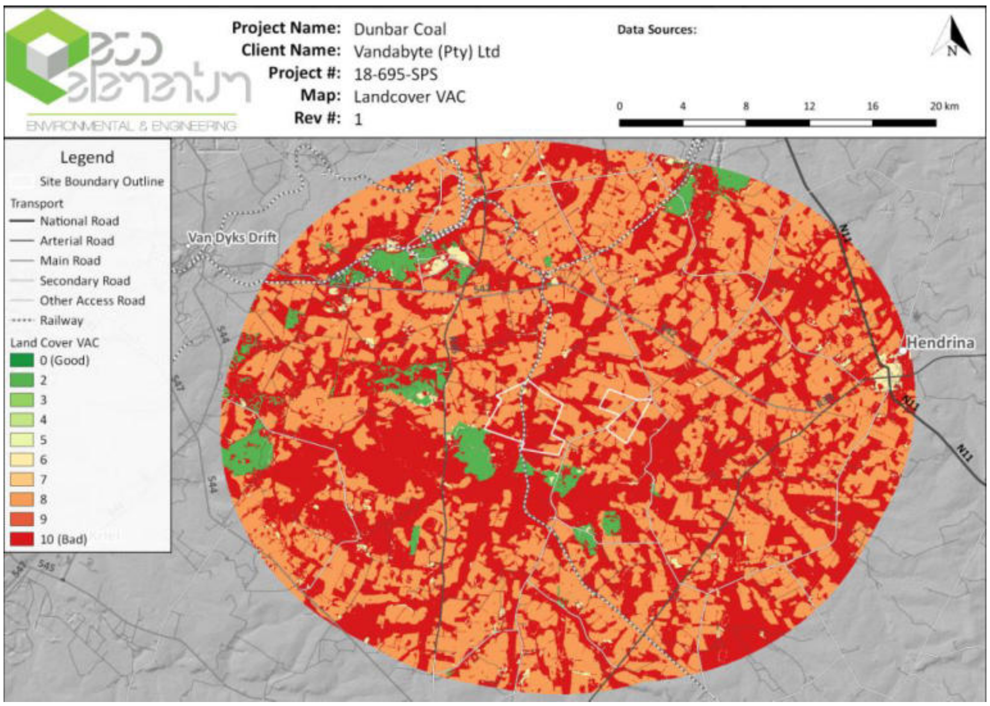


Figure 7-83: Possible VAC of the Landcover in a 15 km buffer area surrounding the proposed Dunbar Coal Mine project.

Viewshed visibility

For the assessment of the visibility of the area, the viewshed has been calculated for the amount of surface infrastructure features that can be seen from any point on the map (Figure 7-84). The Haul Roads have been split up in multiple positions to simulate how much of the roads are visible.

Viewshed visibility – Distance Ranking

The View Counts from the visibility section above is then further ranked based on distance from the centre of the proposed infrastructure site (Figure 7-85).

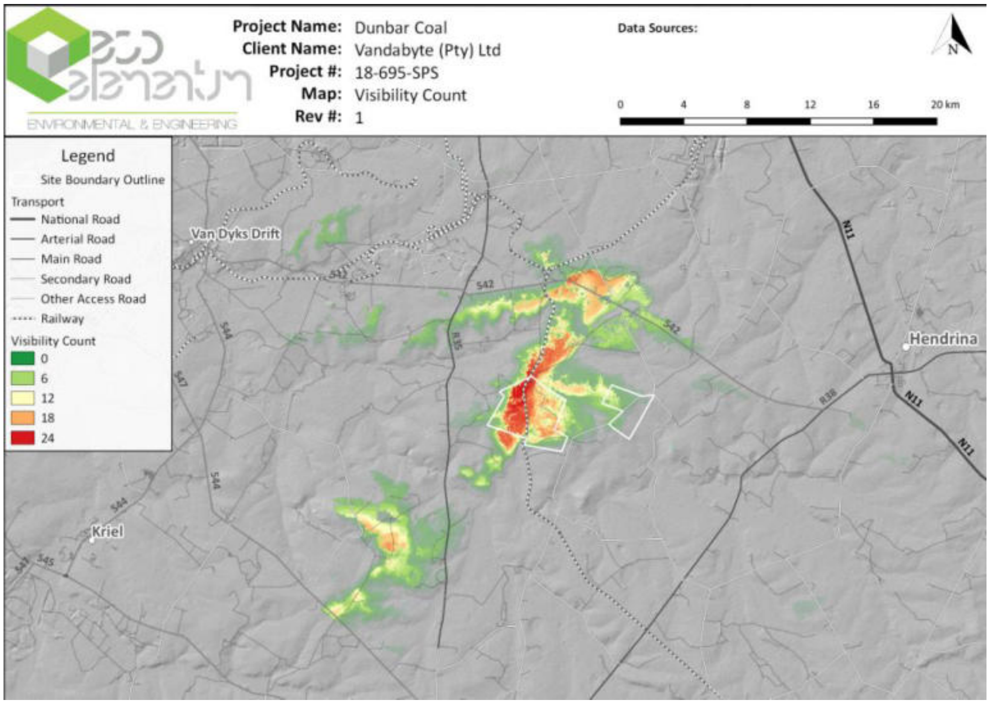


Figure 7-84: Viewshed of proposed Dunbar Coal project – Visibility Count (How many surface infrastructure locations can be seen from any location on the map).

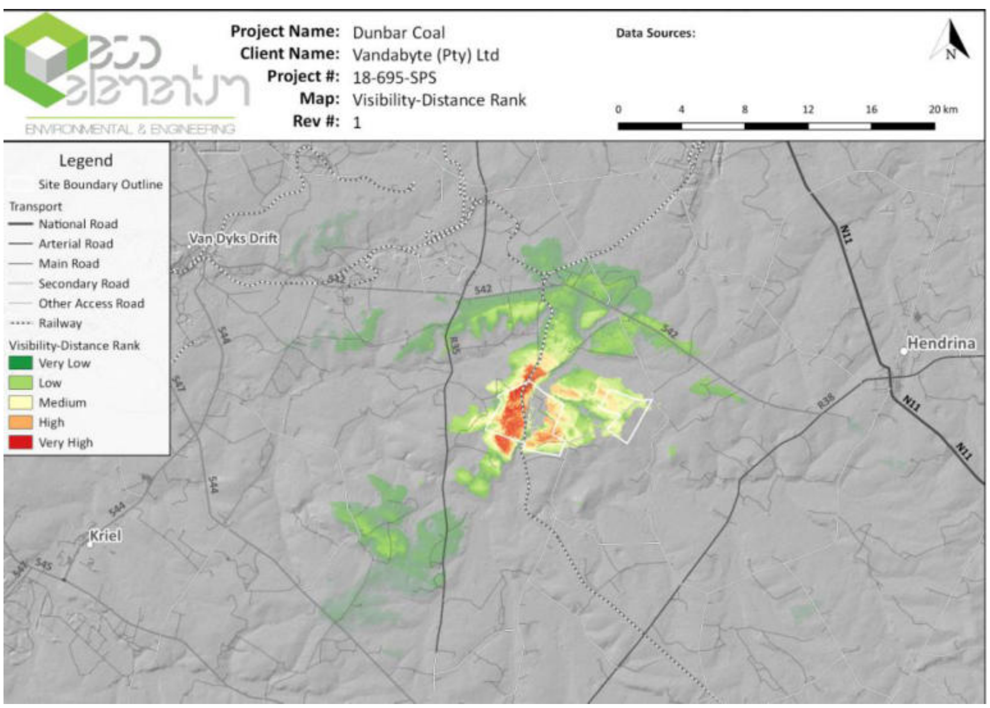


Figure 7-85: Viewshed of proposed Dunbar Coal project – Visibility Count (How many surface infrastructure locations can be seen from any location on the map) ranked according to distance from source.

Visual Exposure

The visible infrastructure count is combined with the distance from the source ranking together with the VAC of the land cover types, the slope, aspect, ruggedness, relative elevation, landforms and slope position to get a quantitative Visual Exposure ranking of all the areas where it may be possible to see the proposed development (Figure 7-86).

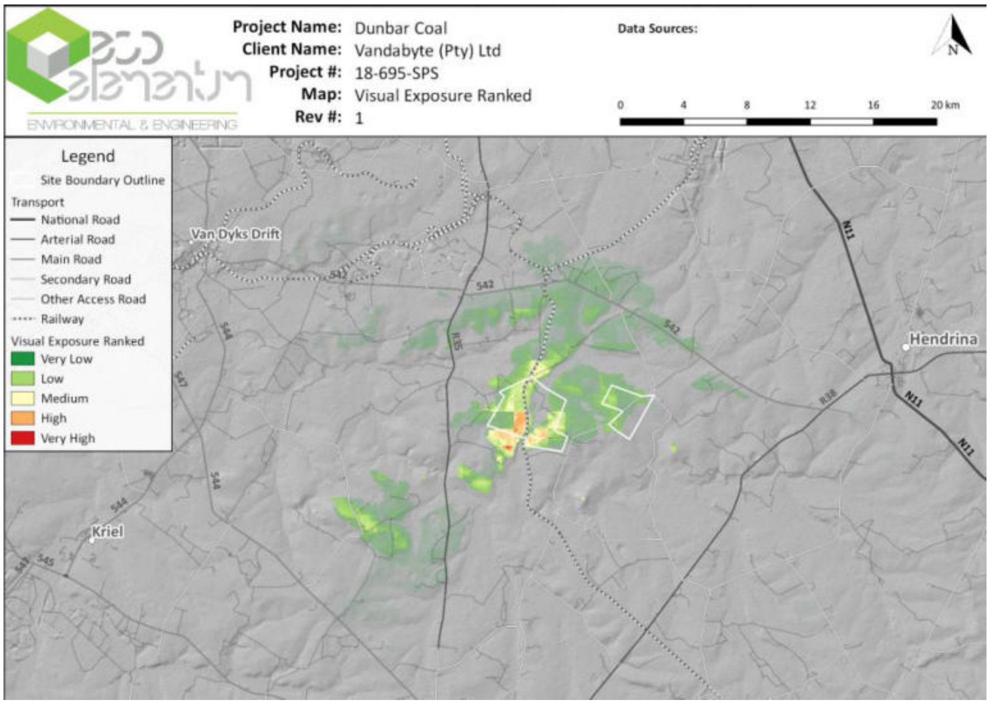


Figure 7-86: Visual Exposure ranking within a 15 km radius of the proposed Dunbar Coal project.

View points

Each identified sensitive receptor is then overlaid on the Visual Exposure Ranking and the value extracted to that pixel to give a quantitative ranking for each of the identified sensitive receptors. Ranking is done from 1 to 10, 1 being very low and 10 very high.

Due to fact that topographic modification can take place by agricultural, vegetation and other activities in the area, the viewshed is only a theoretical study. The viewpoints have been identified based on the sensitivity of the areas to visual disturbance and areas that can be negatively impacted by the related structures (Figure 7-87).

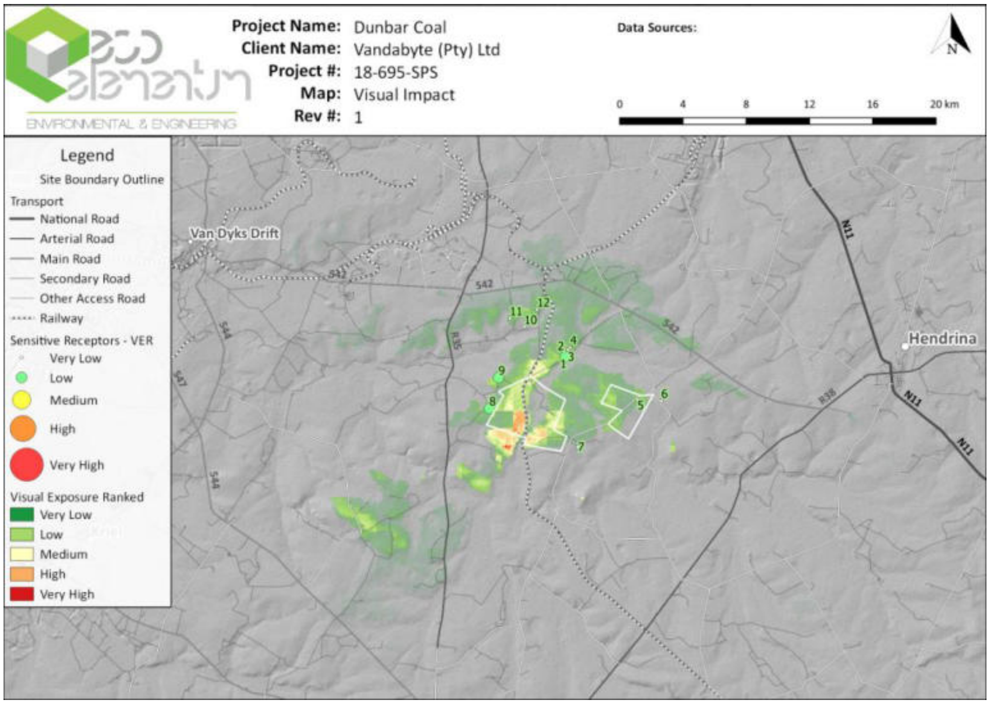


Figure 7-87: Viewpoint sensitive receptors overlaid on the Visual Exposure Ranking.

Summary and Recommendation

The construction and operation phase of the proposed Dunbar Coal project related activities and its associated infrastructure will have a MODERATE visual impact on the natural scenic resources and the topography. However, with the correct mitigation measures the impact might decrease to a point where the visual impact can be seen as less significant. The moderating factors of the visual impact of the proposed mining operations in close range are the following:

- Number of human inhabitants located in the area;
- Natural topography and vegetation;
- Mitigation measures that will be implemented such as the establishment of barriers or screens;
- The size of the operation; and
- Medium absorption capacity of the landscape.

In light of the above mentioned factors that reduce the impact of the facility, the visual impact is assessed as LOW-MEDIUM VISUAL IMPACT after mitigation measures have been implemented.

7.15 NOISE

7.15.1 Ambient Sound Level Measurements

Ambient sound levels were measured from 3 – 5 September 2019 in accordance with the South African National Standard SANS 10103:2008 "*The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication*". The standard specifies the acceptable techniques for sound measurements including:

- type of equipment;
- minimum duration of measurement;
- microphone positions;
- calibration procedures and instrument checks; and
- weather conditions.

The sound measurement locations are illustrated in Figure 7-88 as a blue square.

Figure 7-88: Localities of where ambient sound levels were measured.

7.15.2 Ambient Sound Measurements at EIDSLLT01

The microphone was deployed away from the house on the edge of the property. There were significant large eucalyptus trees in the vicinity of the measurement location that resulted in significant wind-induced noises with increased wind speeds. Sounds heard onsite are described in the following table.

Table 7-39: Noises/sounds heard during site visits at receptor EIDSLLT01.

Ambient Sound Character – Sounds of significance heard onsite	
Magnitude Scale Code: Barely Audible, Audible, Dominating	**Faunal and Natural**
	Deployment: Wind induced noises audible and dominant at times, with wind-induced noises from large eucalyptus trees. Birds clearly audible. Collection: Birds sounds. Wind induced noises audible from large eucalyptus trees.
	Residential and other Anthropogenic
	Deployment: Sheep bleating at times. Collection: -
	Industries, Commercial and Road Traffic
	Deployment: - Collection: -

Impulse equivalent sound levels (South African legislation): Figure 7-89 illustrates how the impulse-weighted 10-minute equivalent values change over time with the Table defining the average values for the time period. This sound descriptor is mainly used in South Africa to define sound and noise levels. The instrument is set to measure the impulse time-weighted sound levels.

Fast equivalent sound levels (International guidelines): Fast-weighted 10-minute equivalent (average) sound levels for the day and night-time periods are shown in Figure 7-89 with the Table defining the average values for the time period. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

Statistical sound levels ($L_{A90,f}$): The L_{A90} level is presented in this report as it is used to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on the average sound level. **L_{A90}** is a statistical indicator that describes the noise level that is exceeded 90% of the time and frequently used to define the background sound level internationally. The instrument is set to fast time-weighting. It is illustrated against time in Figure 7-90.

Measured maximum and minimum sound levels: These are statistical sound descriptors that can be used to characterise the sound levels in an area along with the other sound descriptors. These sound level descriptors are defined in Figure 7-90.

The statistical data (**$L_{A90,f}$**) indicate a location with elevated noise levels, even though **L_{Amin}** data indicate a location with a potential to become quiet. The elevated **$L_{A90,f}$** level indicate a relative constant noise in the area that was not defined during the site visit. **L_{Amax}** levels did not frequently exceed 65 dBA at night. When more than 10 sound events occur at night (where the noise level exceeds 65 dBA) maximum events may disturb the sleep of people.

Table 7-40: Sound levels considering various sound level descriptors at EIDSLLT01

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)	Comments
Day arithmetic average	-	47.5	43.1	36.2	-	-
Night arithmetic average	-	40.0	37.9	34.0	-	-
Day minimum	-	35.4	32.2	-	23.4	-
Day maximum	85.2	66.2	55.2	-	-	-
Night minimum	-	32.1	30.2	-	25.6	-
Night maximum	75.9	53.5	49.6	-	-	-
Day 1 equivalent	-	55.1	46.3	-	-	Afternoon and evening only
Night 1 Equivalent	-	41.3	39.0	-	-	8 hour night equivalent average
Day 2 equivalent	-	48.6	44.2	-	-	16 hour day equivalent average
Night 2 Equivalent	-	42.3	39.6	-	-	8 hour night equivalent average
Day 3 equivalent	-	49.8	44.9	-	-	Morning only

Considering the character of the area sounds heard as well as the average sound level values, ambient sound levels are typical of a sub-urban noise district as illustrated in Figure 7-91 for the night-time period and typical of a rural noise district as per Figure 7-92 for the daytime period. Adopting the precautious principle, the ideal acceptable zone rating level would be typical of a rural noise district (35 dBA at night and 45 dBA during the day) as defined in SANS 10103:2008. Considering the average equivalent night-time sound levels (37.9 dBA), mining activities should not increase the total noise levels higher than 45 dBA.

Considering the character of the area, sounds heard as well as the average $L_{Aeq,i}$ values, ambient sound levels are typical of a sub-urban noise district as illustrated in Figure 7-91 and Figure 7-92.

Spectral character: Third octaves were measured and are displayed for the first night and second day (Figure 7-93 and Figure 7-94) with the averaged spectral character illustrated for the night and daytime periods in Figure 7-95 and Figure 7-96.

<u>Lower frequency (20 – 250 Hz)</u> – Noise sources of significance in this frequency band would include nature (wind and surf especially – indicated by a relatively smooth curve) and sounds of anthropogenic origin and vehicles (engine sounds and electric motors – erratic bumps at certain frequencies). Lower frequencies tend to travel further through the atmosphere than higher frequencies. People generally do not hear these frequencies unless very quiet due to the low response of the ear to these low frequencies. Sounds from wind-induced noises generally have significant acoustic energy in this frequency range (normally identified by a smooth curve).

There was significant low-frequency noise during both night-time periods with the source(s) unknown. The same peaks in the frequency are visible in the daytime data.

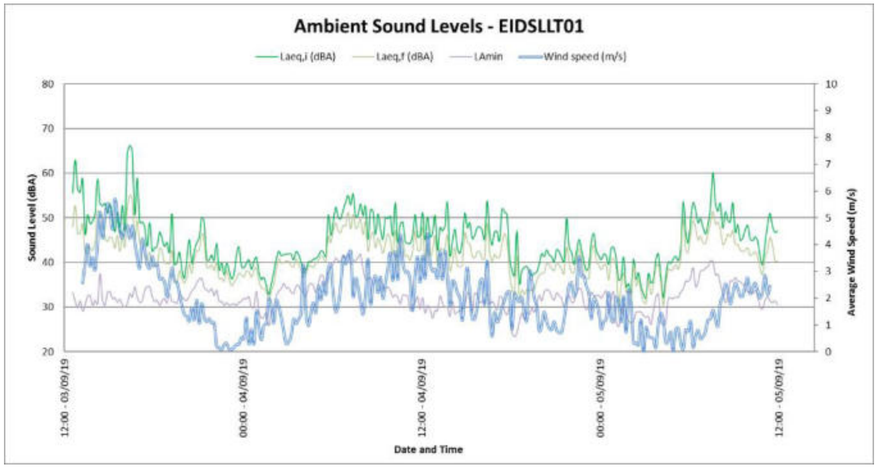


Figure 7-89: Ambient Sound Levels at EIDSLLT01

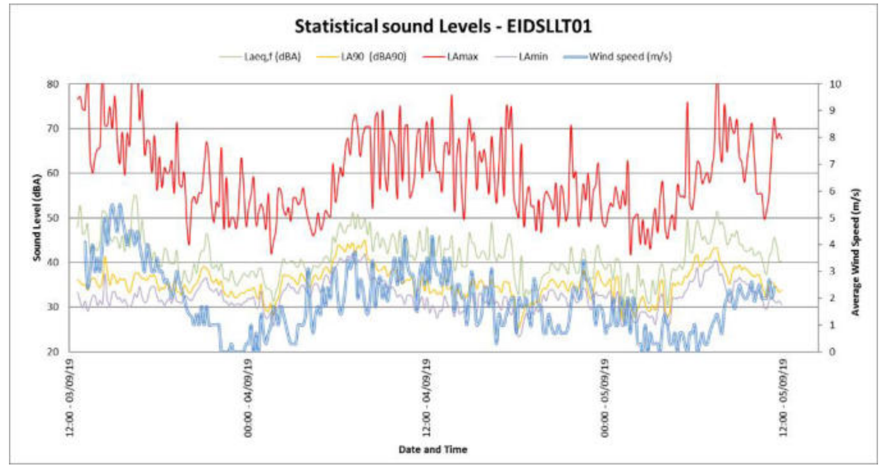


Figure 7-90: Maximum, minimum and statistical values at EIDSLLT01

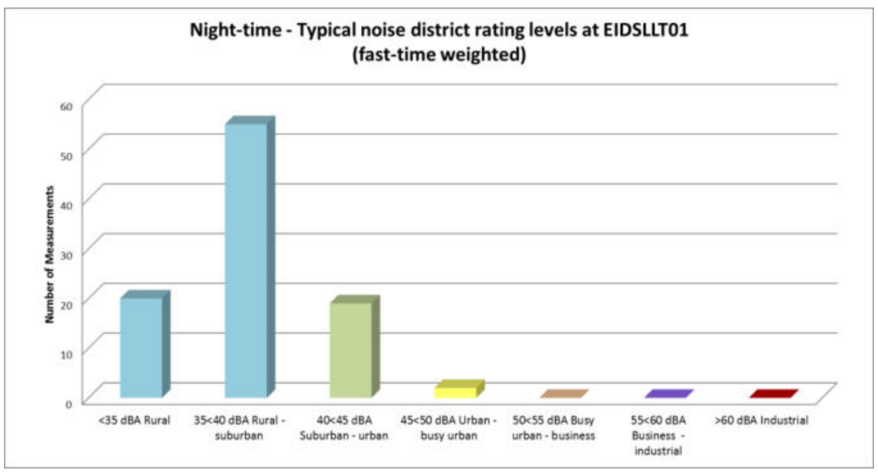


Figure 7-91: Classification of night-time noise levels – EIDSLLT01

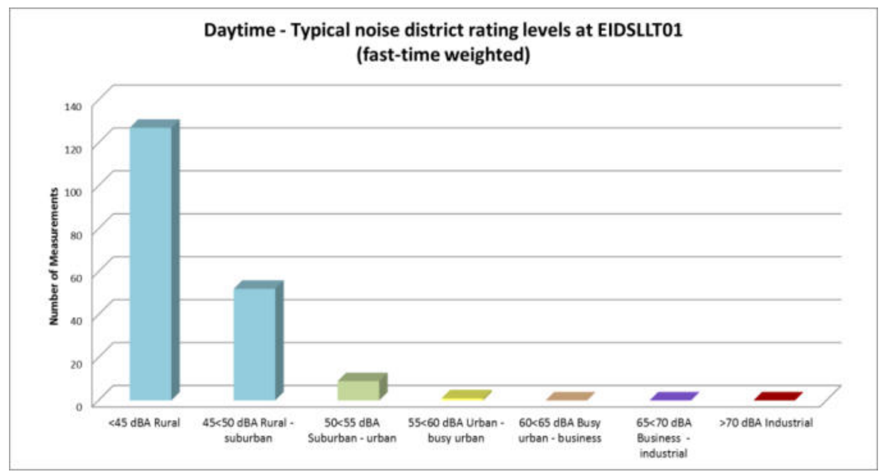


Figure 7-92: Classification of daytime noise levels - EIDSLLT01

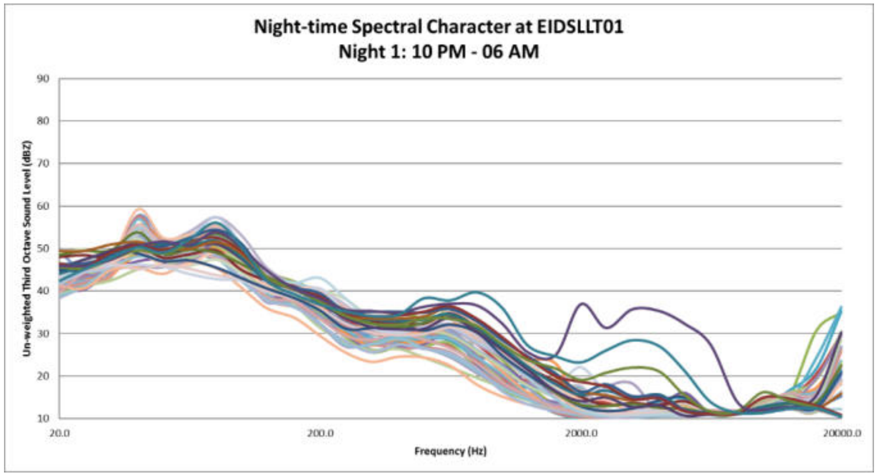


Figure 7-93: Spectral frequencies – EIDSLLT01, Night 1

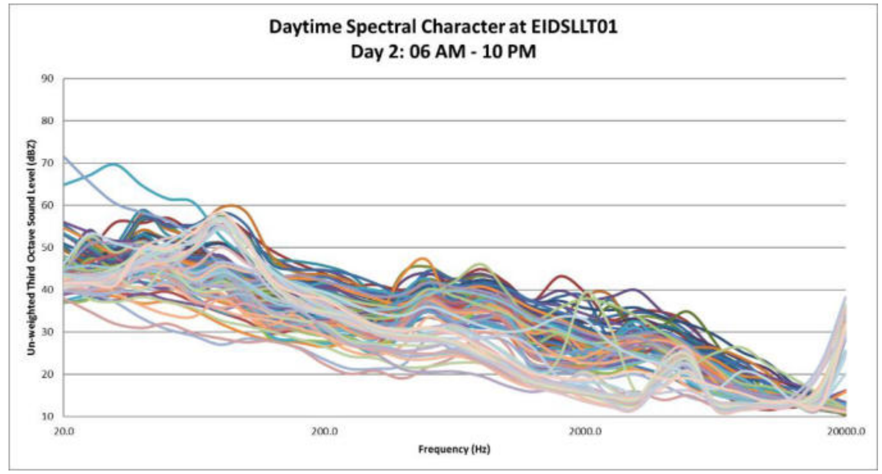


Figure 7-94: Spectral frequencies - EIDSLLT01, Day 2

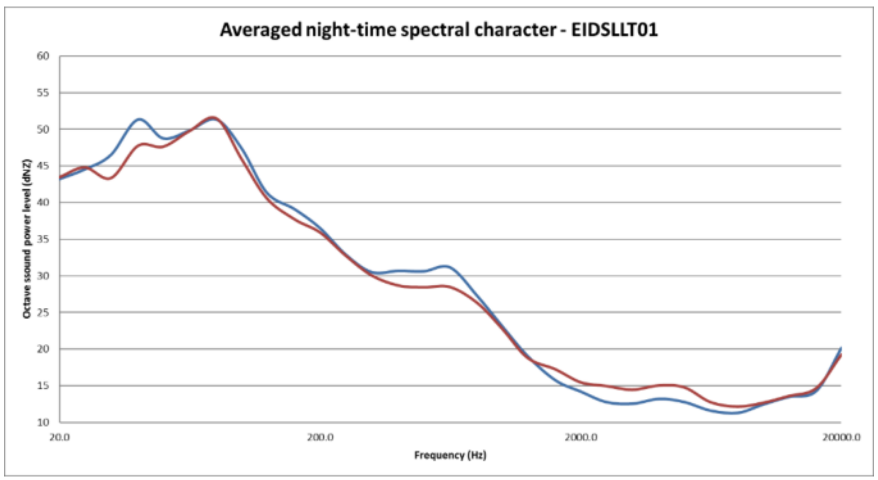


Figure 7-95: Averaged night-time spectral frequencies - EIDSLLT01

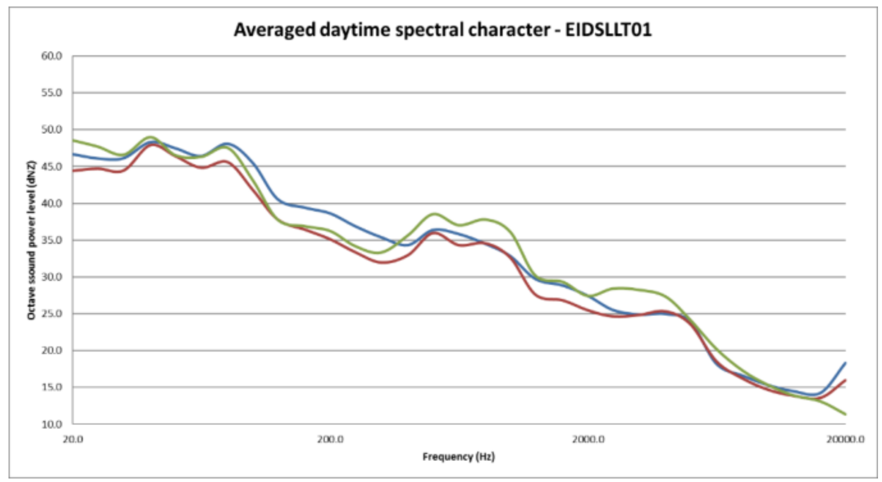


Figure 7-96: Averaged daytime spectral frequencies - EIDSLLT01

Third octave surrounding the 1,000 Hz (200 – 2,000 Hz) – This range contains energy mostly associated with human speech (350 Hz – 2,000 Hz) and dwelling noises (including sounds from larger animals such as chickens, dogs, goats, sheep and cattle). Road-tyre interaction (from vehicular traffic) normally peaking in 630 – 1,600 Hz range (depending on vehicular speed and road characteristics).

There was some acoustic energy in the 500 – 630 Hz frequency band.

Higher frequency (2,000 Hz upwards) – Smaller faunal species such as birds, crickets and cicada use this range to communicate and hunt etc.

7.15.3 Ambient Sound Measurements at EIDSLLT02

The instrument was deployed away from the house close to the security fence. There were significant large eucalyptus trees in the vicinity of the measurement location that resulted in significant wind-induced noises with increased wind speeds. Sounds heard at the measurement location are defined below. Equipment used to gather data is presented in below.

Table 7-41: Noises/sounds heard during site visits at receptor EIDSLLT02

Ambient Sound Character – Sounds of significance heard onsite	
Magnitude Scale Code: Barely Audible, Audible, Dominating	**Faunal and Natural**
	Deployment: Birds dominant. Wind induced noises due to vegetation in area.
	Collection: Birds dominant. Wind induced noises due to vegetation in area.
	Residential and other Anthropogenic
	Deployment: -
	Collection: -
	Industries, Commercial and Road Traffic
	Deployment: Workers at the stores.
	Collection: Trucks being loaded at the stores.

Table 7-42: Equipment used to gather data at EIDSLLT02

Equipment	Model	Serial no	Calibration Date
SLM	Svan 955	27637	October 2018
Microphone	ACO Pacific 7052E	52437	October 2018
Calibrator	Quest CA-22	J 2080094	July 2017

- Microphone fitted with the appropriate windshield.

Impulse equivalent sound levels (South African legislation): Figure 7-97 illustrates how the impulse-weighted 10-minute equivalent values change over time with Table 7-43 defining the average values for the time period. This sound descriptor is mainly used in South Africa to define sound and noise levels. The instrument is set to measure the impulse time-weighted sound levels.

Fast equivalent sound levels (International guidelines): Fast-weighted 10-minute equivalent (average) sound levels for the day and night-time periods are shown in Figure 7-97 with the Table defining the average values for the time period. Fast-weighted equivalent sound levels are included in this report as this is the sound descriptor used in most international countries to define the Ambient Sound Level.

Statistical sound levels ($L_{A90,f}$): The L_{A90} level is presented in this report as it is used to define the "background ambient sound level", or the sound level that can be expected if there were little single events (loud transient noises) that impacts on the average sound level. L_{A90} is a statistical indicator that describes the noise level that is exceeded 90% of the time and frequently used to define the background sound level internationally. The instrument is set to fast time-weighting. It is illustrated against time on Figure 7-98 and defined in Table 7-43.

Table 7-43: Sound levels considering various sound level descriptors at EIDSLLT02

	$L_{Amax,i}$ (dBA)	$L_{Aeq,i}$ (dBA)	$L_{Aeq,f}$ (dBA)	$L_{A90,f}$ (dBA90)	$L_{Amin,f}$ (dBA)	Comments
Day arithmetic average	-	46.9	42.0	36.4	-	-
Night arithmetic average	-	41.3	38.0	33.0	-	-
Day minimum	-	32.4	27.0	-	21.0	-
Day maximum	82.1	62.8	57.4	-	-	-
Night minimum	-	30.1	27.6	-	20.8	-
Night maximum	80.5	57.1	54.1	-	-	-
Day 1 equivalent	-	45.8	40.9	-	-	Evening only
Night 1 Equivalent	-	47.1	43.2	-	-	8 hour night equivalent average
Day 2 equivalent	-	51.8	46.7	-	-	16 hour day equivalent average
Night 2 Equivalent	-	48.1	43.3	-	-	8 hour night equivalent average
Day 3 equivalent	-	52.3	48.1	-	-	8 hour night equivalent average

Measured maximum and minimum sound levels: These are statistical sound descriptors that can be used to characterise the sound levels in an area along with the other sound descriptors. These sound level descriptors are defined in Table and illustrated in Figure 7-98.

As with measurement location EIDSLLT01, the statistical data (**$L_{A90,f}$**) indicate a location with elevated noise levels, even though **L_{Amin}** data indicate a location with a potential to become quiet. The elevated **$L_{A90,f}$** level indicate a relative constant noise in the area that was not defined during the site visit. **L_{Amax}** levels did exceed 65 dBA about 15 times over the 2-night period (7 and 8 times respectively). When more than 10 sound events occur at night (where the noise level exceeds 65 dBA) maximum events may disturb the sleep of people.

Considering the character of the area sounds heard as well as the average sound level values, ambient sound levels are typical of a sub-urban noise district as illustrated in Figure 7-99 for the night-time period and typical of a rural noise district as per Figure 7-100 for the daytime period. Adopting the precautious principle, the ideal acceptable zone rating level would be typical of a rural noise district (35 dBA at night and 45 dBA during the day) as defined in SANS 10103:2008. Considering the average equivalent night-time sound levels (38 dBA), mining activities should not increase the total noise levels higher than 45 dBA.

Spectral character: Third octaves were measured and are displayed for the first night and second day (Figure 7-101 and Figure 7-102) with the averaged spectral character illustrated for the night and daytime periods in Figure 7-103 and Figure 7-104.

Lower frequency (20 – 250 Hz) – Noise sources of significance in this frequency band would include nature (wind and surf especially – indicated by a relatively smooth curve) and sounds of anthropogenic origin and vehicles (engine sounds and electric motors – erratic bumps at certain frequencies). Lower frequencies tend to travel further through the atmosphere than higher frequencies. People generally do not hear these frequencies unless very quiet due to the low response of the ear to these low frequencies. Sounds from wind-induced noises generally have significant acoustic energy in this frequency range (normally identified by a smooth curve).

There was significant low-frequency noise during both night-time periods with the source(s) unknown. The same peaks in the frequency are visible in the daytime data.

Third octave surrounding the 1,000 Hz (200 – 2,000 Hz) – This range contains energy mostly associated with human speech (350 Hz – 2,000 Hz) and dwelling noises (including sounds from larger animals such as chickens, dogs, goats, sheep and cattle). Road-tyre interaction (from vehicular traffic) normally peaking in 630 – 1,600 Hz range (depending on vehicular speed and road characteristics).

There was some acoustic energy in the 400 Hz frequency band.

Higher frequency (2,000 Hz upwards) – Smaller faunal species such as birds, crickets and cicada use this range to communicate and hunt etc.

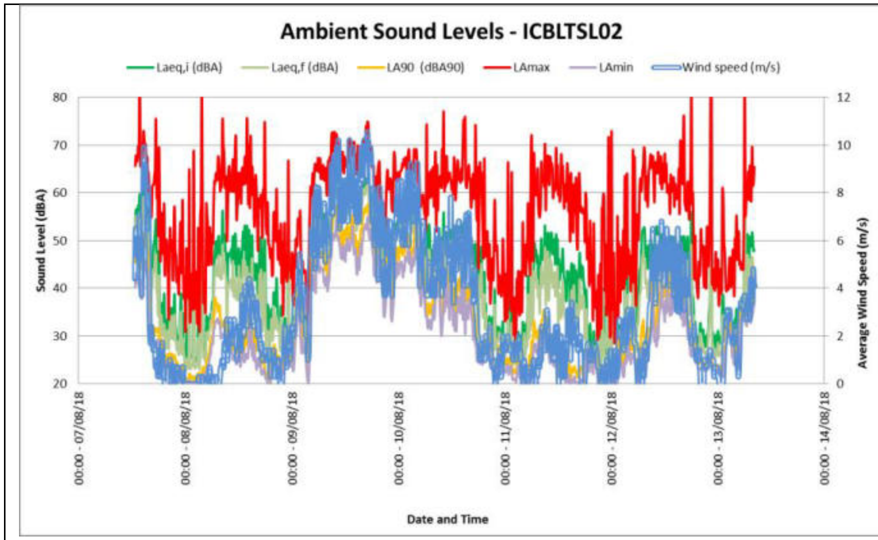


Figure 7-97: Ambient Sound Levels at EIDSLLT02

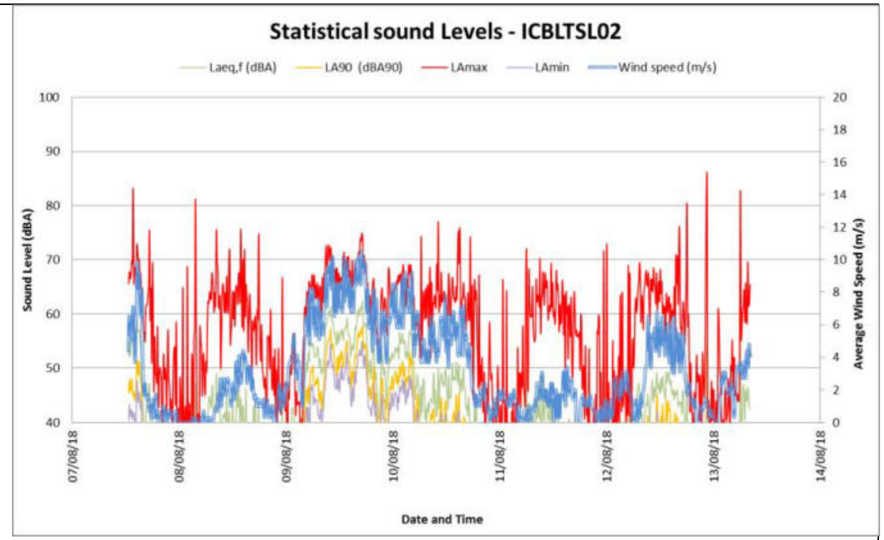


Figure 7-98: Maximum, minimum and statistical values at EIDSLLT02

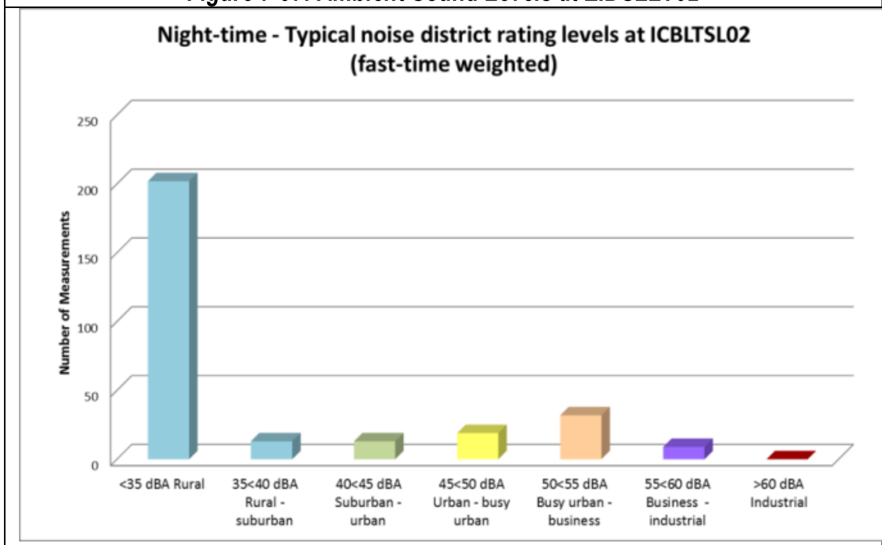


Figure 7-99: Classification of night-time noise levels – EIDSLLT02

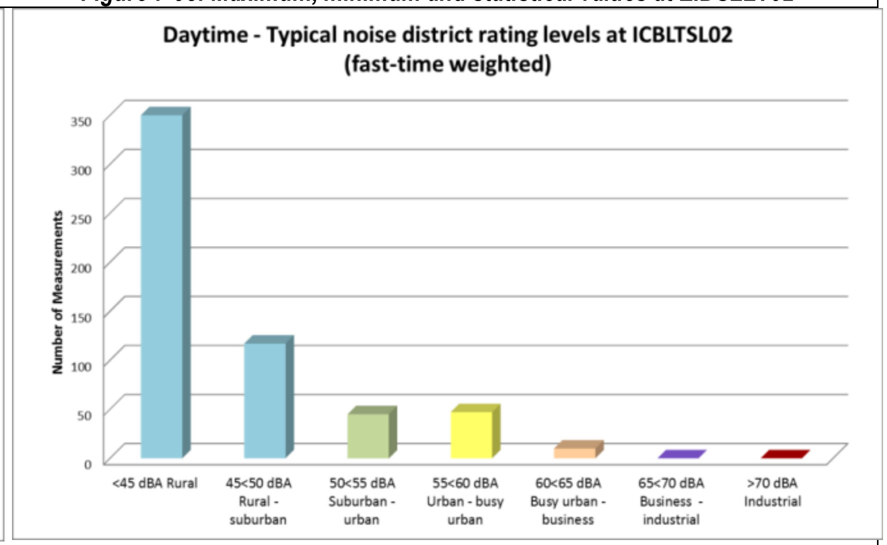


Figure 7-100: Classification of daytime noise levels - EIDSLLT02

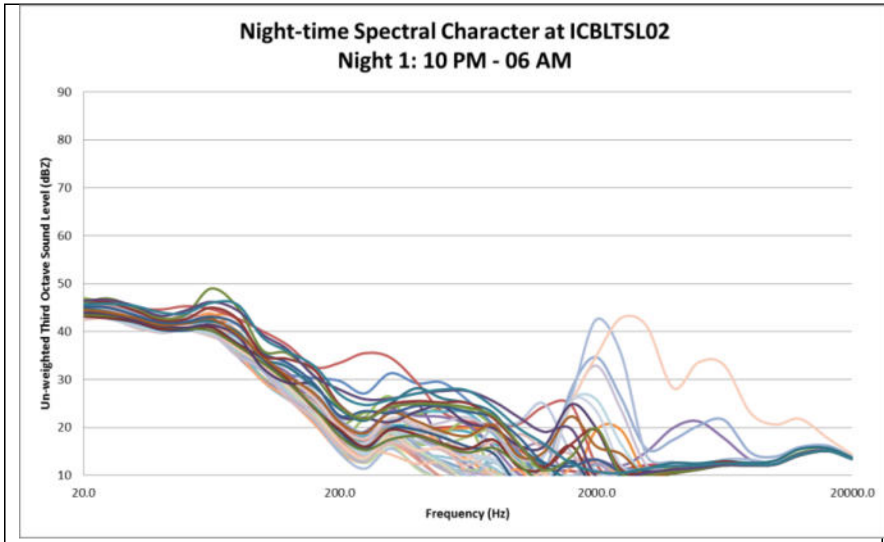


Figure 7-101: Spectral frequencies – EIDSLLT02, Night 1

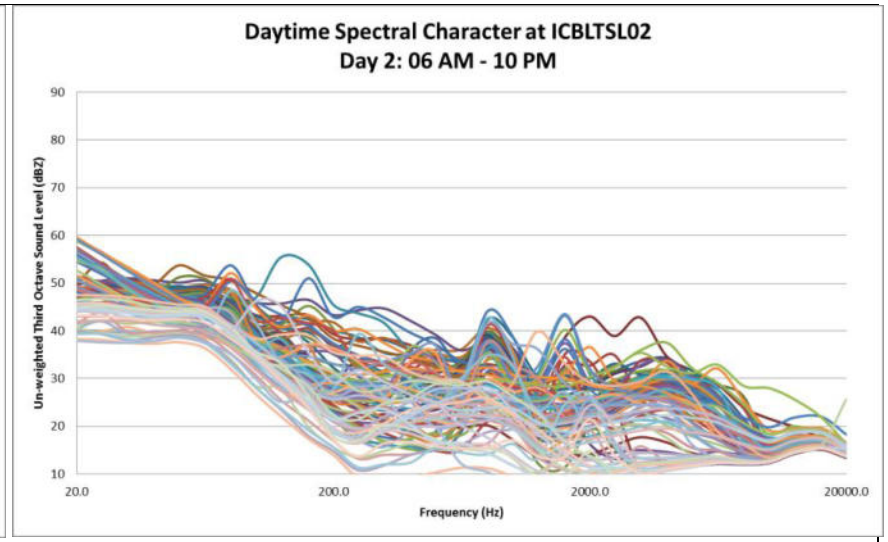


Figure 7-102: Spectral frequencies - EIDSLLT02, Day 2

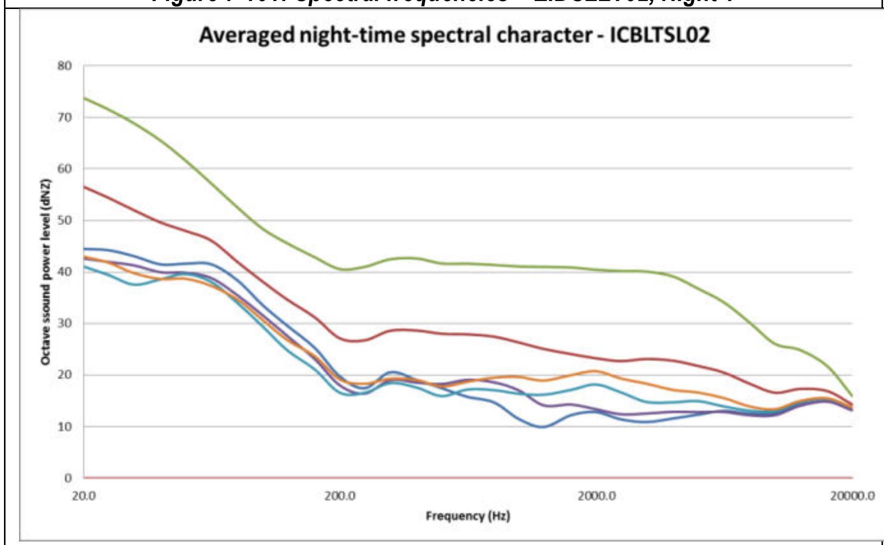


Figure 7-103: Averaged night-time spectral frequencies - EIDSLLT02

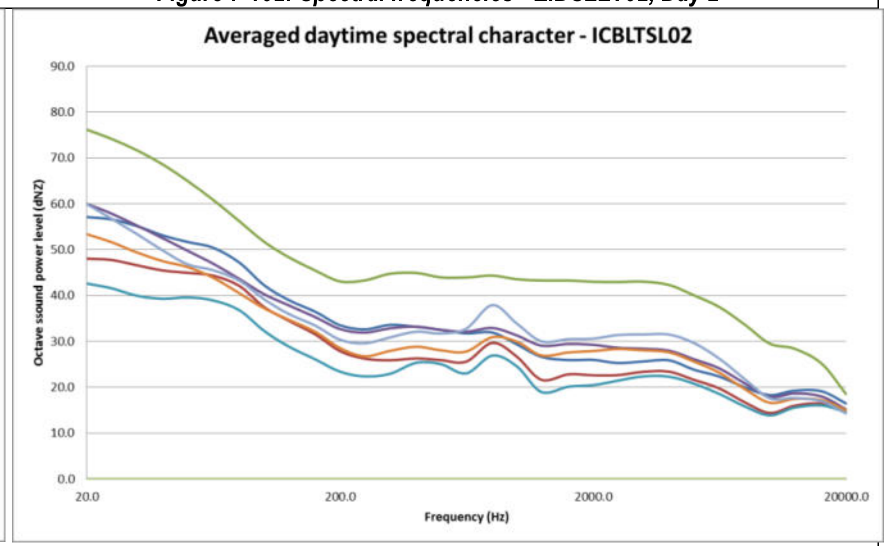


Figure 7-104: Averaged night-time spectral frequencies - EIDSLLT02

7.15.4 Summary of Ambient Sound Levels

The onsite ambient sound levels are defined in the previous section, and, considering the developmental nature of the area as well as the onsite sound levels with sound levels measured in similar areas, it can be summarized that:

- **EIDSLLT01 - Measurement representing sound levels typical dwelling:**
  - Considering the average $L_{Aeq,f}$ daytime data, sound levels are typical of a rural noise district (average daytime levels of 43.1 dBA, mean of the three daytime periods of the equivalent level is 45.1 dBA). Considering the developmental character of the area, daytime ambient sound levels should be typical of a rural noise district;
  - Considering the average $L_{Aeq,f}$ night-time data, sound levels are typical of a sub-urban noise district (average night-time levels of 37.9 dBA, mean of the two night-time periods of the equivalent level is 39.3 dBA). Considering the developmental character of the area, night-time ambient sound levels should be typical of a rural noise district.
- **EIDSLLT02 - Measurement representing sound levels typical dwelling:**
  - Considering the average $L_{Aeq,f}$ daytime data, sound levels are typical of a rural noise district (average daytime levels of 42.0 dBA, mean of the three daytime periods of the equivalent level is 45.2 dBA). Considering the developmental character of the area, daytime ambient sound levels should be typical of a rural noise district;
  - Considering the average $L_{Aeq,f}$ night-time data, sound levels are typical of a sub-urban noise district (average night-time levels of 38.0 dBA, mean of the two night-time periods of the equivalent level is 43.2 dBA). Considering the developmental character of the area, night-time ambient sound levels should be typical of a rural noise district.

Day- and night-time ambient sound levels were higher than measurements collected in other areas with a rural sound character as can be observed from Figure 7-105 and Figure 7-106. Ideally, the activities of the proposed mining activity should not change the existing ambient sound levels with more than 7 dBA. Considering average night-time ambient sound levels, mining activities should not increase the noise levels higher than 45 dBA (similar to the WHO / IFC noise limit for residential use).

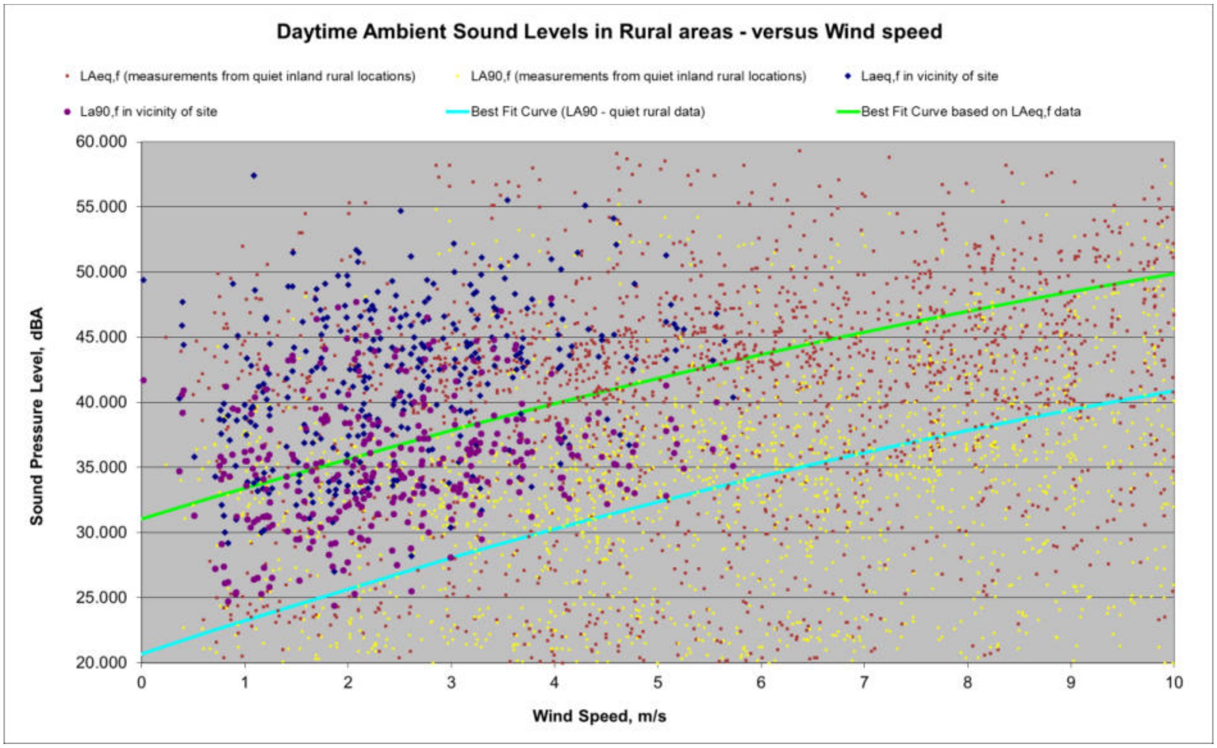


Figure 7-105: Summary of onsite daytime sound levels compared to long-term sound levels measured in other rural areas.

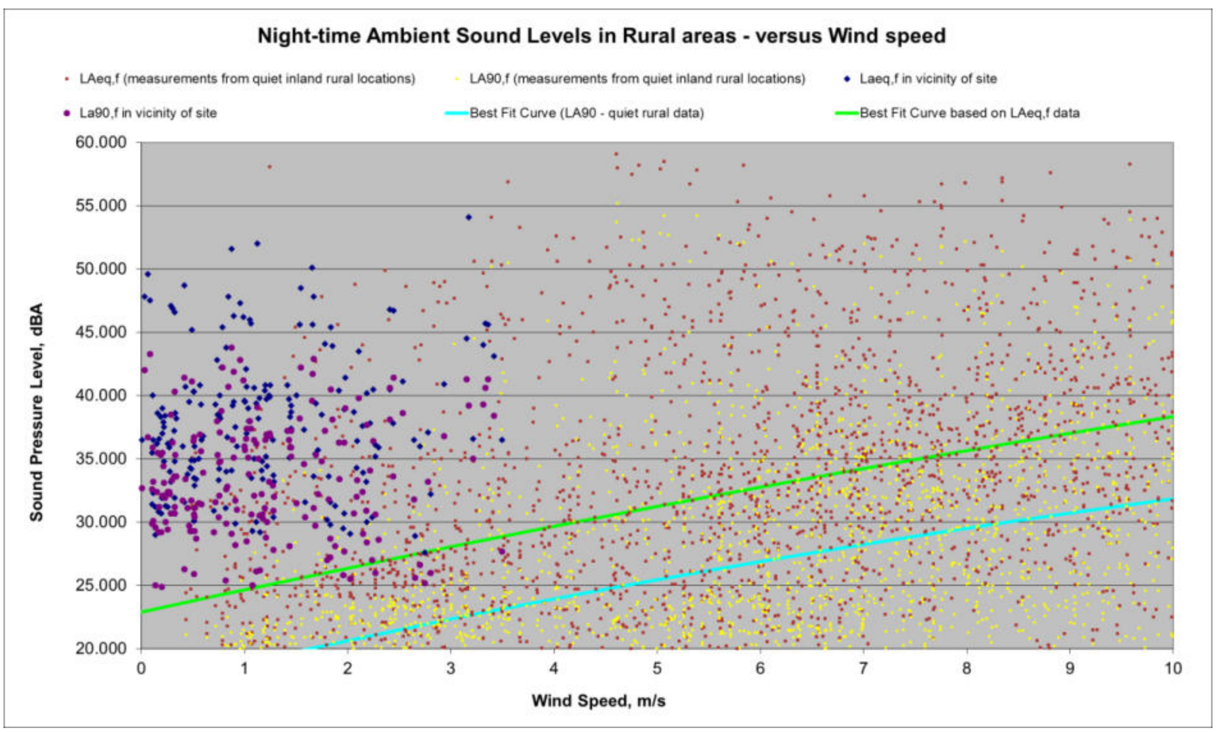


Figure 7-106: Summary of onsite night-time sound levels compared to long-term sound levels measured in other rural areas.

7.15.5 Potential Noise Sources

Increased noise levels are directly linked with the various activities associated with the construction as well as the operational phase of the mining activity. Noise emitted by the construction and operations can be associated with various noise sources, including mechanical sources due to operation of equipment, material impact noises (such as the noise made when materials are dropped at a height to ground level), electrical noise (reverse hooters from equipment or the "whine" of an electrical pump) and noises from vehicles moving around.

This report will focus on three scenarios, namely:

- Construction activities taking place at the proposed mining area. Both a day- and night-time scenario will be investigated, with equipment operating on ground level (no berms between activities and NSDs), with various equipment operating simultaneously;
- A mitigated construction scenario with a berm developed between the proposed mining area and the construction activities. Only the night-time scenario was investigated;
- Typical operational activities taking place at the mining pit, considering the scenario as highlighted below.

7.15.6 Construction Noises

Construction activities include:

- Site establishment;
- Construction of access roads;
- Vegetation removal;
- Topsoil removal and the development of stockpile footprints. It will be assumed that the topsoil and soft material will be stockpiled in the edge of the opencast to assist in the mitigation of noises from the mine;
- The removal of soft (using excavator) and hard overburden (drill and blast to remove very hard material) during the development of the opencast/box cut. Drilling activities will continue at night; and
- The establishment of infrastructures such as pollution control dam, offices/workshops, stockpile areas and plant (crushing/screen etc.) area.

Potential maximum noise levels generated by construction equipment, as well as the potential extent are presented in the Table below. The potential extent depends on a number of factors, including the prevailing ambient sound levels during the instance the maximum noise event occurred, as well as the spectral characteristics of the noise and the ambient soundscape in the surroundings.

Average or equivalent sound levels are another factor that impacts on the ambient sound levels and is the constant sound level that the receptor can experience. Typical sound power levels associated with various activities that may be found at a construction site is presented in Table 7-44.

The level and character of the construction noise will be highly variable as different activities with different equipment take place at different times, for different periods of time (operating cycles), in different combinations/sequences and on different parts of the construction site.

For the construction scenario it was selected to model the following activities/equipment:

- a general noise (such as a bulldozer) operating in the area where the boxcut, PCDs, RoM, plant, stockpiles and dumps are proposed;
- a general noise source at the location proposed for the boxcut;
- an number of excavators and articulated dump trucks (ADTs) loading topsoil and overburden at the boxcut area;
- an ADT off-loading topsoil on the edge of the boxcut area (constructing berm). This noise source only operate during the day;
- drills operating at the location proposed for the boxcut;

20 ADTs and 10 LDVs per hour travelling to and on the construction site at an average speed of 40 km/h.

Table 7-44: Potential maximum noise levels generated by construction equipment

Equipment Description [19]	Impact Device?	Maximum Sound Power Levels (dBA)	Operational Noise Level at given distance considering potential maximum noise levels (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modelling only considering distance) (dBA)											
			5 m	10 m	20 m	50 m	100 m	150 m	200 m	300 m	500 m	750 m	1000 m	2000 m
Backhoe	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Chain Saw	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Compactor (ground)	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Compressor (air)	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Concrete Batch Plant	No	117.7	92.7	86.7	80.6	72.7	66.7	63.1	60.6	57.1	52.7	49.2	46.7	40.6
Concrete Mixer Truck	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Concrete Pump Truck	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Crane	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Dozer	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Drill Rig Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Drum Mixer	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6

[19] Equipment list and Sound Power Level source: http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/handbook09.cfm

Dump Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Excavator	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Flat Bed Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Front End Loader	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Generator	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Grader	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Impact Pile Driver	Yes	129.7	104.7	98.7	92.6	84.7	78.7	75.1	72.6	69.1	64.7	61.2	58.7	52.6
Jackhammer	Yes	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Man Lift	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Mounted Impact Hammer	Yes	124.7	99.7	93.7	87.6	79.7	73.7	70.1	67.6	64.1	59.7	56.2	53.7	47.6
Paver	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Pickup Truck	No	89.7	64.7	58.7	52.6	44.7	38.7	35.1	32.6	29.1	24.7	21.2	18.7	12.6
Pumps	No	111.7	86.7	80.7	74.6	66.7	60.7	57.1	54.6	51.1	46.7	43.2	40.7	34.6
Rivit Buster/Chipping Gun	Yes	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Rock Drill	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Roller	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Sand Blasting (single nozzle)	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Scraper	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Slurry Plant	No	112.7	87.7	81.7	75.6	67.7	61.7	58.1	55.6	52.1	47.7	44.2	41.7	35.6
Slurry Trenching Machine	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Soil Mix Drill Rig	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Tractor	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Vacuum Excavator (Vac-Truck)	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Vacuum Street Sweeper	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Ventilation Fan	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Vibrating	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6

Hopper														
Vibratory Concrete Mixer	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Vibratory Pile Driver	No	129.7	104.7	98.7	92.6	84.7	78.7	75.1	72.6	69.1	64.7	61.2	58.7	52.6
Warning Horn	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Welder/Torch	No	107.7	82.7	76.7	70.6	62.7	56.7	53.1	50.6	47.1	42.7	39.2	36.7	30.6

Table 7-45: Potential equivalent noise levels generated by various equipment.

Equipment Description	Equivalent (average) Sound Levels (dBA)	Operational Noise Level at given distance considering equivalent (average) sound power emission levels (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modelling only considering distance) (dBA)											
		5 m	10 m	20 m	50 m	100 m	150 m	200 m	300 m	500 m	750 m	1000 m	2000 m
Bulldozer CAT D11	113.3	88.4	82.3	76.3	68.4	62.3	58.8	56.3	52.8	48.4	44.8	42.3	36.3
Bulldozer CAT D6	108.2	83.3	77.3	71.2	63.3	57.3	53.7	51.2	47.7	43.3	39.8	37.3	31.2
Bulldozer Komatsu 375	114.0	89.0	83.0	77.0	69.0	63.0	59.5	57.0	53.4	49.0	45.5	43.0	37.0
Crusher/Screen (MTC Mobile)	109.6	84.6	78.6	72.6	64.6	58.6	55.1	52.6	49.0	44.6	41.1	38.6	32.6
Crushing plant (50 tons/h)	114.5	89.5	83.5	77.5	69.5	63.5	60.0	57.5	54.0	49.5	46.0	43.5	37.5
Conveyor transfer	103.2	78.3	72.2	66.2	58.3	52.2	48.7	46.2	42.7	38.3	34.7	32.2	26.2
Drilling Machine	109.6	84.6	78.6	72.6	64.6	58.6	55.1	52.6	49.1	44.6	41.1	38.6	32.6
Dumper/Haul truck - CAT 700	115.9	91.0	85.0	78.9	71.0	65.0	61.4	58.9	55.4	51.0	47.5	45.0	38.9
Dumper/Haul truck - Terex 30 ton	112.2	87.2	81.2	75.2	67.2	61.2	57.7	55.2	51.7	47.2	43.7	41.2	35.2
Excavator - Hitachi EX1200	113.1	88.1	82.1	76.1	68.1	62.1	58.6	56.1	52.6	48.1	44.6	42.1	36.1
Excavator - Hitachi 870 (80 t)	108.1	83.1	77.1	71.1	63.1	57.1	53.6	51.1	47.5	43.1	39.6	37.1	31.1
FEL - Bell L1806C	102.7	77.7	71.7	65.7	57.7	51.7	48.2	45.7	42.1	37.7	34.2	31.7	25.7
FEL - CAT 950G	102.1	77.2	71.2	65.1	57.2	51.2	47.6	45.1	41.6	37.2	33.7	31.2	25.1
FEL - Komatsu WA380	100.7	75.7	69.7	63.7	55.7	49.7	46.2	43.7	40.1	35.7	32.2	29.7	23.7
General noise	108.8	83.8	77.8	71.8	63.8	57.8	54.2	51.8	48.2	43.8	40.3	37.8	31.8
Grader - Operational Hitachi	108.9	83.9	77.9	71.9	63.9	57.9	54.4	51.9	48.4	43.9	40.4	37.9	31.9
Grader	110.9	85.9	79.9	73.9	65.9	59.9	56.4	53.9	50.3	45.9	42.4	39.9	33.9
Screening plant	105.5	80.6	74.6	68.5	60.6	54.6	51.0	48.5	45.0	40.6	37.0	34.6	28.5
Water Dozer, CAT	113.8	88.8	82.8	76.8	68.8	62.8	59.3	56.8	53.3	48.8	45.3	42.8	36.8

7.15.7 Operational Noises – General

7.15.7.1 Mining Activities

Coal will be mined through an opencast bench mining method. The benches will be mined at a height of 10 metres with the final mining depth determined by the coal resource.

The following mining method will be assumed for the noise model:

- Vegetation and topsoil will be stripped ahead of mining using a bulldozer. At least one cut will already be stripped and available for drilling between the active topsoil stripping operation and the open void. This will be limited to day-time activities;
- The topsoil will be loaded onto dump trucks by excavators and hauled to stockpiles or areas that require rehabilitation using articulated dump trucks. This will be mainly limited to the day-time period;
- Soft overburden will be loaded onto dump trucks by excavators and hauled to stockpiles or areas that require rehabilitation. This could take place 24 hours per day;
- Drilling operations will commence in the front of the advancing pit after the topsoil and soft overburden has been removed. This will take place 24 hours per day 5 m below the ground surface;
- After the hard overburden was broken by means of blasting, it will be loaded onto ADTs by excavators and hauled to stockpiles or areas that require rehabilitation at least 15 m below the ground surface. This will be repeated until the coal resource is reached. Excavation and the hauling of overburden will continue at night;
- Drilling and blasting of the coal resource with the Run of Mine (RoM) crushed and screened in the pit before being loaded and hauled to the plant. This will take place 24 hours per day 20m below the ground surface;
- Topsoil and soft material will be placed on the edge of the mining area to act in as a noise protection berm. These berms will be located between the active mining activities and the closest receptors and will be at least 3 m high;
- Construction activities at the second pit (location north-west corner, second pit) similar to the construction phase; and
- Various plant activities to beneficiate the resource, stockpiling and loading onto road trucks to allow transport to the market (no product transport at night).

The level and character of the noise during this phase is more constant than with the construction phase, but can be significantly higher and more intrusive, especially if there is an impulsive[20] component involved (such as from tipping, crushing and equipment banging on other equipment) and these noise generating activities takes place at night.

As with all noises (and with the construction phase), the audibility, as well as the potential of a noise impact on receptors, is determined by factors such as the sound character, spectral frequencies, number and magnitude of maximum noise events,

[20] A sound characterized by brief excursions of sound pressure (transient signal) that significantly exceed the ambient sound level.

the average noise levels etc. Potential maximum noise levels generated by various equipment and the potential extent of these sounds are presented in Table 7-44, with Table 7-45 illustrating the equivalent (average) noise levels and potential extent.

Sound power emission levels as defined in Table 7-46 will be used in the noise modelling for both the construction and operational phase.

Table 7-46: Sound power emission levels used for operational phase modelling

Equipment	**Sound power level, dB re1 pW, in octave band, Hz**							**SPL**
Centre frequency	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**(dBA)**
ADT truck - Bell 25 ton	102.5	108.6	106.5	105.4	104.5	99.2	97.2	108.4
Bulldozer CAT D5	107.4	105.9	104.8	104.5	104.4	97.5	90.2	107.4
Coal beneficiation plant (50kt/m)	110.6	111.2	110.9	111.2	110.8	107.0	100.6	117.5
Drilling Machine and compressor	107.2	109.4	109.2	106.1	104.7	101.2	99.8	120.0
Excavator and truck	111.0	112.2	109.3	106.4	105.4	101.6	98.4	110.0
FEL - Bell L1806C	109.0	106.7	107.3	97.9	95.8	92.5	87.6	102.7
FEL and Truck	105.0	117.0	113.0	114.0	111.0	107.0	101.0	110.0
General noise	95.0	100.0	103.0	105.0	105.0	100.0	100.0	108.8
Grader	100.0	111.0	108.0	108.0	106.0	104.0	98.0	110.9
Mobile Crusher	121.1	122.3	120.1	120.0	117.3	112.5	106.3	109.6
Road Truck average	90.0	101.0	102.0	105.0	105.0	104.0	99.0	109.6

7.15.7.2 Traffic

A source of noise during the operational phase will be traffic to and from the site, traffic around the infrastructure facilities, ROM and product transport and activities associated with waste management. While trucks moving around on the site do have a clearly audible noise during passing, the average noise contribution is relatively low compared to the other noise sources. For the purpose of this study, potential peak hauling activities will be assumed at an average of 16 trucks per hour travelling at 60 km/h from the site to the D622 road (day-time only). Around 10 ADTs are moving around onsite between the active mining pit and the processing plant (day and night).

7.15.8 Potential Noise Sources: Future noise scenario – Decommissioning

The Decommissioning Phase is considered as the phase which begins after the last coal is removed from the mine area and ends when the mine receives a Closure certificate from the DMR.

Rehabilitation normally takes place concurrently with mining, and final rehabilitation allows for the backfilling of all the remaining material and building rubble into the open pit area and the sloping of the high-wall areas.

Activities that can take place include:

- Decommissioning and rehabilitation of the remaining infrastructure unless it is required for post-mining impact management or for the final end land use. This includes the following:
    - Removal of all remaining redundant infrastructure.
    - Removal of any contaminated soil.
    - The rehabilitation of disturbed areas including the necessary ripping of compacted soils and the shaping of rehabilitated areas to ensure free drainage.
    - Placement of topsoil on rehabilitated surface areas followed by seeding (if necessary to re-establish vegetation).
    - Monitoring and maintenance of the rehabilitated areas.
    - Application for a Closure Certificate for the site.

However, while there are numerous activities that can take place during the decommissioning stage, the potential noise impact will only be discussed in general. This is because the noise impacts associated with the decommissioning phase is normally less than both the construction and operational phases for the following reasons:

- Final decommissioning normally takes place only during the day, a time period when existing ambient sound levels are higher, generally masking most external noises for surrounding receptors; and
- There is a lower urgency of completing this phase and less equipment remains onsite (and are used simultaneously) to affect the final decommissioning

7.15.9 Noise Impact on Animals[21]

A significant amount of research was undertaken during the 1960's and 70's on the effects of aircraft noise on animals. While aircraft noise has a specific characteristic that might not be comparable to industrial noise, the findings should be relevant to most noise sources. A general animal behavioural reaction to aircraft noise is the startle response with the strength and length of the startle response to be dependent on the following:

- which species is exposed;
- whether there is one animal or a group of animals, and
- whether there have been some previous exposures.

Overall, the research suggests that species differ in their response to noise depending on the duration, magnitude, characteristics and source of the noise, as well as how accustomed the animals are to the noise (previous exposure).

Extraneous noises impact on animals as it can increase stress levels and even impact on their hearing. Masking sounds may affect their ability to react to threats, compete and seek mates and reproduce, hunt and forage, communicate and generally to survive.

[21]Report to Congressional Requesters, 2005; USEPA, 1971; Autumn, 2007; Noise quest, 2010

Unfortunately, there are numerous other factors in the faunal environment that also influence the effects of noise. These include predators, weather, changing prey/food base and ground-based disturbance, especially anthropogenic. This hinders the ability to define the real impact of noise on animals.

The only animal species studied in detail are humans, and studies are still continuing in this regard. These studies also indicate that there is considerable variation between individuals, highlighting the loss of sensitivity to higher frequencies as human's age. Sensitivity also varies with frequency with humans. Considering the variation in the sensitivity to frequencies and between individuals, this is likely similar to all faunal species. Some of these studies are repeated on animals, with behavioural hearing tests being able to define the hearing threshold range for some animals as indicated in Figure 7-107 below.

Only a few faunal (animal) species have been studied in a bit more detail so far, with the potential noise impact on marine animals most likely the most researched subject, with a few studies that discuss behavioural changes in other faunal species due to increased noises. Few studies indicate definitive levels where noises start to impact on animals, with most based on laboratory level research that subject animals to noise levels that are significantly higher than the noise levels these animals may experience in their environment (excluding the rare case where bats and avifauna fly extremely close to an anthropogenic noise, such as from a moving car or the blades of a wind turbine).

From these and other studies, the following can be concluded that:

- Animals respond to impulsive (sudden) noises (higher than 90 dBA) by running away. If the noises continue, animals would try to relocate (Drooling, 2007).
- Animals start to respond to increased noise levels with elevated stress hormone levels and hypertension. These responses begin to appear at exposure levels of 55 to 60 dBA (Baber, 2009).
- Animals of most species exhibit adaptation with noise (Broucek, 2014), including impulsive noises, by changing their behaviour.
- More sensitive species would relocate to a more quiet area, especially species that depend on hearing to hunt or evade prey, or species that makes use of sound/hearing to locate a suitable mate (Drooling, 2007).
- Noises associated with helicopters, motor- and quad bikes does significantly impact on animals. This is due to the sudden and significant increase in noise levels due to these activities.

To date, there are, however, no guidelines or sound limits with regards to noise levels that can be used to estimate the potential significance of noises on animals.

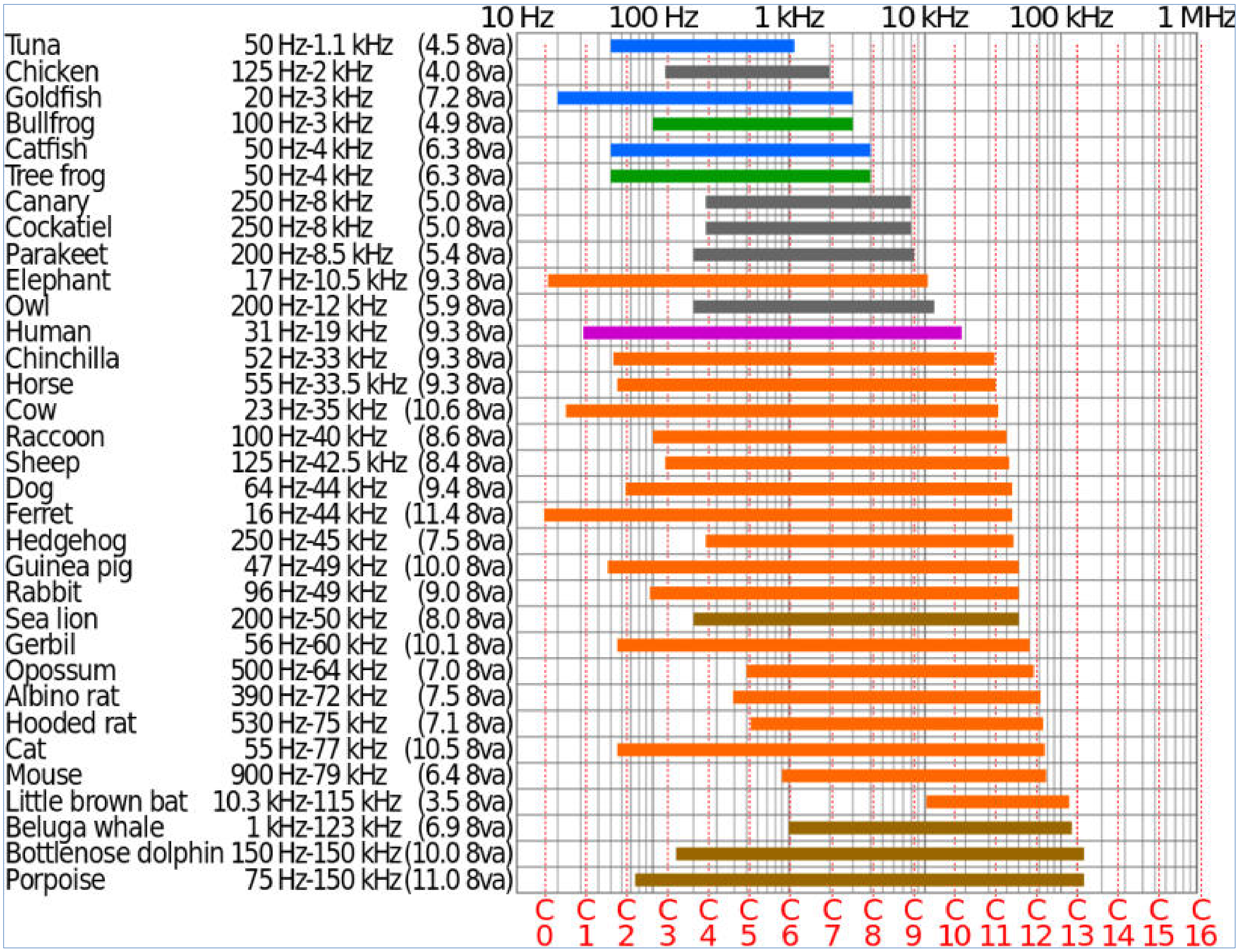


Figure 7-107: Logarithmic Chart of the Hearing Ranges of Some Animals.

7.15.10 Domestic Animals

It may be that domesticated animals are more accustomed to noise sources of an industrial, commercial or other anthropogenic nature, although exposure to high noise levels may affect domestic animals' well-being. Sound levels in animal shelters can exceed 100 dB, much more than what can be expected at a domestic dwelling from an industrial, commercial or transportation noise source (10-minute equivalent)[22&23]. The high noise levels may see negative influences on animals' cardiovascular systems and behaviour and may be damaging to the hearing of dogs in the kennel facility[24].

Domesticated animals may also respond differently to noises than animals in the wild. Domesticated dogs are pack animals and may respond excitedly or vocally to other noises, smells, visual and other stimulants, in contrast to wild animals that may flee due to any slight unfamiliar sounds or noises. Animals that are transported at least once in their life (such as pigs to an

[22]Crista L. Coppola. Noise in the Animal Shelter Environment: Building Design and the Effects of Daily Noise Exposure.
[23] David Key, Essential Kennel Designs.
[24]Wei, B. L. (1969). Physiological effects of audible sound. AAAS Symposium Science, 166(3904), 533-535.

abattoir) would endure high noise levels for the duration of the delivery period. A change in the heart rate, renal blood flow and blood pressure of study subjects were noted in the above studies. How small changes (in environmental noise levels) may impact on domesticated animals has not been studied.

7.15.11 Wildlife

Many natural based acoustics themselves may be loud or impulsive. Examples include thunder, wind-induced noises that could easily exceed 35 dBA ($L_{A90,fast}$) above wind speeds averaging 6 m/s, noise levels during early morning dawn chorus or loud cicada noises during late evening or early morning.

Potential noise impacts on wildlife are very highly species dependent. Studies showed that most animals adapt to noises and would even return to a site after an initial disturbance, even if the noise continues. The more sensitive animals that might be impacted by noise would most likely relocate to a quieter area. Stress levels can increase in animals restricted to areas where the sound levels are impacting on them (due to the level, character or both).

There are a few specific studies discussing the potential impacts of noise on wildlife associated with construction, transportation and industrial facilities. Available information indicates that noises from transportation and industrial sources may mask the sound of a predator approaching; similarly, predators depending on hearing would not be able to locate their prey.

7.15.12 Avifauna[25]

Noise impacts on birds include:

- It can cause hearing damage (very loud or loud impulsive sounds);
- It can increase stress levels (directly and indirectly);
- Masking (directly or indirectly) the sounds of their food, predators or mates;
- Their typical food sources may move;
- Relocation to less suitable habitats; and
- other behavioural reactions.

As with the impact on other wildlife, the impact of noise on avifauna depends on the character of the noise (including the impulsive character), the magnitude or intensity of the noise as well as the familiarity the birds have with the sound.

Similarly, different birds change their response to these sounds differently. Some may not be impacted while more sensitive species may relocate, some birds –

- may start to sing at different times;
- may change the frequency, pitch or character of their calls/singing/signals; or/and
- increase the volume of their calls/singing/signals.

As with other animals, there are no guidelines or even studies highlighting acceptable sound levels or other criteria before noise may start to impact on birds.

[25] Ortega, 2012; Halfwerk, 2011; Francis, 2012; Francis, 2011; Parris, 2009, Brumm, 2004.

7.15.13 Laboratory Animal Studies

Although many laboratory animals have wild counterparts (rats, mice) the laboratory test subjects differ in many aspects (genetics, behaviour etc.). Also, noise levels of studies are conducted at generally very high levels at over 100 dB, much more than what would be experienced in environmental settings around industrial, commercial or transportation activities.[26] Other dissimilarities to laboratory tests and a natural environment include the time exposure (duration of noise), the spectral and noise character (impulsive noise vs. constant noise) etc. Although there exist dissimilarities in tests conducted and noise levels around commercial and industrial environments, laboratory rodents exposed to high noise levels did indicate physiological, behavioural changes, hearing loss and other such effects[27].

7.15.14 Why noise concerns communities[28]

Noise can be defined as "unwanted sound", and an audible acoustic energy that adversely affects the physiological and/or psychological well-being of people, or which disturbs or impairs the convenience or peace of any person. One can generalise by saying that sound becomes unwanted when it:

- Hinders speech communication;
- Impedes the thinking process;
- Interferes with concentration;
- Obstructs activities (work, leisure and sleeping); and
- Presents a health risk due to hearing damage.

However, it is important to remember that whether a given sound is "noise" depends on the listener or hearer. The driver playing loud rock music on their car radio hears only music, but the person in the traffic behind them hears nothing but noise.

Response to noise is unfortunately not an empirical absolute, as it is seen as a multi-faceted psychological concept, including behavioural and evaluative aspects. For instance, in some cases, annoyance is seen as an outcome of disturbances, in other cases, it is seen as an indication of the degree of helplessness with respect to the noise source.

Noise does not need to be loud to be considered “disturbing”. One can refer to a dripping tap in the quiet of the night, or the irritating “thump-thump” of the music from a neighbouring house at night when one would like to sleep.

Severity of the annoyance depends on factors such as:

- Background sound levels, and the background sound levels the receptor is used to;
- The manner in which the receptor can control the noise (helplessness);
- The time, unpredictability, frequency distribution, duration, and intensity of the noise;
- The physiological state of the receptor; and
- The attitude of the receptor about the emitter (noise source)..

[26]USEPA, 1971.
[27] Baldwin, 2007.
[28]World Health Organization, 1999; Noise quest, 2010; Journal of Acoustical Society of America, 2009

Table 7-47: Acceptable Zone Sound Levels for noise in districts (SANS 10103:2008)

1	2	3	4	5	6	7
Type of district	**Equivalent continuous rating level ($L_{Req.T}$) for noise** dBA					
	Outdoors			**Indoors, with open windows**		
	Day/night $L_{R,dn}$ [a]	**Daytime** $L_{Req,d}$ [b]	**Night-time** $L_{Req,n}$ [b]	**Day/night** $L_{R,dn}$ [a]	**Daytime** $L_{Req,d}$ [b]	**Night-time** $L_{Req,n}$ [b]
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with one or more of the following: workshops; business premises; and main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

SANS 10103:2008 also provides a guideline for estimating community response to an increase in the general ambient noise level caused by an intruding noise. If Δ is the increase in sound level, the following criteria are of relevance:

- **Δ ≤ 3 dBA:** An increase of 3 dBA or less will not cause any response from a community. It should be noted that for a person with average hearing acuity an increase of less than 3 dBA in the general ambient noise level would not be noticeable.
- **3 < Δ ≤ 5 dBA:** An increase of between 3 dBA and 5 dBA will elicit 'little' community response with 'sporadic complaints'. People will just be able to notice a change in the sound character in the area.
- **5 < Δ ≤ 15 dBA:** An increase of between 5 dBA and 15 dBA will elicit a 'medium' community response with 'widespread complaints'. In addition, an increase of 10 dBA is subjectively perceived as a doubling in the loudness of a noise. For an increase of more than 15 dBA, the community reaction will be 'strong' with 'threats of community action'.

Note that an increase of more than 7 dBA is defined as a disturbing noise and prohibited (National Noise Control Regulations).

7.16 BLASTING AND VIBRATION

7.16.1 Study area and Potential Sensitive Structures

Figure 7-108 illustrates the representative Potential Sensitive Structures (PSS) or Blast Sensitive Receptors (BSR) located within 2,000m that may be affected by blasting activities, with Figure 7-109 depicting a number of structures (including pylons, buildings and structures, cement dams, roads and railroads, etc.) located within 500m. The following should be noted:

- Area within the 500 m buffer from opencast limits: Area around the mine pit where people and animals will be moved prior to blasting may take place (buffer indicates area during some future stage of mining). Ground vibration and air blast levels likely to be significant with a high risk of fly-rock closer to the blast area (see also Figure 7-108 where structures located within 500m from future locations where blasting may take place are indicated).

- Area 500 to 2,000 m from opencast limits (see also Figure 7-108): Area outside the zone where fly rock may be a concern, but:
    - noise from the airblast will be very high;
    - in the unmanaged situation ground vibration and air blast levels could be of a significant concern.
    - in a managed situation ground vibration and air blast levels may be insufficient to result in structural damage to most structures but vibration and air blast levels will be sufficiently high to create annoyance with the blasting and project.
- Area further than 2000 m from opencast limits:
    - Noise from the airblast could be high and will be clearly audible;
    - In the unmanaged situation ground vibration and air blast levels could result in concerns and potential complaints;
    - In a managed situation ground vibration and air blast levels will be low and unlikely to result in concerns and complaints.

Further than 2,000m there is a low possibility of any structural damage in the managed situation. People however may still be concerned about blasting due to the secondary effects of blasting (such as the resonance from flat surfaces potentially perceived as vibration) as well as the perceived risks and dangers. It should be noted that there is no agreed distance where people may not experience annoyance with the blasting activity, whether audible, detectable or due to a ground vibration.

Roads

The paved P622 pass the site approximately 1,300m to the south-east from the opencast area (see also Figure 7-108).

Railway lines

There is a railway line approximately 600m directly west of the opencast area (see also Figure 7-108).

Power Pylons and lines

There is a power line running south-east to north-west 280m north of the opencast pit, with two other lines running further than 500m from the mining area. Not indicated (though considered) on Figure 7-108 are telephone poles and smaller power lines within 2,000m from the mining area, including power pylons servicing the trains.

Structures

There are a number of metal and cement structures located close to the proposed opencast pits (see also Figure 7-108). The statuses of these structures are unknown and were not investigated. These structures include:

- A number of permanent brick buildings and sensitive structures constructed out of corrugated iron;
- Some cement dams and boreholes;
- A number of ventilation fans.

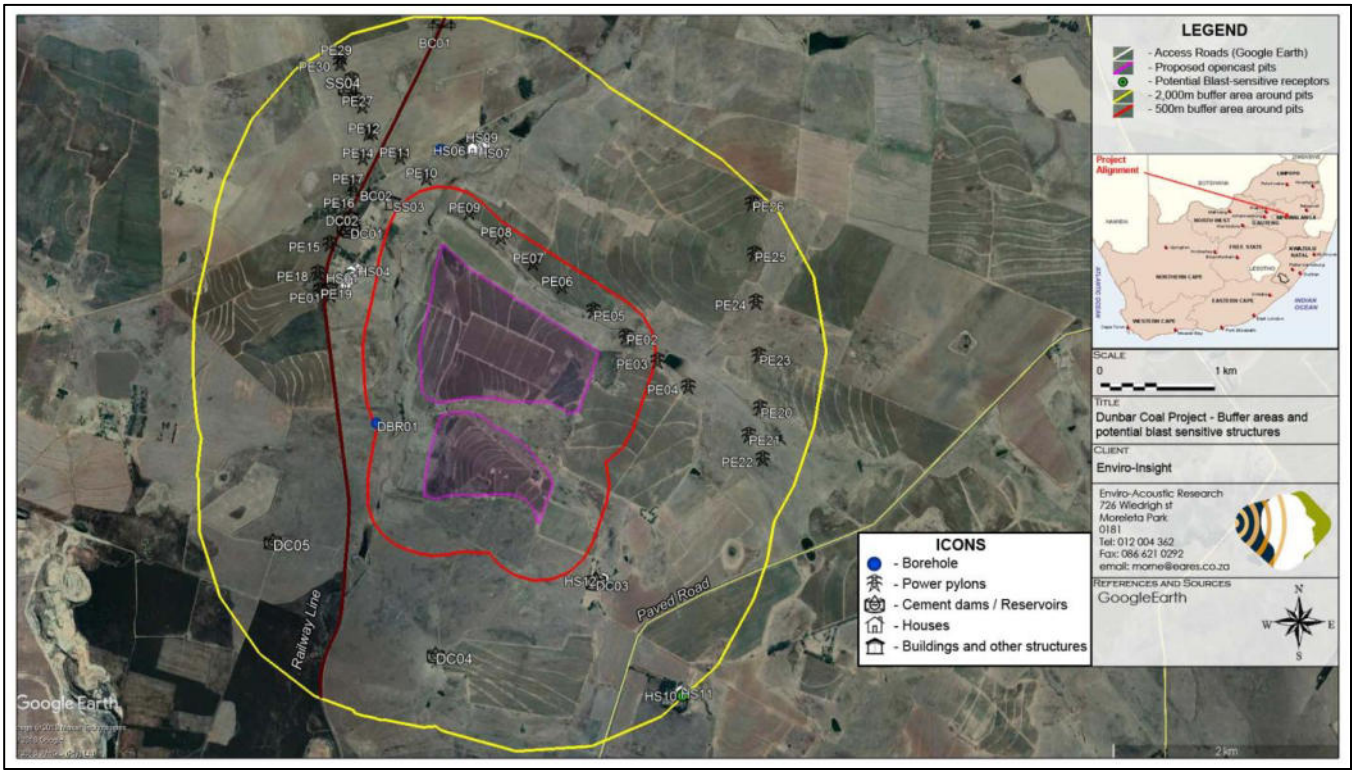


Figure 7-108: Aerial image indicating potential PSS and receptors within 2,000m of potential blasting area.

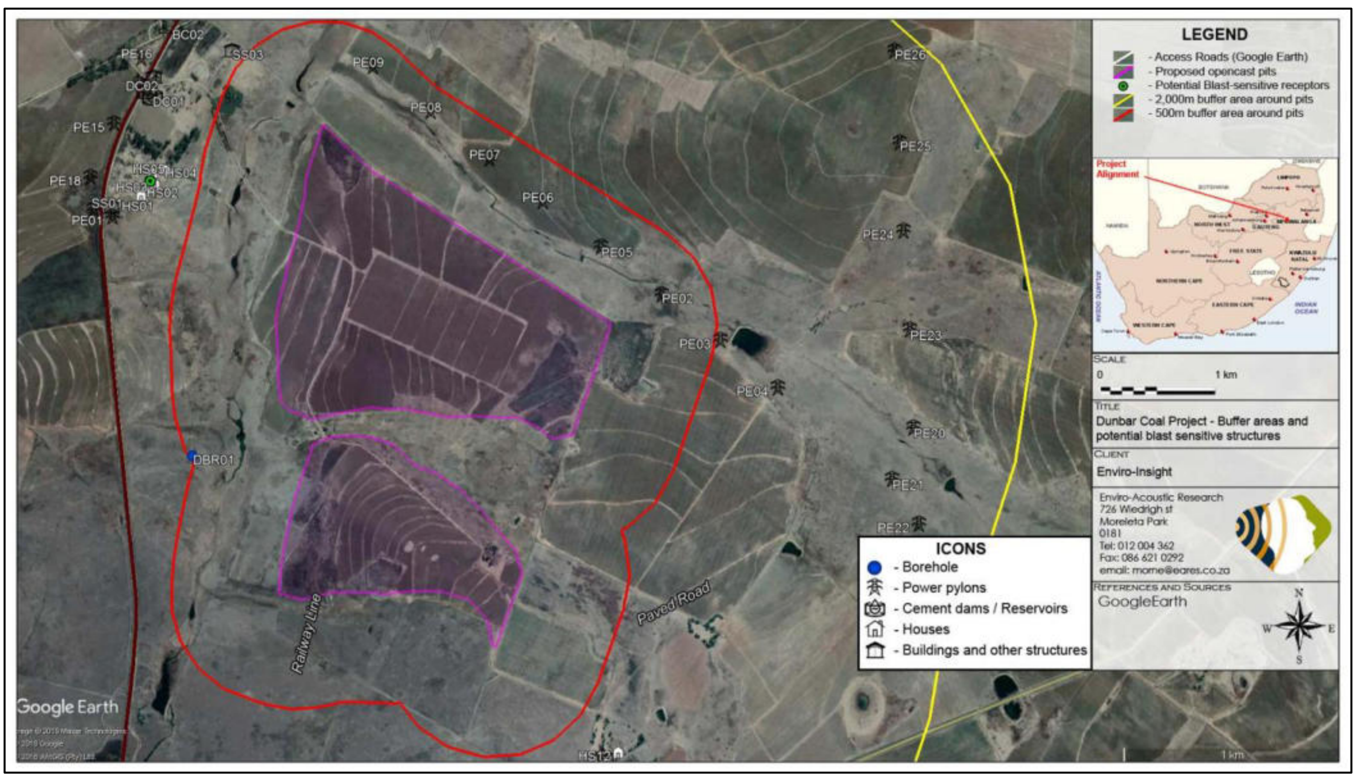


Figure 7-109: Aerial image indicating PSS close to the proposed project area.

7.16.2 Current Impacts

The site is located in an area with a significant mining character. There are a number of opencast mines in the area and people may have been exposed to instances of vibration and air blasts due to blasting in the area

Blasting activities could take place during both the construction (development of initial boxcut) and operational phase. As this assessment considers the worst-case scenario (large blast) there is no difference between construction and operational phase blasts.

7.16.3 Projected magnitude of blasting impacts

When a blast is detonated, a great deal of energy is liberated although only 20 – 30% of the energy used for rock fragmentation and displacing (Aloui, 2016). The rest of the explosive energy is wasted in the form of ground vibration, air blast and noise as well as fly rocks. Blasting vibration and air blast levels as well as the potential zone of impact for fly rock can be calculated using the blast design parameters defined in Table 7-48.

Table 7-48: Blast design – design parameters

Design parameter	Assumed blast parameters – Scenario 1	Optimized blast parameters – Scenario 2
Average depth of borehole, including subdrill (m)	10.33	10.33
Bench height (m)	10.00	10.00
Subdrill (m)	0.33	0.33
Borehole diameter (mm)	110	110
Burden (m)	4.0	3.0
Spacing (m)	5.0	4.0
Stemming Length (m)	2.58	3.44
Burden stiffness ratio	2.2	2.0
Column length (m)	8.13	8.00
Explosive density (g/cm^3)	1.15	1.15
Explosives per borehole (kg)	85.2	87.4
Charge mass per meter (kg/m)	10.5	10.9
Maximum number of blast holes per delay *(assumed)*	5.0	5.0
Maximum explosive per delay (kg)	426.0	437.0
Powder Factor (kg/m^3)	0.41	0.71

7.16.3.1 Projected magnitude of ground vibration

The accepted method of a scaled distance is used. This equation mainly uses two constants (initially assumed until it can be calculated using data from blasts), the quantity of explosives used (in kg) and the distance from the blast in meters. For any specific blast, distance to the closest PSS is fixed and cannot be changed with the only parameter that can be changed being the mass of explosives detonated per instance (per charge).

The larger the explosive mass (per delay), the higher the amplitude of the ground vibration. As such the amplitude of the ground vibration can be reduced by reducing the mass of the explosives fired at the same time, or with the appropriate use of delays (using timed blasts) to reduce the mass of explosives detonated per instance. This is referred to as the "charge per delay mass".

Therefore, using Equation 1, the potential ground vibration can be calculated for the assumed blast parameters (see Figure 7-110) as well as the "Rule of Thumb" blast parameters (optimised for a 0.7 powder factor) (see Figure 7-111). Figure 7-112 illustrates the distance from a potential blast (mass per charge) for various vibration limits.

Potential buffers are illustrated in:

- Figure 7-115 for the optimized blast parameters, indicating the buffer area where vibration levels of 2.54 mm/s may impact on people;
- Figure 7-116 for the optimized blast parameters, indicating the buffer area where vibration levels of 6 mm/s may impact on sensitive structures such as corrugated, adobe and mud buildings;
- Figure 7-117 for the optimized blast parameters, indicating the buffer area where vibration levels of 75 mm/s may impact on electrical power pylons.

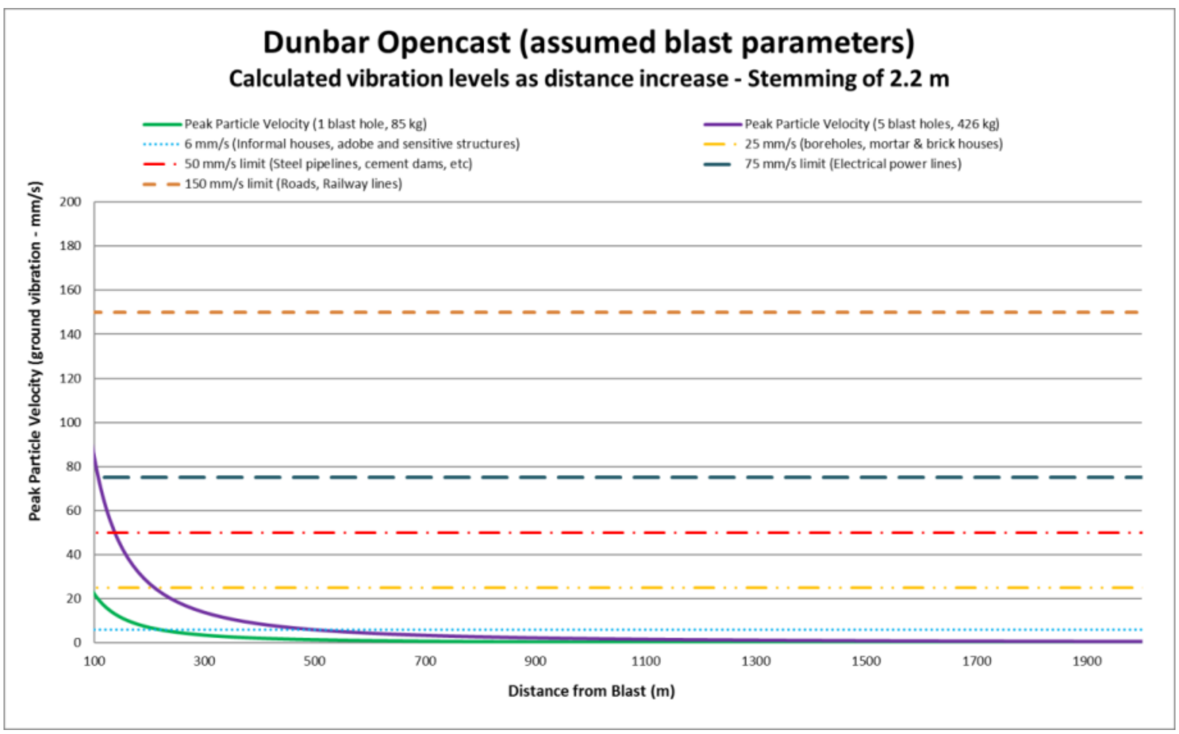


Figure 7-110: Ground vibration levels as the distance increase for assumed blast parameters.

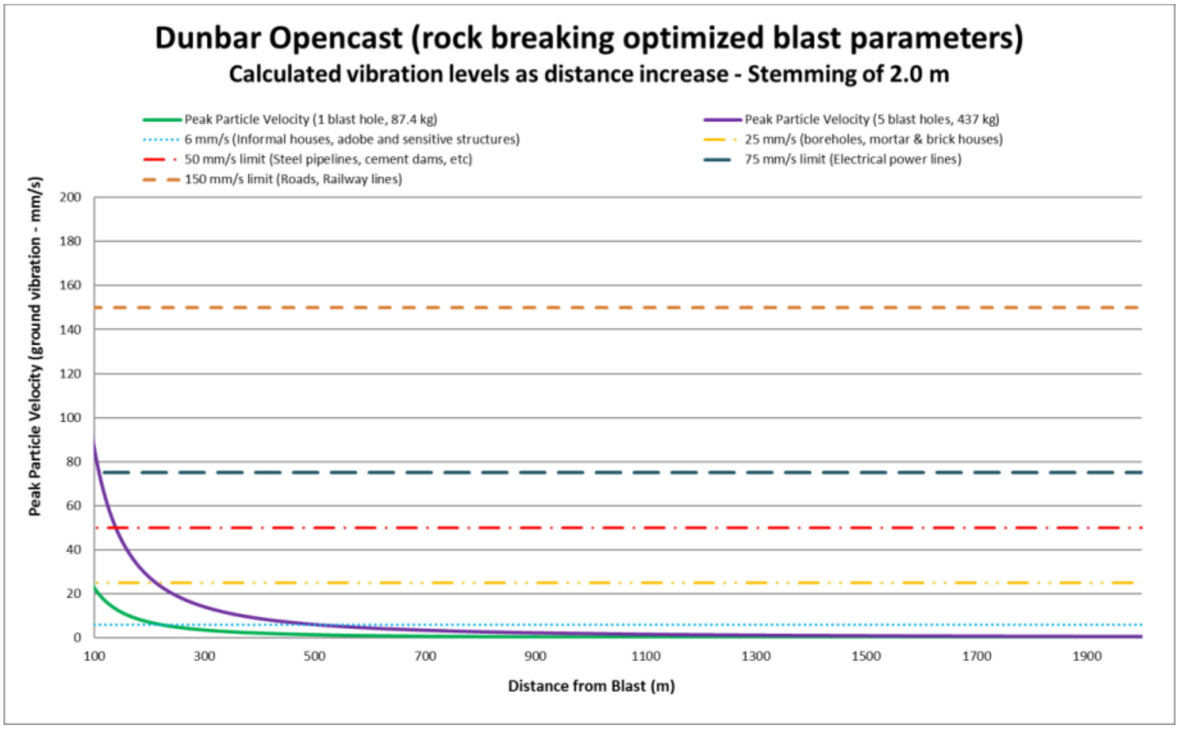


Figure 7-111: Ground vibration levels as the distance increase for optimised blast parameters (ideal rock breakage).

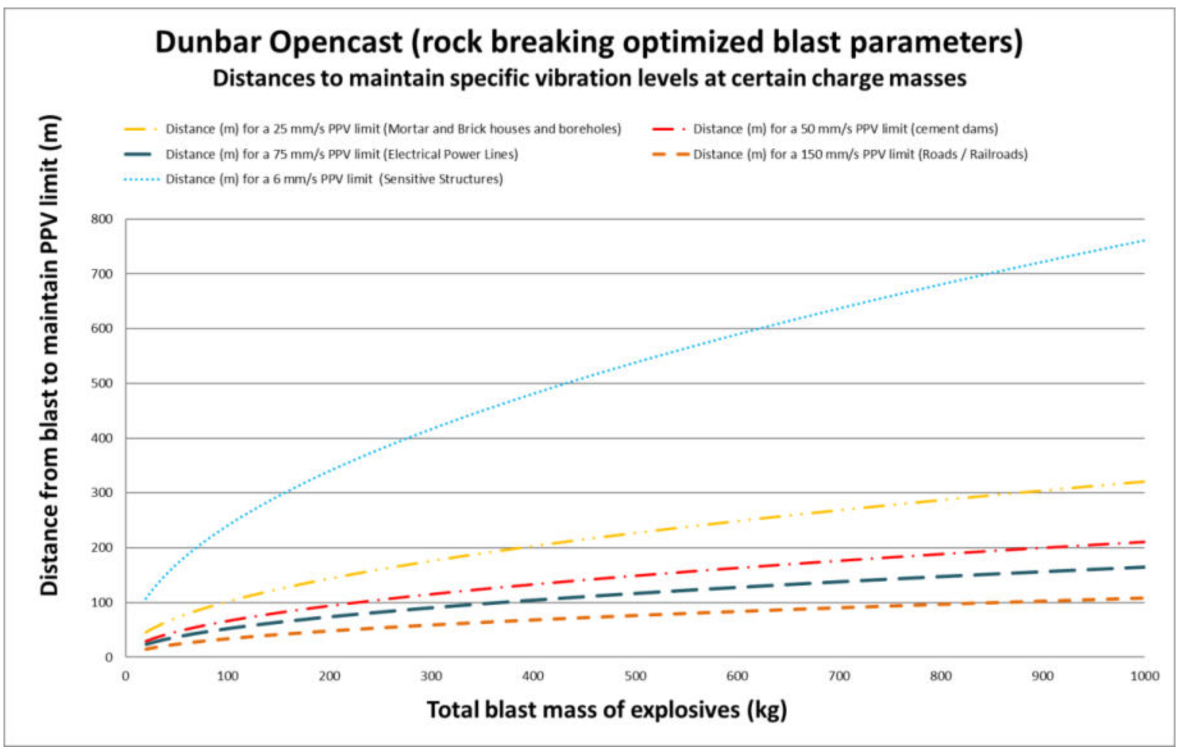


Figure 7-112: Required distances to maintain specific vibration levels at certain charge masses.

7.16.3.2 Projected magnitude of Air blast level

As with ground vibration, the method used to calculate the air blast level is also based on a scaled distance formula. The USBM formula only consider the mass of explosives used (in kg) and the distance from the blast in meters where the AS2187.2 method in addition also use two constants that allow the refinement for site specific conditions. Both the methods were considered with the USBM being the more pre-cautious method (higher air pressure level at the same distance than the Australian method).

As can be seen from equation 2, the air blast level can be reduced by reducing the mass of the explosives fired at the same instance (controlled or timed blasting). The two options (assumed and optimized blast parameters) will be considered. Using Equation 2, the potential air blast level can be calculated for the options as indicated in:

- Figure 7-113 for the assumed blast parameters using the USBM method; and
- Figure 7-114 for the assumed blast parameters using the AS 2187.2 method.

The potential extent of the impact (120 dBA noise limit) is illustrated on an aerial image in Figure 7-118 (the USBM method). As can be seen from these figures and similarly to ground vibration, the deeper the blasthole, the more explosives are used which would increase the airblast levels (everything being the same).

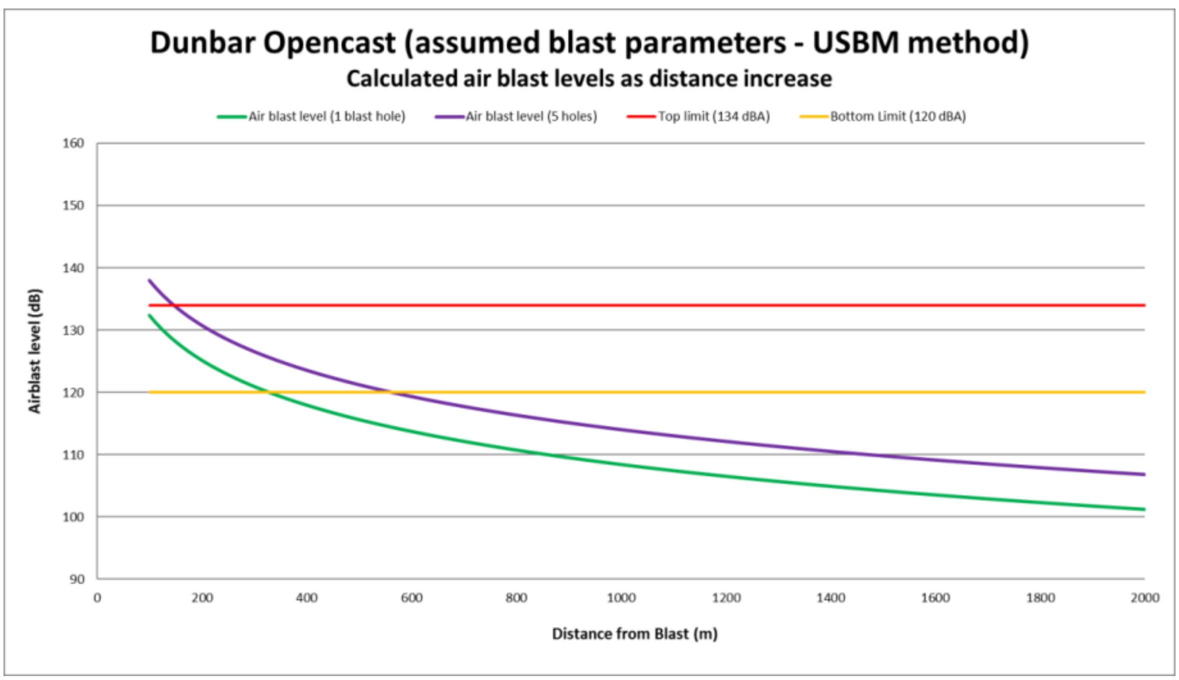


Figure 7-113: Air blast levels as the distance increase for assumed blast parameters using the USBM method

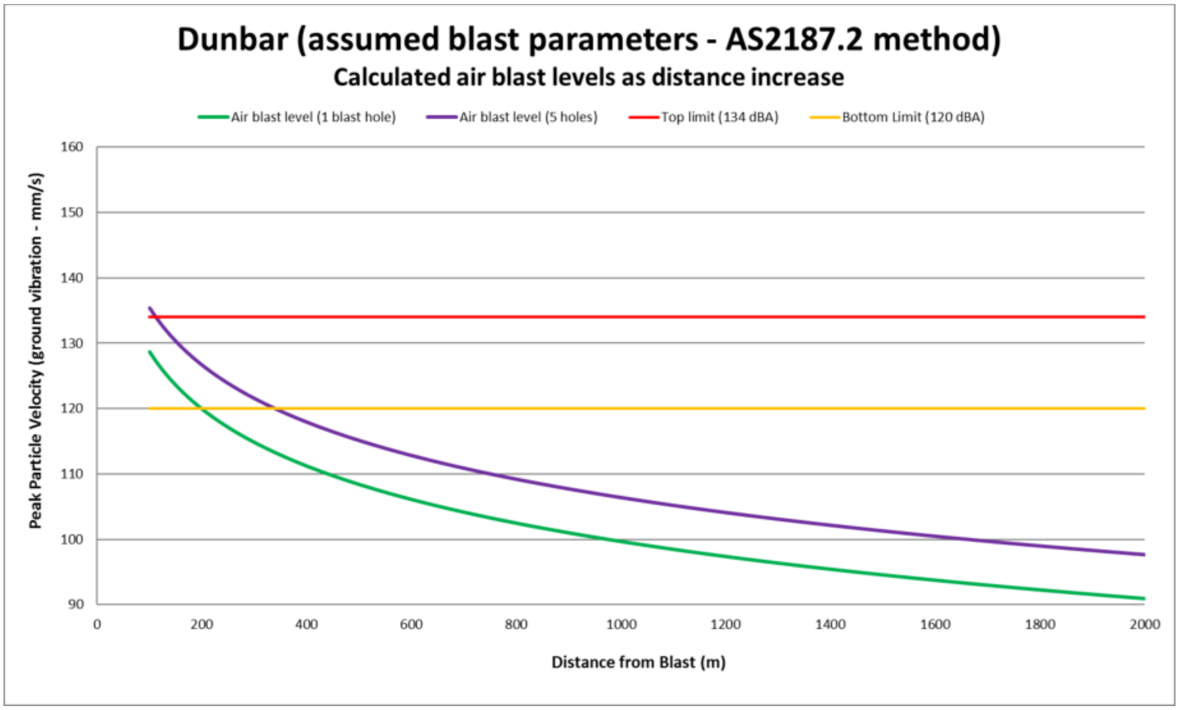


Figure 7-114: Air blast levels as the distance increase for assumed blast parameters using the AS2187.2 method

7.16.3.3 Projected Magnitude of Fly rock Risks

The different ways that fly rock may be created as well as the methods how it can be calculated is discussed in the report. The explosive mass (per meter) is used in all three formula, with blast design (the burden and stemming length) playing a very important role. Using these equations, the potential extent of fly rock was calculated and defined below with the extent of the risk illustrated on an aerial image on Figure 8-25. It should be noted, that, even with the best precautions, fly rock will occur and could travel further than the distances indicated in this report. As such a safety factor is recommended, which in some cases could be as high as 4 times the maximum throw distance. It is recommended that the mine at all times use a minimum exclusion zone of 500 m (equipment, people or livestock).

Table 7-49: Type of Flyrock and potential area of risk

Fly rock type	Value (m) – Assumed blast parameters	Value (m) – Optimized blast parameters
Face bursting	43 m (for a 4 m burden)	96 m (for a 3 m burden)
Cratering	203 m (for a 2.2 m stemming depth)	274 m (for a 2.0 m stemming depth)
Rifling	69 m (for a 2.2 m stemming depth)	94 m (for a 2.0 m stemming depth)

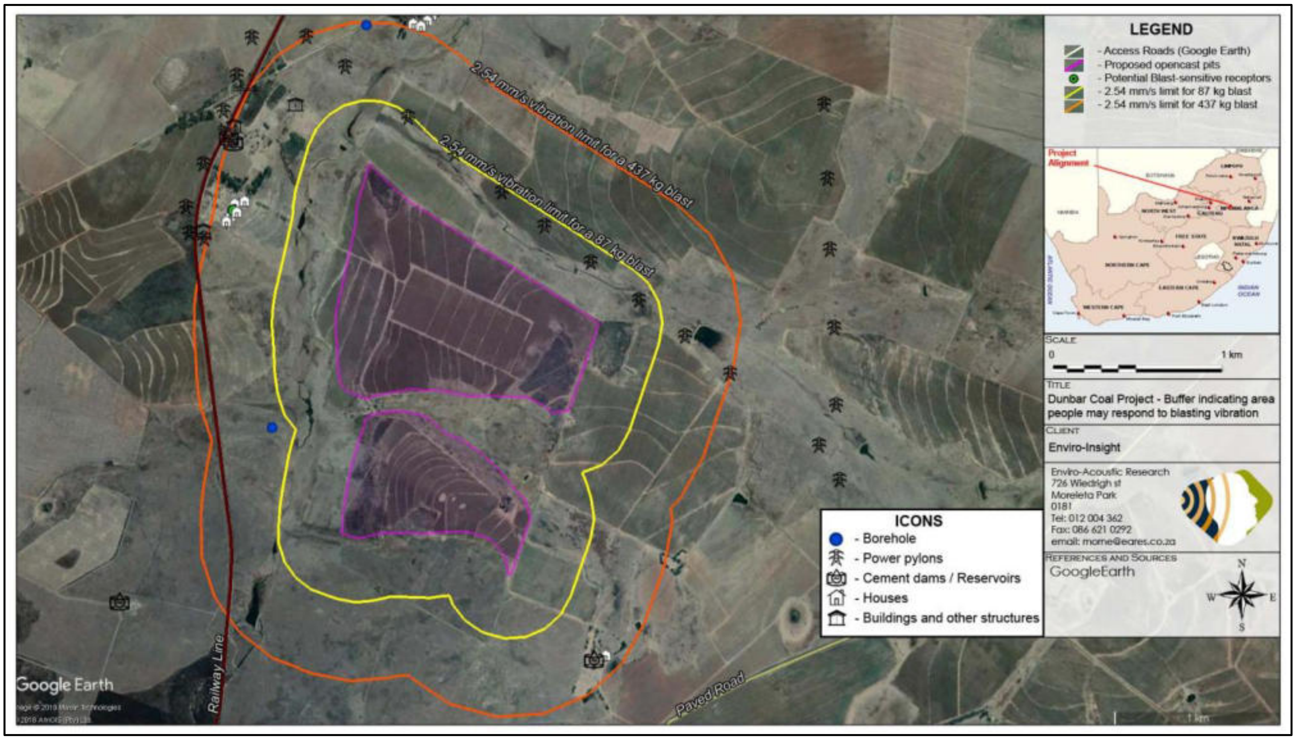


Figure 7-115: Projected Extent of Blasting Impacts – Potential area where people may respond to blasting vibration for the optimized blast parameters

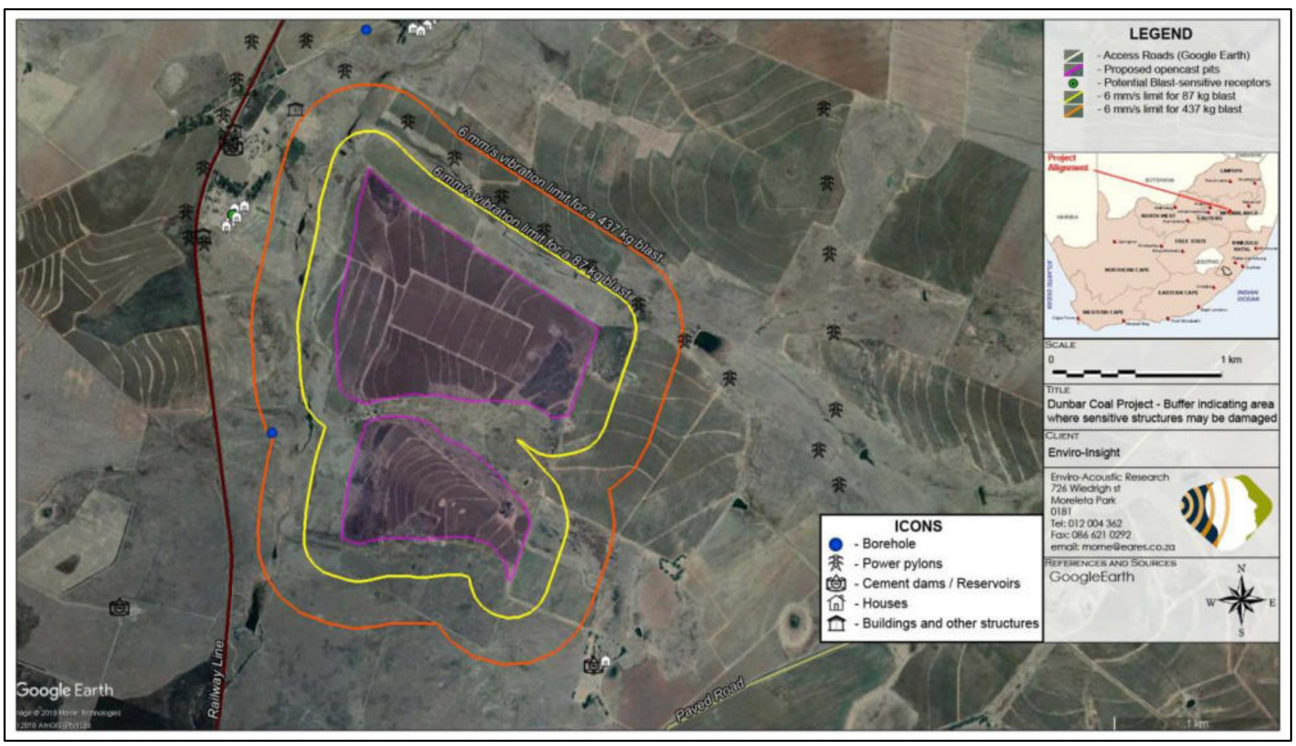


Figure 7-116: Projected Extent of Blasting Impacts – Potential area where sensitive structures may be damaged for the optimized blast parameters.

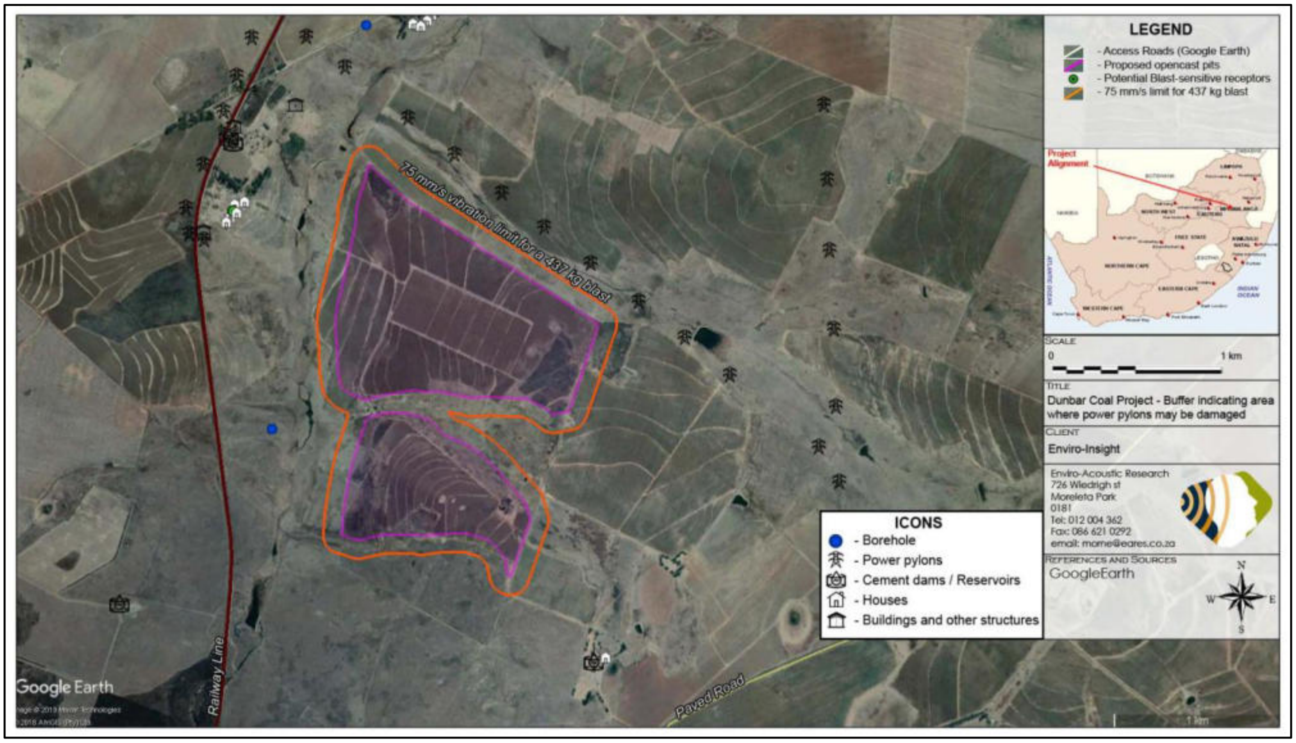


Figure 7-117: Projected Extent of Blasting Impacts – Potential area where pylons may be damaged for the optimized blast parameters.

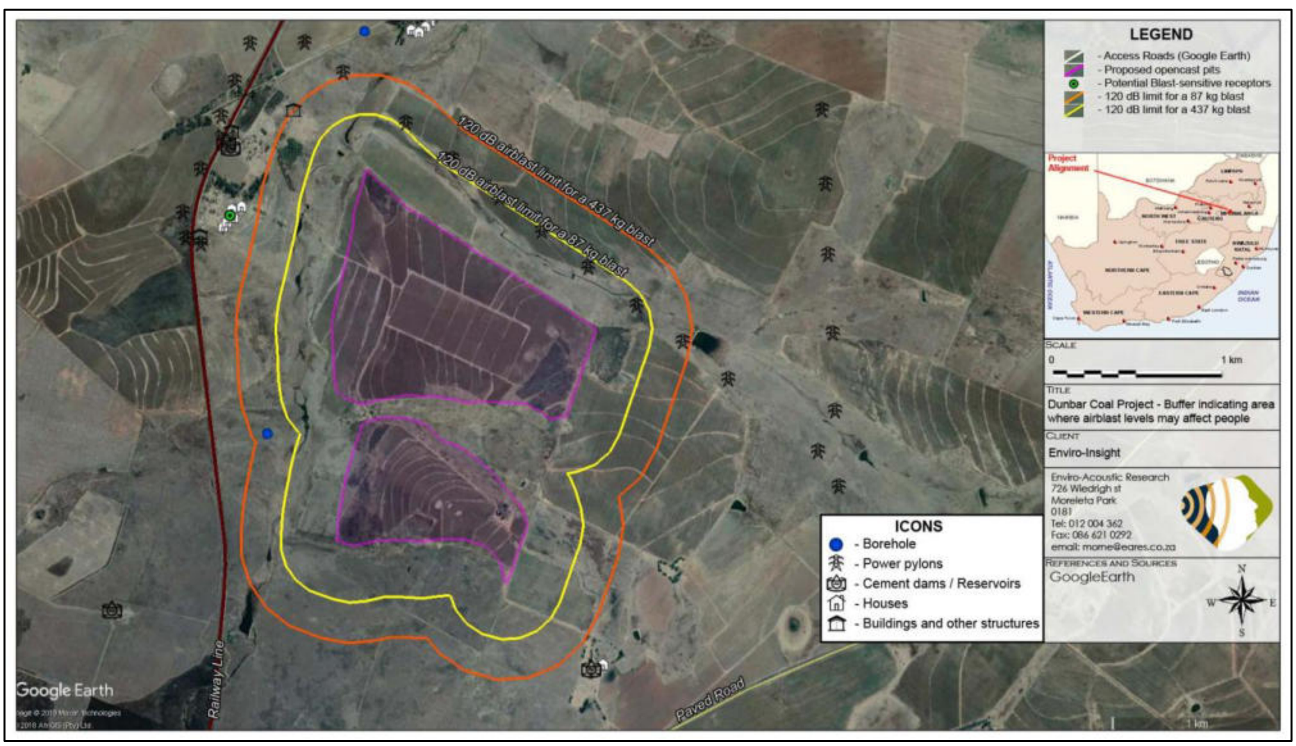


Figure 7-118: Projected Extent of Blasting Impacts – Air blast level for the optimized blast parameters.

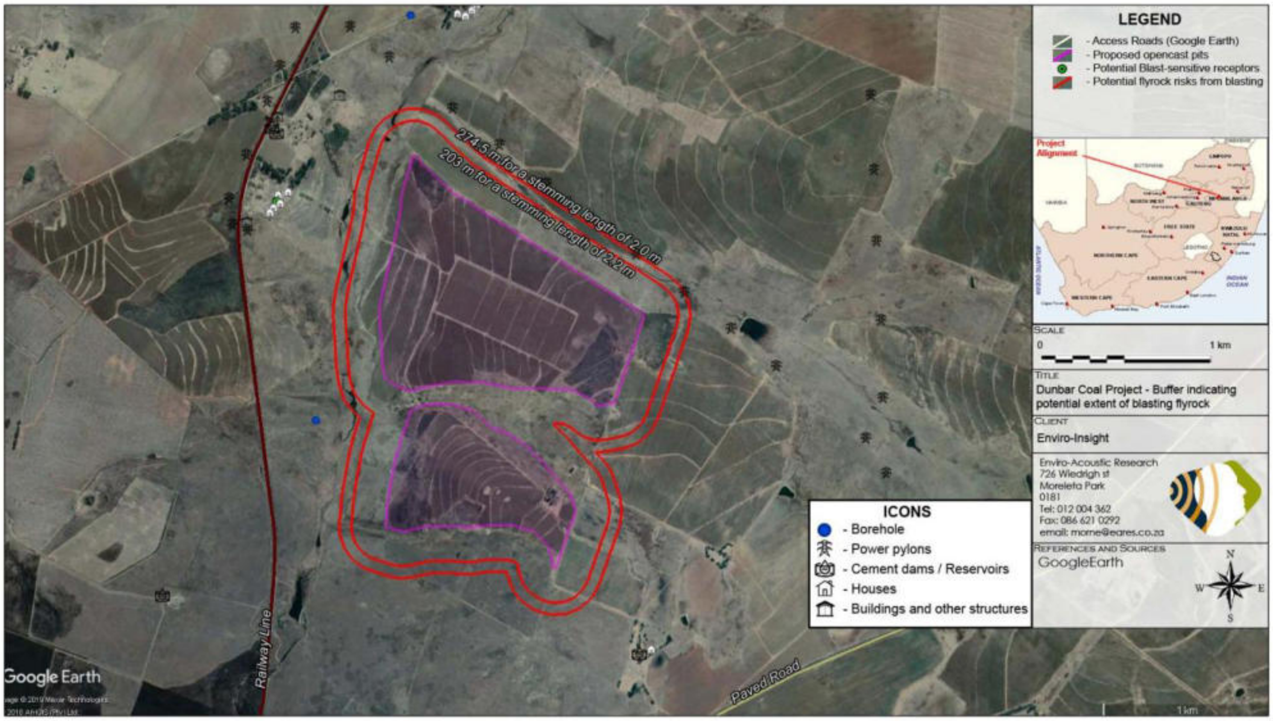


Figure 7-119: Projected Extent of Blasting Impacts – Fly rock risks.

7.17 AIR QUALITY

The Air Quality Assessment undertaken during the EIA Phase is attached as Appendix 12.

7.17.1 Background

7.17.1.1 Regional Air Quality

South Africa is located in the sub-tropics where high pressures and subsidence dominate. However, the southern part of the continent can serve as a source of hot air that intrudes sub-tropics, and that sometimes lead to convective movement of air masses. On average, a low pressure will develop over the southern part of the continent, while the normal high pressures will remain over the surrounding oceans. These high pressures are known as Indian High Pressure Cells and Atlantic High pressure Cells. The intrusion of continents will allow for the development of circulation patterns that draw moisture (rain) from either tropics (hot air masses over equator) or from the mid-latitude and temperate latitudes.

Southern Africa is influenced by two major high pressure cells, in addition to various circulation systems prevailing in the adjacent tropical and temperate latitudes. The mean circulation of the atmosphere over Southern Africa is anticyclonic throughout the year (except near the surface) due to the dominance of the three high pressure cells, namely South Atlantic High Pressure, off the west coast, the South Indian High Pressure off the east coast and the Continental High Pressure over the interior.

It is these climatic conditions and circulation movements that are responsible for the distribution and dispersion of air pollutants within the proposed Dunbar Coal Project area and between neighbouring provinces and countries bordering South Africa.

7.17.1.2 Site-Specific Dispersion Potential

A period wind rose for the site is presented in Figure 7-120 below. Wind roses comprise of 16 spokes which represents the direction 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 of wind speed and direction categories.

Based on an evaluation of the meteorological data simulations run from a global NEMS weather model at ~30 km resolution from 1985 to current of the project area. The following deductions regarding the prevailing wind direction and wind frequency can be assessed. Looking at Figure 7-120 below, the predominant wind direction is predicted to occur mainly from the east-north-east more than 1100 hours per year, with wind speeds higher than 5 km/h.

At the site, calm conditions with wind speeds of 12 km/h or less, are predicted 2-7 days per month throughout the year. 12-19 km/h winds are predicted 10-16 days per month through the year. Wind speeds of more than 19 km/h are predicted to occur 9-17 days per year on average.

7.17.1.3 Atmospheric Stability

The tendency of the atmosphere to resist or enhance vertical motion and thus turbulence is termed atmospheric stability. Stability is related to both the change of temperature with height and wind speed. A neutral atmosphere neither enhances nor inhibits mechanical turbulence. An unstable atmosphere enhances turbulence, whereas a stable atmosphere inhibits mechanical turbulence. The turbulence of the atmosphere is the most important parameter affecting dilution of air pollution as the more unstable the atmosphere, the greater the dilution of air pollution.

Atmospheric stability is commonly categorised into six stability classes. The atmospheric boundary layer is usually unstable during the day due to turbulence caused by the sun's heating effect on the earth's surface. The depth of this mixing layer depends mainly on the amount of solar radiation, increasing in size gradually from sunrise to reach a maximum at about 5 - 6 hours after sunrise. The degree of thermal turbulence is increased on clear warm days with light winds. During the night-time a stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral.

A neutral atmospheric potential neither enhances nor inhibits mechanical turbulences. Unstable atmospheric condition enhances turbulence, whereas stable conditions inhibit mechanical turbulence.

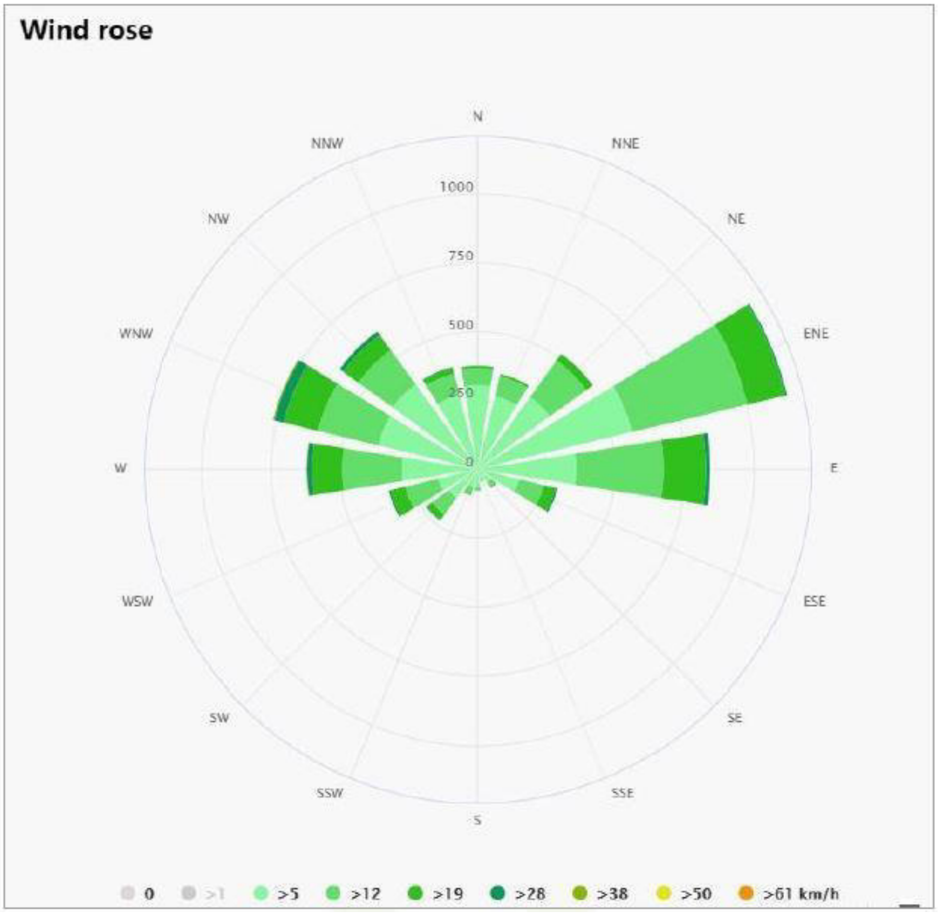


Figure 7-120: NEMS 30 km simulation model wind rose for the proposed Dunbar Coal project area for the period 1985 to current.

7.17.1.4 Winds Speed, Temperature and Precipitation Validation

To validate the NEMS model simulation results, only weather stations with more than 10 years' consistent data are considered for validation. The validation is thus not necessarily the closest station with actual measured data but rather the closest reliable station. The measurements from the chosen station are then aggregated on a weekly or monthly data. Figure 13 below show the closest station to the proposed Dunbar Coal project area that fall within the validation criteria as stated above, in this case Ermelo, 58 km away and at a similar altitude. The recorded data show good correlation in respect to temperature and wind speed. No precipitation comparison was made.

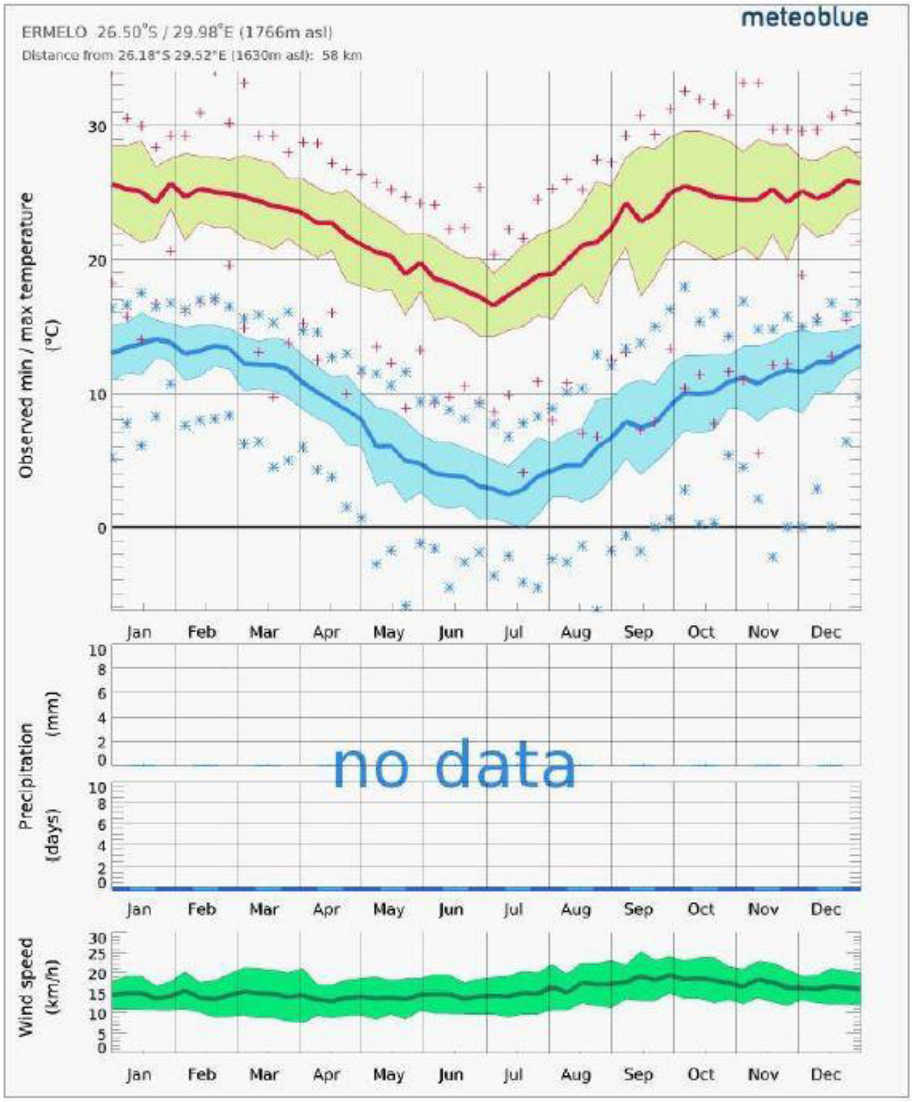


Figure 7-121: Measurement data for the closest measurement location with enough data to verify the NEMS model result.

7.17.2 Baseline Air Quality Results

7.17.2.1 Sensitive Receptors

Sensitive receptors identified in the immediate vicinity of the study area and proposed project area has been listed below (Figure 7-122):

- Farm steads

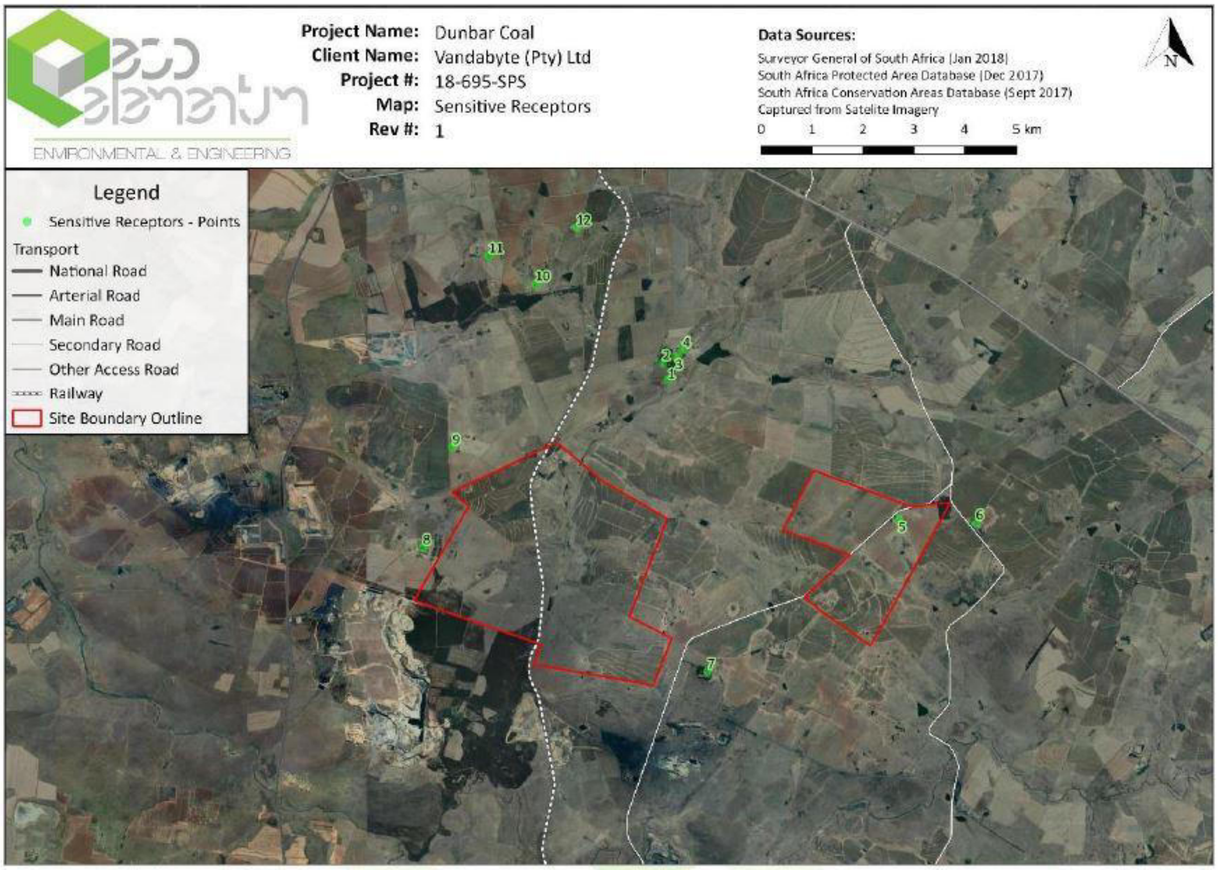


Figure 7-122: Sensitive receptors in the immediate area of the mining boundary.

7.17.2.1.1 Vehicle Exhaust Gases

Vehicle exhausts contain a number of pollutants including carbon dioxide (CO2), carbon monoxide (CO), hydrocarbons, oxides of nitrogen (NOx), sulphur and PM10. Tiny amounts of poisonous trace elements such as lead, cadmium and nickel are also present. The quantity of each pollutant emitted depends upon the type and quantity of fuel used, engine size, speed of the vehicle and abatement equipment fitted. Once emitted, the pollutants are diluted and dispersed in the ambient air. Pollutant concentrations in the air can be measured or modelled and then compared with ambient air quality criteria.

7.17.2.1.2 Veld Fires

Veld fires are widespread across the world, occurring in autumn, winter and early spring. In addition to controlled burning for fire-breaks and veld management, many fires are set deliberately for mischievous reasons. Some are accidental, notably those started by motorists throwing cigarettes out of car windows. Emissions from veld fires are similar to those generated by coal and wood combustion. Whilst veld fire smoke primarily impacts visibility and landscape aesthetic quality, it also contributes to the degradation of regional scale airquality. Dry combustible material is consumed first when a fire starts. Surrounding live, green material is dried by the large amount of heat that is released when there are veld fires, sometimes this material also burns. The major pollutants from veld burning are particulate matter, carbon monoxide, and volatile organics.

Nitrogen oxides are emitted at rates from 1 to 4 g/kg burned, depending on combustion temperatures. Emissions of sulphur oxides are negligible (USEPA, 1996).

7.17.2.1.3 Trucks Passing On the Gravel Road, Loading And Offloading Raw Materials

Dust emissions occur when soil is crushed by a vehicle, as a result of the soil moisture level being low. Vehicles used on the roads will generate PM-10 emissions throughout the area and they carry soils onto the paved roads which would increase entrainment PM-10 emissions. The quantity of dust emissions from unpaved roads varies linearly with the volume of traffic.

7.17.2.1.4 Wind Erosion As A Result Of ROM Material and Topsoil Stockpiles

The topsoil and waste rock stockpiles generated during the construction phase will be minimal and probably used for construction purposes on site (berm and foundations for buildings), reason being that this will be limited to the mining areas – since the project is mainly an opencast operation. At the ROM stockpile, there will be constant transfer of ore from the opencast to the stockpile and then to the crushing/screening.

7.17.2.1.5 Material Handling (Loading, Hauling and Tipping)

Material handling during loading, hauling and tipping as mining processes has been known to have influence on dust generation in terms of increasing the fugitive dust emissions being generated. With the different kind of materials – topsoil, soft, and hard, tipping will be negligible. The tipping is mostly associated with the ROM at the processing plant vicinity. During these activities factors such as the surrounding wind regime, the material tipping rate, and the moisture content of the material all have an influence on the dust generation at the tipping transfer points.

7.17.2.1.6 Plant – Crushing and Screening

There are two basic methods of crushing, either compressive or impact. The main types within these categories are:

- Compressive; jaw crushers, single and double toggles, gyratory crushers, cone crushers, roll crushers, ball mills and rod mills.
- Impact; rotary or vertical shaft impactors (e.g. Barmac), hammer mills (fixed or swing hammers).

Compressive crushing produces dust but does not in itself produce a great deal of air movement, but rather the material passing through the crusher causes the dust from the process and the processed material to become airborne. Excessive clearance under the crusher can cause a lot of dust generation in the same way as a high discharge point. Impact-type crushers, for example hammer mills, act as powerful fans and not only produce dust from the impact of hammer on rock, but also blow the dust out.

Screening provides the most difficult dust control problem in mining operations, particularly if dry screening is taking place. Very careful planning of screen layout has to be undertaken to take out the fine cut as early as possible to lessen the dust carried through the screening process, and allow the use of water to both clean chip and allay dust, as water is the cheapest form of dust suppression there is. In most cases, the crushing and screening process represents a significant source of fugitive dust with high quantities of respirable fractions released to the atmosphere. Dust sources around the plant, apart from crushing and screening, include discharge into hoppers, long open chutes, and from conveyors and transfer points. High discharge heights produce an air pressure blast effect and create turbulence, which carries dust into the air. This also causes particle fracture, and free fall allows the wind to pick up and carry the dust for a long distance from the discharge point.

7.17.3 Modeling results

Only the following scenario is plotted as this is considering the preferred scenario considering the result from the air quality model.

1. Un-mitigated - material being handled dry;
2. Mitigated 75% – Sources as Specified with Haul roads at 90% Mitigation.

Figure 7-123: Predicted average annual concentrations for PM10 for the proposed Dunbar Coal project when unmitigated.

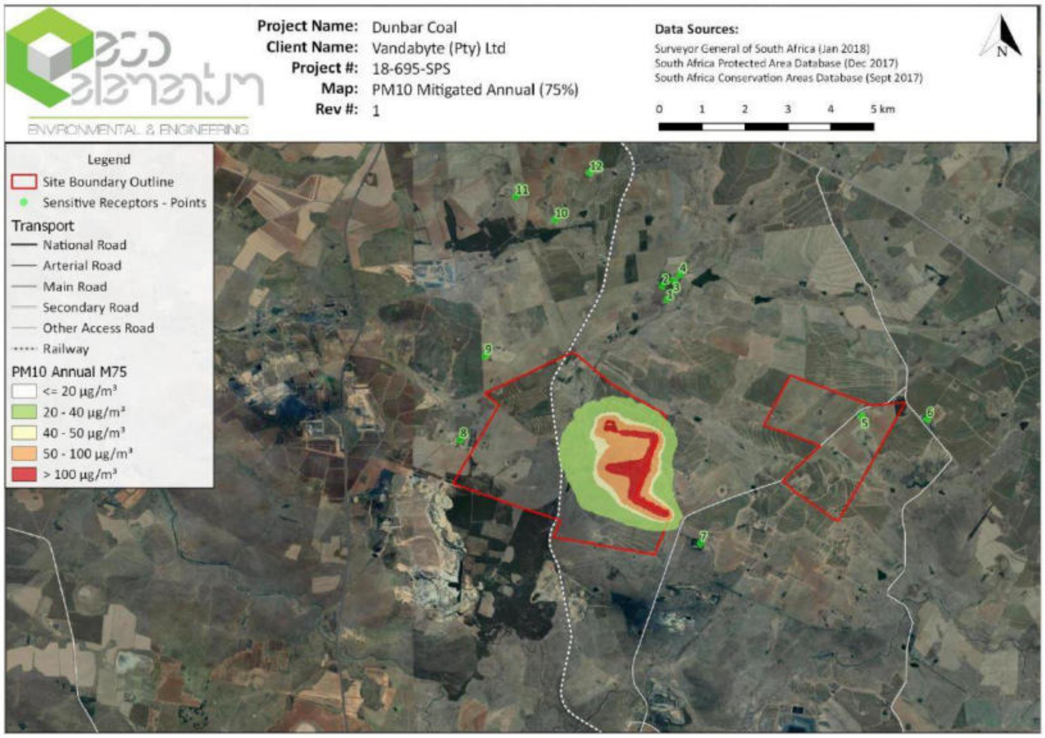


Figure 7-124: Predicted average annual concentrations for PM10 for the proposed Dunbar Coal project operations when mitigated with Haul Roads at 75%.

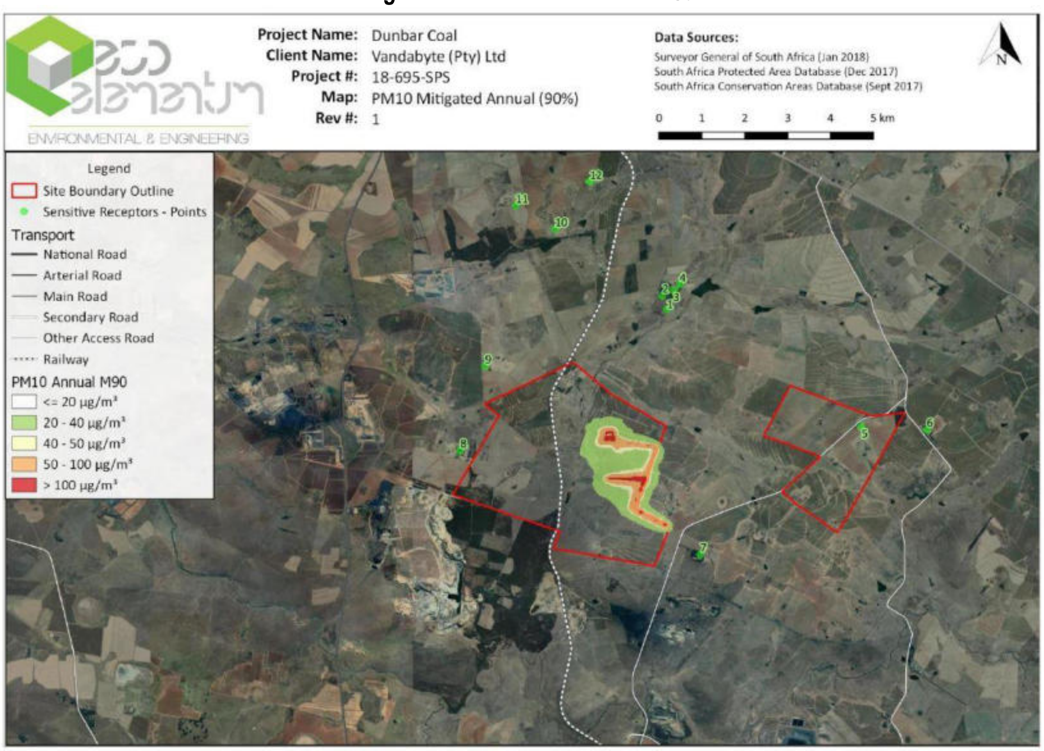


Figure 7-125: Predicted average annual concentrations for PM10 for the proposed Dunbar Coal project operations when mitigated with Haul Roads at 90%.

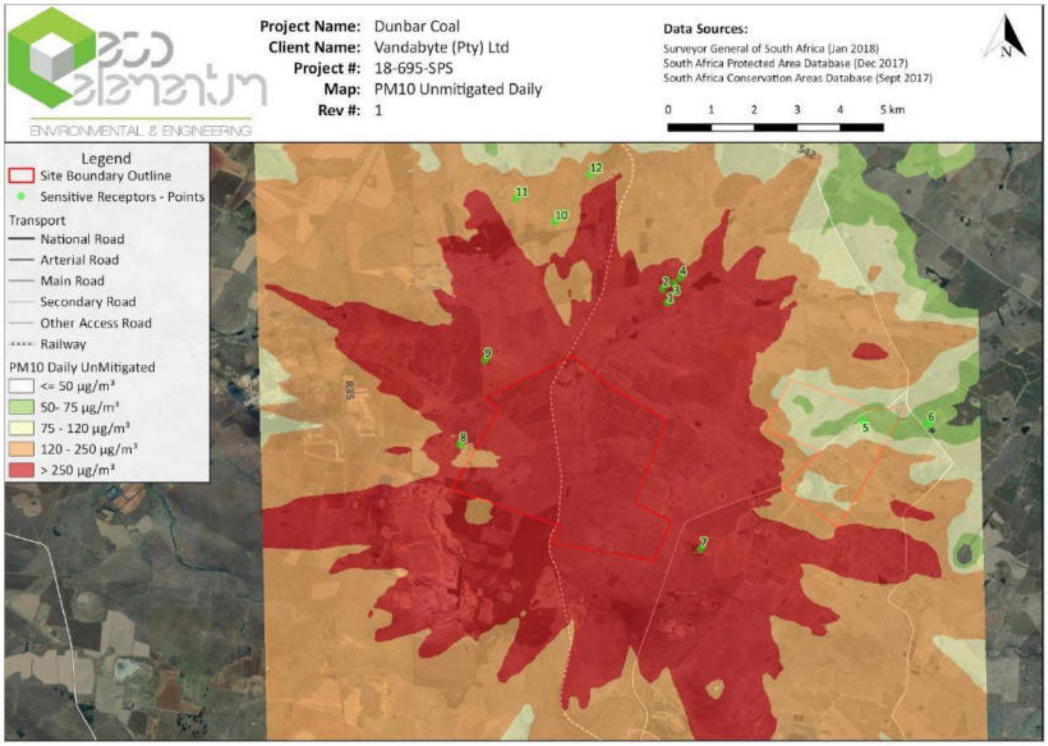


Figure 7-126: Predicted 2nd Highest daily concentrations for PM10 for the proposed Dunbar Coal project operations when unmitigated.

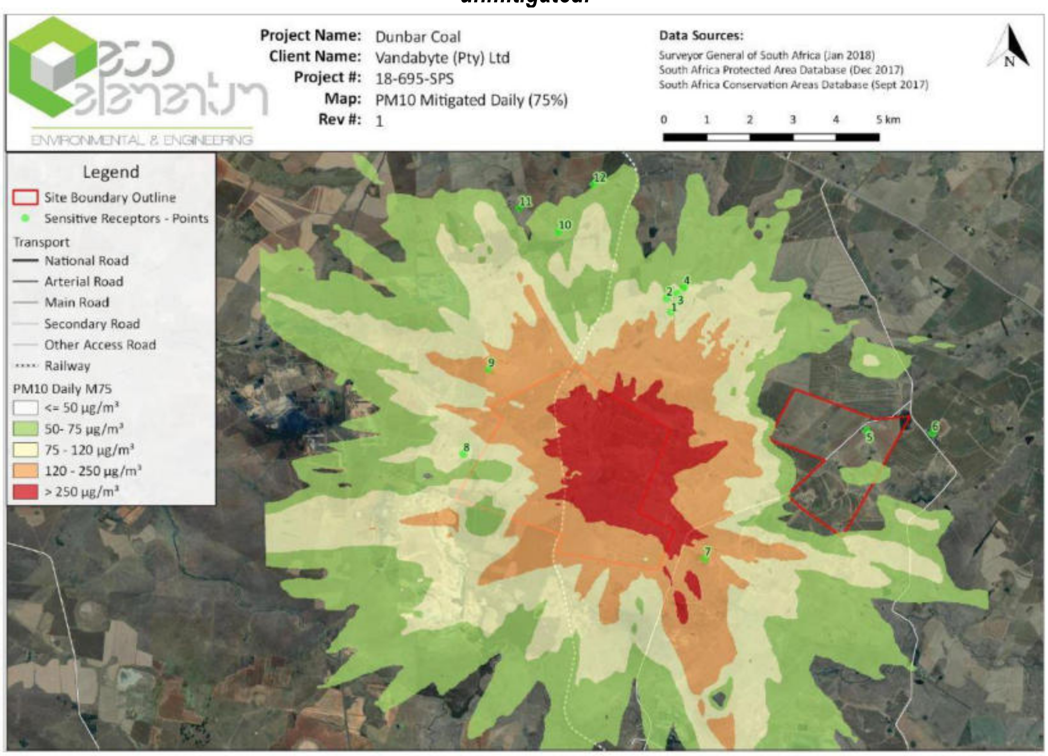


Figure 7-127: Predicted 2nd Highest daily concentrations for PM10 for the proposed Dunbar Coal project operations when mitigated with Haul Roads at 75%.

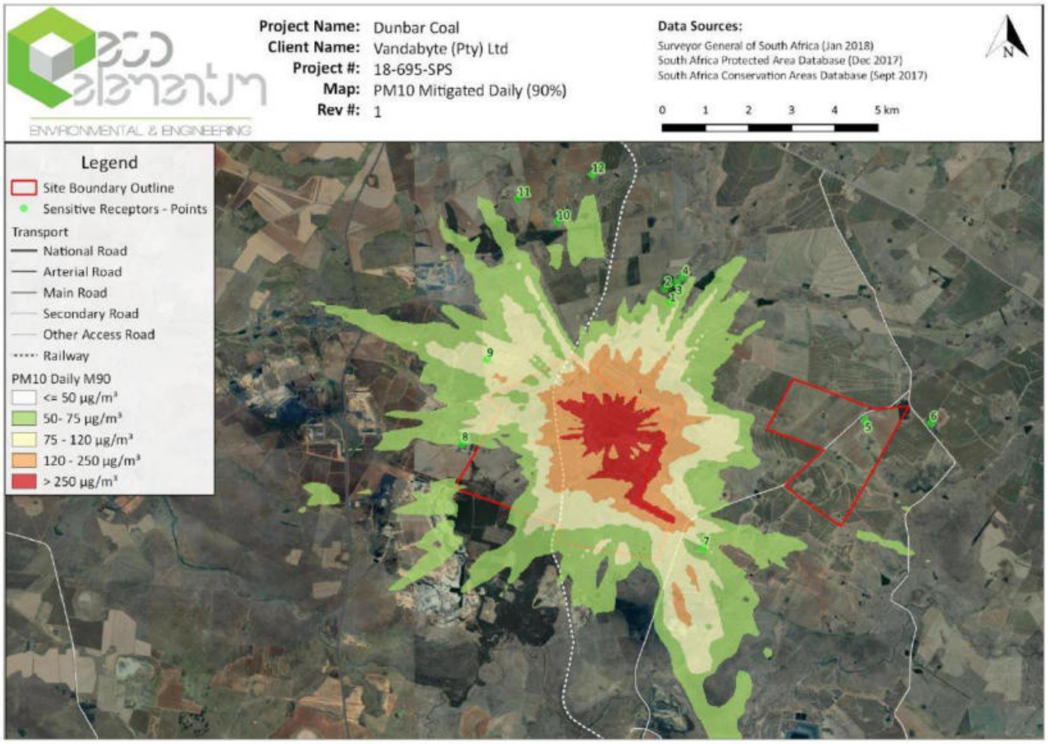


Figure 7-128: Predicted 2nd Highest daily concentrations for PM10 for the proposed Dunbar Coal project operations when mitigated with Haul Roads at 90%.

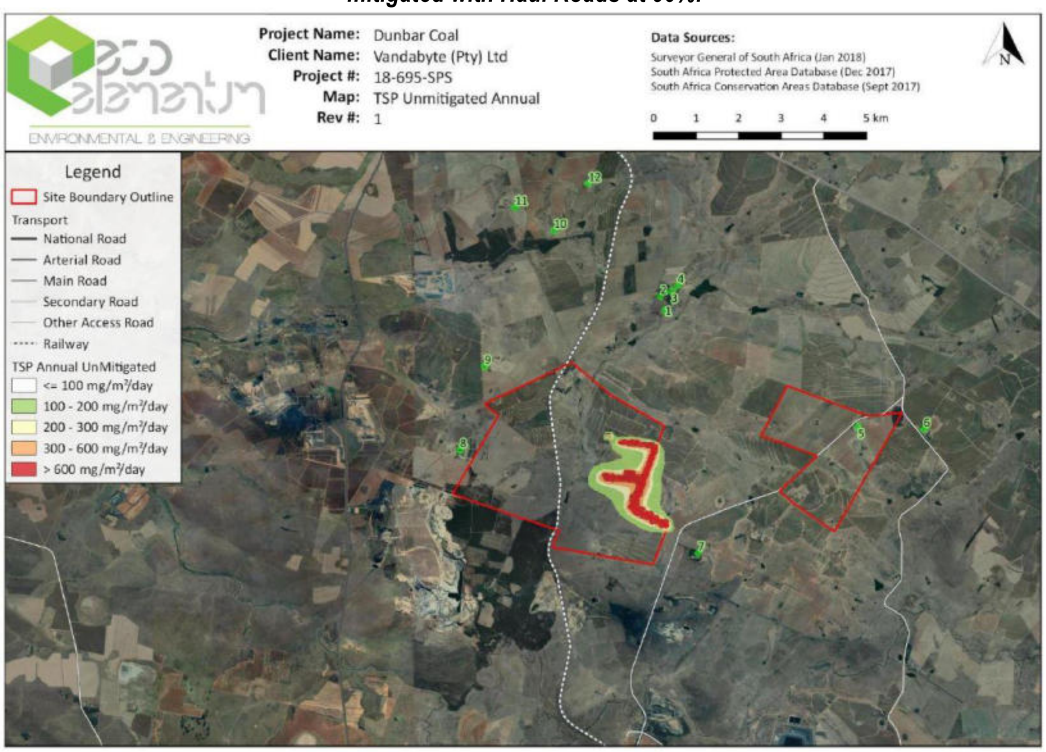


Figure 7-129: Predicted average annual concentrations for TSP for the proposed Dunbar Coal project when unmitigated.

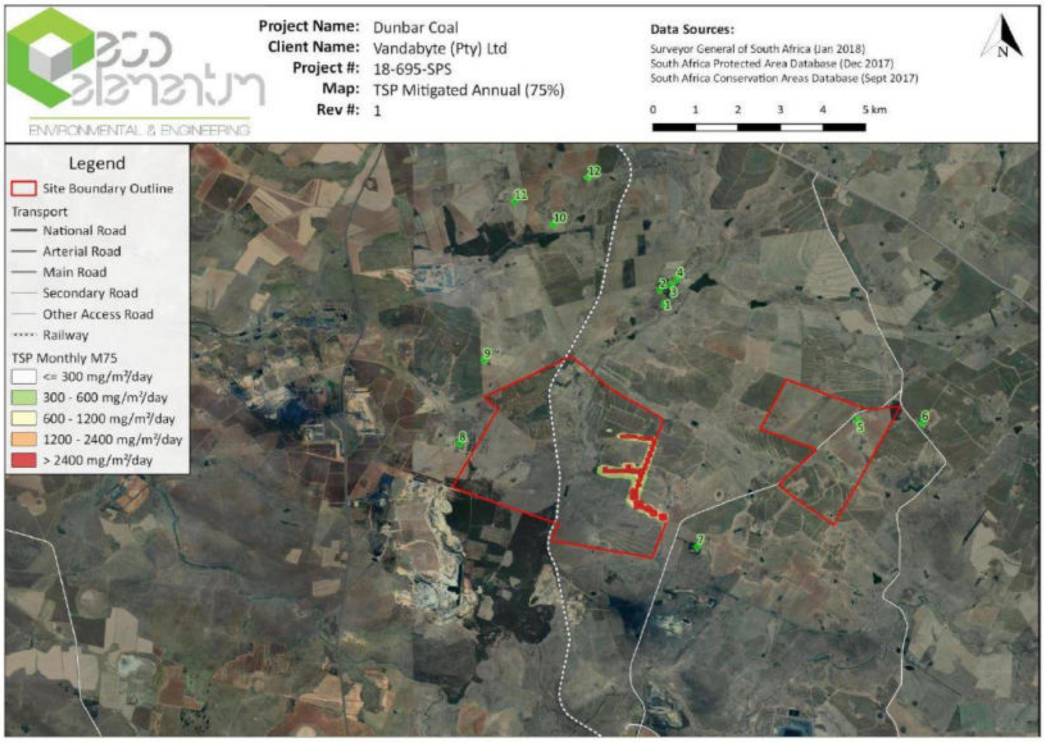


Figure 7-130: Predicted average annual concentrations for TSP for proposed Dunbar Coal project operations when mitigated with Haul Roads at 75%.

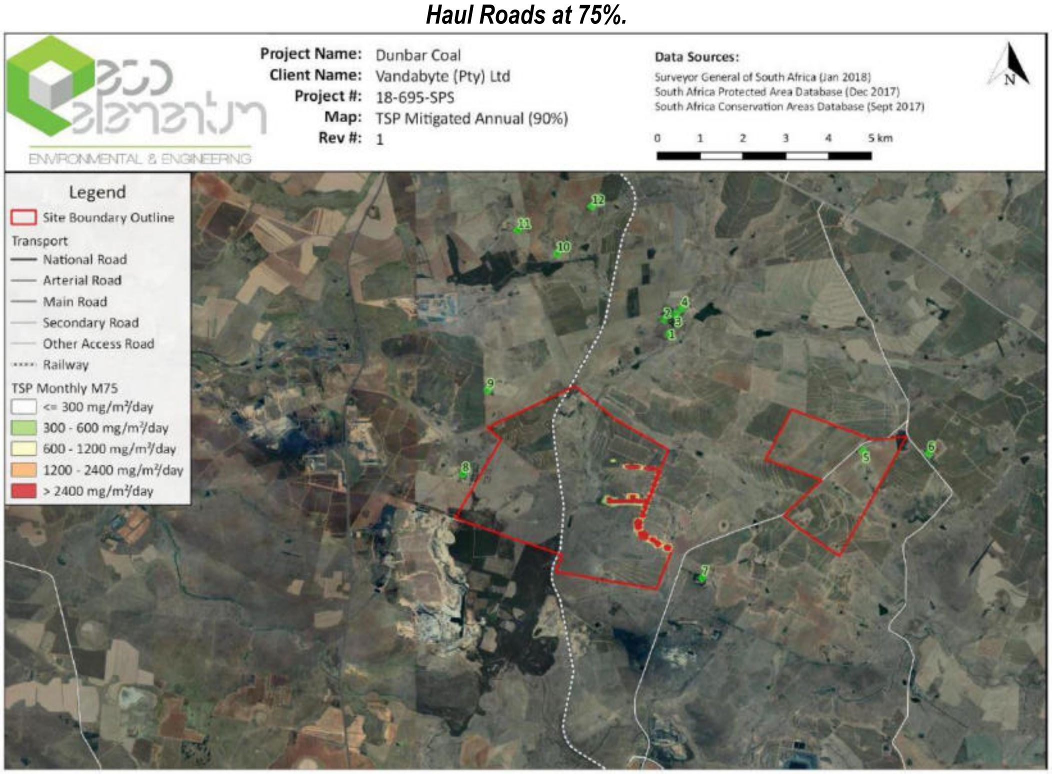


Figure 7-131: Predicted average annual concentrations for TSP for proposed Dunbar Coal project operations when mitigated with Haul Roads at 90%.

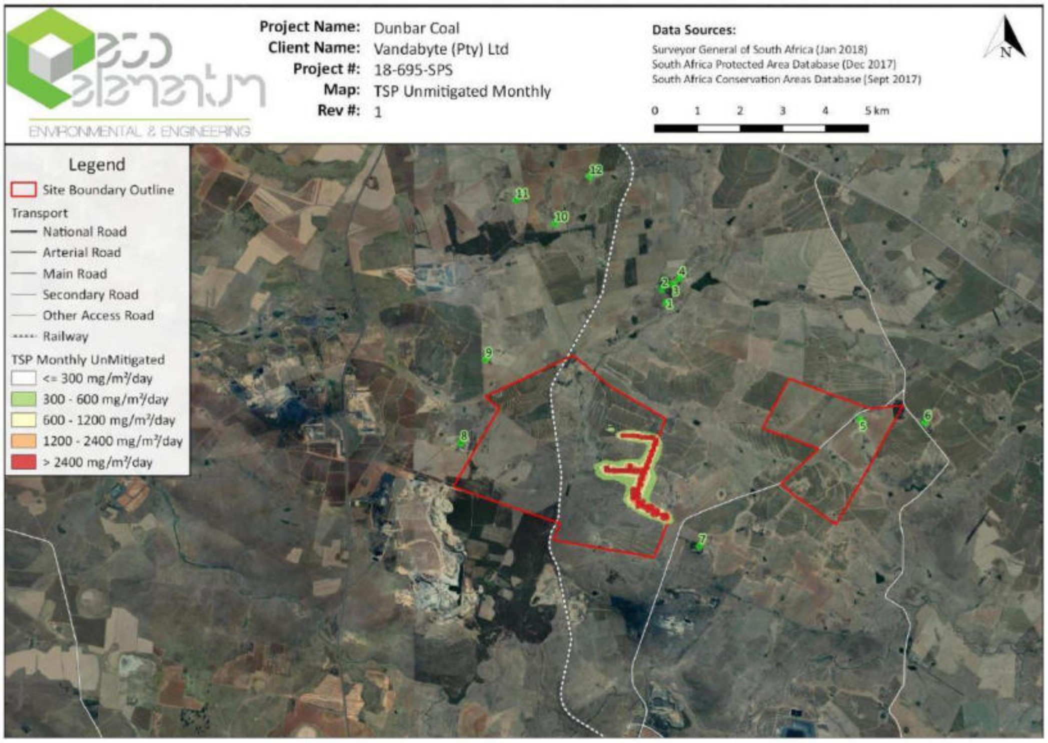


Figure 7-132: Predicted Highest Monthly concentrations for PM10 for proposed Dunbar Coal project operations when unmitigated.

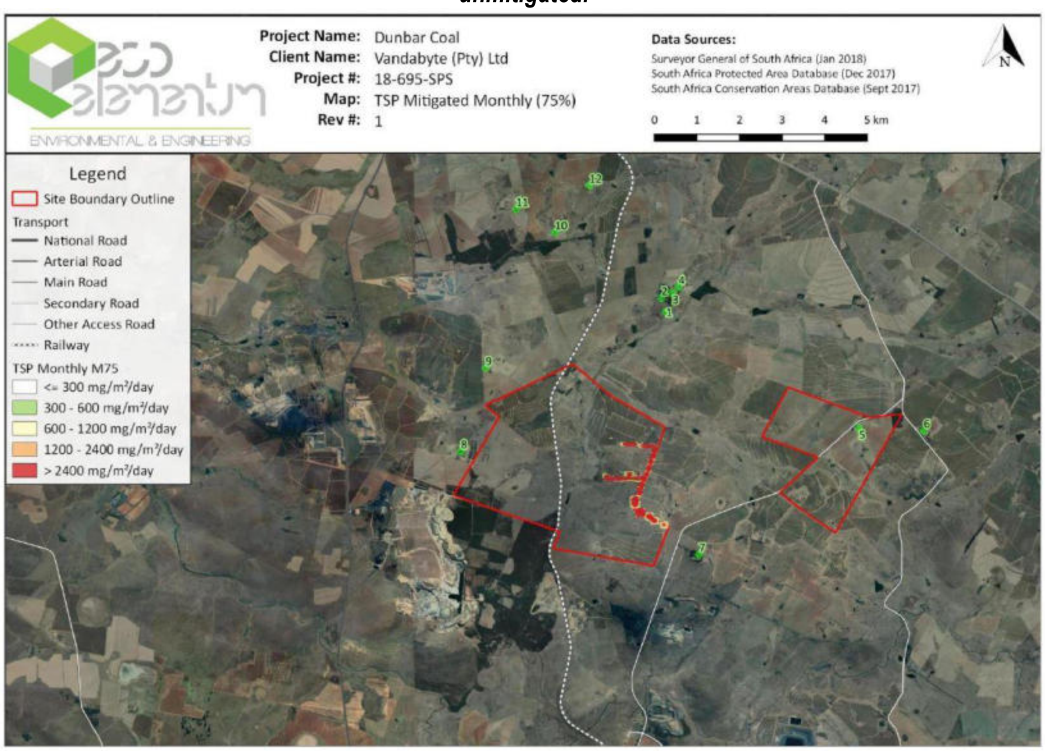


Figure 7-133: Predicted Highest Monthly concentrations for PM10 for proposed Dunbar Coal project operations when mitigated with Haul Roads at 75%.

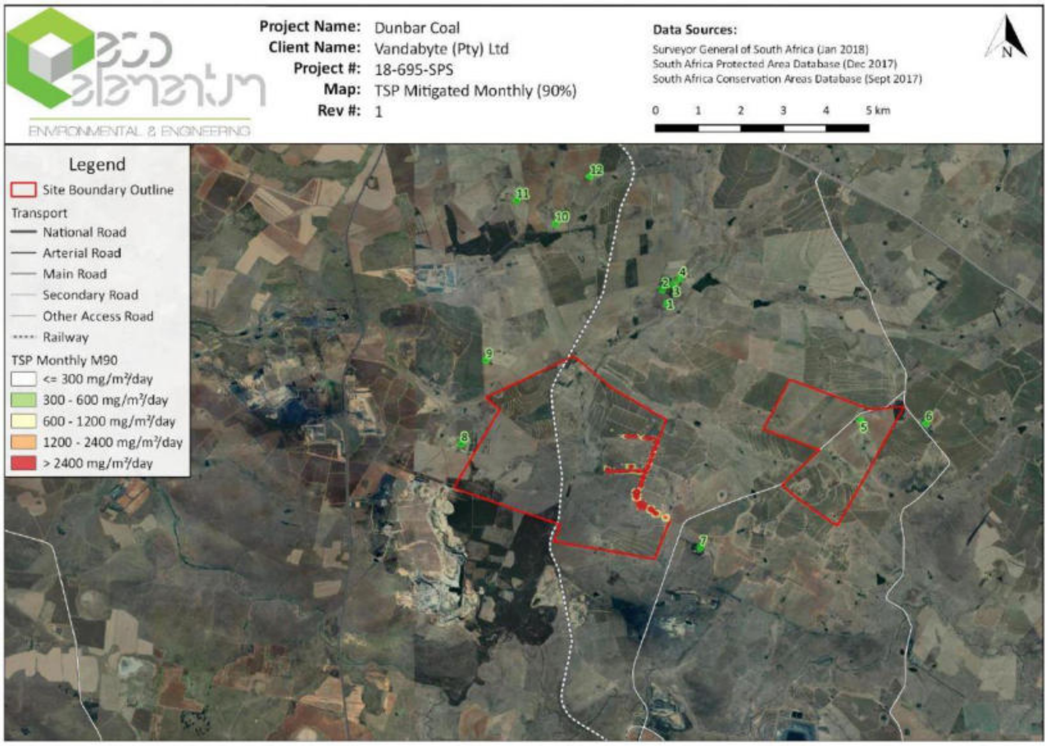


Figure 7-134: Predicted Highest Monthly concentrations for PM10 for proposed Dunbar Coal project operations when mitigated with Haul Roads at 90%.

7.17.4 Climate change

During an assessment in 2016 of South Africa's coal mining sectors' response to climate change adaption demands undertaken by B. Chavalala from UNISA, Climate change adaptation has received limited attention compared to mitigation across all spatial levels. This is besides the documented adverse impacts of climate change in different sectors of societies including mining in general and coal mining specifically. Against this background, the study set three objectives. The first objective was to identify current and possible future climate change impacts that may affect selected coal mines in South Africa. The second objective was to establish the nature and extent to which these mines were ready to address and implement adaptation measures. The last objective was to determine and document existing climate change adaptation practices in selected mines. Employing the mixed methods approach, the research engaged five coal mines located in Mpumalanga, Free State and Kwa Zulu-Natal, gathering both the qualitative and quantitative data. This data was analysed thematically.

The research made three major findings. The first finding was that the climatic conditions in the research areas have been changing over the observed period. In general, rainfall has been declining and temperatures have been increasing, leading to increased cases of extreme fog, mist and heatwaves. The second finding was that there has been an increase in frequency and intensity of extreme weather events, most notably, floods and droughts. These changes in the climate and associated weather events have frequently affected mine operations particularly at the production sub-chain of the coal mining value chain. The third major finding was that despite this evidence of adverse impact of climate change on the production sub-chain of the South African coal mining value chain, adaption responses in all the studied mines showed reactive adaptation to extreme events instead of proactive adaptation planning and implementation. South Africa depends on coal-derived energy, electricity in particular and the coal mines are implicitly exposed and vulnerable to the adverse impacts of climate change. Reducing this exposure and vulnerability dictates the urgent need to implement anticipatory adaptation measures in all the sub-chains of the coal mining value chain.

Coal is the world's most abundant and widely distributed fossil fuel source, and will remain so well into the future. At present approximately 23% of primary global energy needs are met by coal and 40% of electricity is generated from coal. About 70% of world steel production depends on coal feedstock.

The combustion of coal is the largest contributor to the human-made increase of CO_2 in the atmosphere. Electric generation using coal burning produces approximately twice the greenhouse gasses per kilowatt compared to generation using natural gas.

Coal mining releases methane, a potent greenhouse gas. Methane is the naturally occurring product of the decay of organic matter as coal deposits are formed with increasing depths of burial, rising temperatures, and rising pressure over geological time. A portion of the methane produced is absorbed by the coal and later released from the coal seam (and surrounding disturbed strata) during the mining process. Methane accounts for 10.5 percent of greenhouse-gas emissions created through human activity. According to the Intergovernmental Panel on Climate Change, methane has a global warming potential 21 times greater than that of carbon dioxide over a 100-year timeline. The process of mining can release pockets of methane. These gases may pose a threat to coal miners, as well as a source of air pollution. This is due to the relaxation of pressure and fracturing of the strata during mining activity, which gives rise to safety concerns for the coal miners if not managed properly. The build up of pressure in the strata can lead to explosions during (or after) the mining process if prevention methods, such as "methane draining", are not taken.

In 2008 James E. Hansen and Pushker Kharecha published a peer-reviewed scientific study analyzing the effect of a coal phase-out on atmospheric CO_2 levels. Their baseline mitigation scenario was a phase-out of global coal emissions by 2050. Under the *Business as Usual* scenario, atmospheric CO_2 peaks at 563 parts per million (ppm) in the year 2100. Under the four coal phase-out scenarios, atmospheric CO_2 peaks at 422–446 ppm between 2045 and 2060 and declines thereafter.

Climate change is unlikely to have a major direct impact on the mining industry, for which regulations and management strategies are already in place to manage factors such as water usage, water conservation and demand strategies and environmental issues relating to rehabilitation and the provision of rehabilitation guarantees. While a lack of access to water may affect some mining projects, most mining processes do not generally require potable water. Where high-quality water is required, some mines are already installing water treatment units.

Changes in the frequency and intensity of storm events have the potential to impact on mining operations (e.g. tailing dams, sediment and erosion control); however, these impacts can normally be addressed as part of the mine's storm water management plan.

The highest risk to the mining industry from climate change is most likely to come from meeting growing community concerns over environmental issues. This is likely to increase the difficultly in obtaining approvals for mining projects (particularly for coal). Additional constraints on mining may also affect the economic viability of individual mines, leading to flow-on effects to communities, through job losses and a decline in regional revenue. Work to develop clean coal technologies may ameliorate this risk to some extent; however, the actual process of mining is likely to face increasing community pressure.

Clean Coal technologies not only limited to the mining operations but also the end users of the coal will be a key factor in adapting to climate change and a carbon constrained future. Such technologies include:

- Pre and post carbon capture and storage technologies
- New pollution control devices - like advanced scrubbers - that clean pollutants from flue gases before they exit a plant's smokestack
- Chemical Looping combustion technology to concentrate CO2 levels in exhaust
- Production of ultra clean coal which reduces ash from the coal allowing it to be directly fired in gas turbines at higher efficiency and lower greenhouse gas emissions
- Efficiency upgrades and co-firing with less greenhouse intensive fuels in coal fired power stations
- Low – NOx burners which allow coal-fired plants to reduce nitrogen oxide emissions
- High temperature solar thermal applications integrated into coal fired power generation
- Stack Gas Treatment - applied to gaseous emissions from Pulverised Fuel (PF) Combustion
- Advanced Pulverised Fuel Combustion (PF)
- Fluidised Bed Combustion (FBC)
- Gasification and Integrated Coal Gasification Combined Cycle Systems
- Hybrid and advanced systems
- Fuel cell technologies utilising gas from coal
- Oxy-firing technology to raise the concentration of CO2 in flue gases to better enable its capture
- Coal Gasification including underground gasification in situ
- Capture and utilisation of fugitive emissions from coal mines.

7.18 WASTE CLASSIFICATION

The Waste Classification undertaken during the EIA Phase is attached as Appendix 13.

Based on a description of the planned operations at the Dunbar Coal Mine (Nurizon, 2019) it is understood that the mining and mineral processing residues will include discard coal and waste rock (also referred to as overburden) that will be stockpiled for future use in the rehabilitation of the excavations once mining is completed. Although the RoM and coal products that will be temporarily stockpiled on site have the potential to contribute waterborne contaminants to the environment, these will be managed in a manner that prevents environmental pollution, and furthermore, the coal materials do not fall under the definition of waste.

Coal discard is generated from the density separation (so-called washing) of mined coal. RoM brought out from the mine consists of organic and mineral matter components, with different density. The RoM is cleaned or 'washed' by separating the lower-density organic material from the higher-density discard, based on the differential in buoyancy. In the wash plant a process called heavy-media separation is applied. The heavy-media separation process involves the use of a suspension of finely divided magnetite in water to provide a medium with a specific gravity, which is adjusted to the characteristics of the coal chosen to achieve a given degree of separation and achieve the desired product quality, and the acceptable level of coal loss.

The discard generated from the wash process is a low quality coal that contains sulphur and other incombustible minerals (ash) at concentrations too high for its intended use. Although coal discard contains significant amounts of usable carbon, and can be seen as a significant resource, the coal discard generated at the Dunbar Coal Mine is treated as a waste for the purpose of this assessment. According to the Mine Works Program for the Dunbar Coal Mine (Nurizon, 2019), the discard will be placed at the bottom.

Waste rock is rock that is incidental to the mining operation and which is brought to the surface in order to access the resource being mined. The lower No 4 and No 2 coal seams represent the primary resource that will be extracted at the Dunbar Coal Mine. The layers of rock present in-between the coal seams represent the waste rock that will be extracted to access the coal. The waste rock will be stockpiled on site, to be replaced back into the pit as mining progresses.

7.18.1 Mineralogical Composition

The information received from Eco Elementum include a report by WaterLab, which report the results of an x-ray diffraction analysis performed on the sample of waste rock and coal from the Dunbar Coal Mine. The report indicates the mineralogical composition of the sample as follows (see Table 7-50).

Table 7-50: Summary of the reported mineralogical composition of the waste rock and coal samples.

Mineral	Formula	DC-OVB	DBR Carb Shl	INDB08/4L/2
		Amount (weight %)		
Quartz	SiO_2	76.25	29.78	12.81
Kaolinite	$Al_2Si_2O_5(OH)_4$	-	59.49	35.25
Rutile	TiO2	-	0.64	0.43
Muscovite	$K\ Al_2\ ((OH)_2\ Al\ Si_3\ O_{10})$	1.94	3.53	0
Calcite	$CaCO_3$	1.9	0	1.3
Pyrite	FeS	-	0	0.39
Dolomite	Fe_3O_4	-	0.96	4.33
Orthoclase	$K\ Al\ Si_3\ O_8$	3.01	-	-
Plagioclase	$(Na,Ca)(Si,Al)_4O_8$	12.73	-	-
Sepiolite	$Mg_4Si_6O_{15}(OH)_2 \bullet 6(H_2O)$	4.17	-	-
Organic Carbon	C	-	5.59	45.49

The results indicate that the two samples representing waste rock (DC-OVB & DBR Carb Shl) consist predominantly of silicates (quartz and kaolinite). Important to note is that both waste rock samples contain no, or at least very little, pyrite. The coal sample (INDB08/4L/2) consists of less than 50% carbon with a significant quantity of silicates. Given the understanding of what coal discard would constitute this coal sample is accepted to be indicative of a typical discard coal. The coal sample is shown to contain a trace quantity of pyrite, at 0.39%.

7.18.2 Acid Generating Potential

The analytical data provided by Eco Elementum includes three sets of results which can be used to determine the acid generating potential of a material. In geological materials such as coal and the geological strata associated with coal deposits, the presence of sulphide minerals point to a potential for generating acid.

Sulphide minerals are unstable in the presence of atmospheric oxygen and oxidise to form sulphate, ferrous iron and acidity (H+) as products.

Water in contact with the oxidation products has a low pH induced and the resulting solution has the potential to dissolve major and trace metallic elements from the material. The first set of analytical data that can be used to indicate the potential for acid production is sulphur speciation results. In this analysis the oxidation state or species of sulphur and carbon present in the sample is determined. The Table below presents a summary of the results from the analysis performed on the Dunbar Coal Mine waste rock and coal samples. The results indicate that most of the sulphur present in the samples is present as sulphide, with less of it indicated as the oxidised sulphate product.

Table 7-51: Summary of carbon and sulphur results for the waste rock and coal samples.

Parameter	DC-OVB	DBR Carb Shl	INDB08/4L/2
	Weight %		
Total Sulphur	0.06	0.09	1.25
S (sulphate)	0.01	0.05	0.43
S (sulphide)	0.05	0.03	0.81

The presence of sulphide in the coal sample indicate that the material has a potential to generate acid under oxidative conditions, while the very low concentration of sulphate in the waste rock samples indicate very little chance of these materials generating acid. This is confirmed by results from Nett Acid Generation (NAG) testing performed on the samples. Table 7-52 below present a summary of the NAG results.

Table 7-52: Summary of NAG results for the waste rock and coal samples.

Sample	NAG pH: (H_2O_2)	NAG at pH 4.5	NAG at pH 7.0
	-	kg $H_2SO_4.t^{-1}$	
DC-OVB	8.3	<0.01	<0.01
DBR Carb Shl	6.5	<0.01	0.2
INDB08/4L/2	7	<0.01	<0.01

NAG is a static test used to give an indication of acid forming potential. It involves the addition of H2O2 to a prepared sample of mine rock or process residue to oxidise reactive sulphide minerals, followed by measurement of the pH of the reaction solution and titration of any net acidity produced. Generally, a NAG pH below 4.5 is indicative of a potentially acid generating material.

A NAG result is best used in conjunction with other static methods, such as Acid-Base Accounting (ABA). Table below present results of an ABA test conducted on the samples of Dunbar Coal Mine waste rock and coal. ABA investigates the balance between the acid production and acid consumption properties of a material to give an indication of whether the material could produce acidic conditions in water that comes in contact with the materials.

The first aspect to note from the results is a pH above 7 is measured for all samples. The results of the ABA further indicate that the samples of waste rock are non-acid forming while the coal sample is indicated as intermediate.

Table 7-53: Summary of ABA results for the waste rock and coal samples.

Sample	Paste pH	Total Sulphur	Acid Potential (AP)	Neutralization Potential (NP)	Nett Neutralization Potential (NNP)	Neutralising Potential Ratio (NPR) (NP : AP)
		%	kg $CaCO_3.t^{-1}$			NP:AP
DC-OVB	8.4	0.06	1.9	15	13	7.98
DBR Carb Shl	7.4	0.09	2.66	4.8	2.14	1.8
INDB08/4L/2	7.6	1.25	39	46	7.54	1.19

7.18.3 Total Analysis

Table 7-54 presents a summary of the total element composition of the Dunbar Coal Mine waste rock and coal samples submitted for analysis. Elements and ions listed are those detected above the limit of detection, or those of importance with regard to environmental and human health.

The total element composition analysis was performed in accordance with the methods prescribed in GNR 635 as follows:

Acid digestion (total digestion) of the sample; followed by quantitative analysis by inductively coupled optical emission spectrometry (ICP-OES), and other methods, for the following:

- ICP analysis for 30 elements;
- Additional analysis for mercury (Hg), hexavalent chromium (Cr VI) and total fluoride (F).

7.18.4 Leach Testing and Analysis

Table 2.6 presents a summary of the leach test and analysis results of the Dunbar Coal Mine waste rock and coal samples. Elements and ions listed above are those detected above the limit of detection, or those of importance with regard to environmental and human health.

The leach test and analysis was performed in accordance with the methods prescribed in GNR 635 as follows:
An aqueous extraction conducted at a liquid to solid ratio of 20:1, in accordance with the prescribed leach testing procedure AS 4439.3 (1997) standard, which is analysed as follows:

- ICP analysis for 30 elements;
- Total dissolved salt (TDS) concentration and specific anions and cations including Cr(VI), Cl, SO4, NO3 as N, and F;
- pH of the leach solution.

Table 7-54: Summary of elemental analysis results for the waste rock and coal samples.

Parameter	DC-OVB	DBR Carb Shl	INDB08/4L/2
	mg.kg^{-1}		
As	0.5	2.4	6.1
B	<10	<10	51.2
Ba	757.6	356.4	381.2
Cd	<0.400	0.4	<0.400
Co	<10	12.0	<10
Cr (total)	194.8	225.6	77.6
Cr(VI)	<5	<5	<5
Cu	<4.00	22.0	7.6
F	262.0	410.0	267.0
Hg	<0.400	<0.400	0.4
Mn	166.4	69.2	116.8
Ni	<10	27.2	11.2
Pb	23.1	29.4	26.4
V	<10	74.0	24.4
Zn	29.2	101.2	16.0

Table 7-55: Summary of leach test results for the waste rock and coal samples.

Parameter	DC-OVB	DBR Carb Shl	INDB08/4L/2
	mg.L^{-1}		
As	0.004226	<0.001	<0.001
B	<0.025	<0.025	<0.025
Ba	0.036	0.138	0.056
Cd	<0.001	<0.001	<0.001
Co	<0.025	<0.025	<0.025
Cr (total)	<0.025	<0.025	<0.025
Cr(VI)	<0.01	<0.01	<0.01
Cu	<0.010	<0.010	<0.010
F	<0.2	<0.2	<0.2
Fe	0.108	0.041	<0.025
Hg	<0.001	<0.001	0.029687
Mn	0.102	<0.025	<0.025
Ni	<0.025	<0.025	<0.025
Pb	<0.001	0.00417	<0.001
V	<0.025	<0.025	<0.025
Zn	<0.025	0.323	<0.025
pH	6.6	6.8	6.9

The leach test confirms the ABA and NAG results by reporting a near neutral pH values for all the materials. Accordingly, almost no metallic elements, aside from iron (Fe), are dissolved in noteworthy concentrations from any of the samples.

7.18.5 Material Characteristics

The waste rock and coal materials from the Dunbar Coal Mine contain very low concentrations of oxidisable sulphides. Even if all the available sulphides are oxidised, it is unlikely that the natural pH of the materials would be significantly altered. The analytical results reported for the Dunbar samples indicate that waste rock, as well as likely also any coal discard which may be generated at the operations, are geochemically stable.

7.18.6 Classification under GNR 635

The Tables below lists the total and leachable concentrations of inorganic determinants measured in the samples of waste rock and coal from the Dunbar Coal Mine. These Tables further list the leachate and total concentration threshold values prescribed in GNR 635. The threshold value columns are shaded and where the reported total concentration or leach concentration exceeds the threshold, the values are shaded correspondingly.

Based on the comparison of the measured total and leachable concentrations with the threshold values, the overburden, carbonasios shale and coal materials from the Dunbar Coal Mine all classify as Type 3. The Type 3 classification is due to the total concentration of Arsenic, Barium, Copper, Lead and Fluoride and the leachate concentrations of Mercury from the coal sample (INDB08/4L/2). The concentrations of these elements exceed the TCT0 and LCT0 values only by a small margin and are all well below the TCT1 and LCT1 values.

Table 7-56: Waste Classification Table for Inorganic Determinants in the DC-OVB Sample from the Dunbar Coal Mine.

Determinant		Measured Concentrations		Threshold Levels (GNR 635)							Waste Type
		Total Concentration (TC)	Leachate Concentration (LC)	TCT0	TCT1	TCT2	LCT0	LCT1	LCT2	LCT3	
		$mg.kg^{-1}$	$mg.L^{-1}$	$mg.kg^{-1}$			$mg.L^{-1}$				
Metal Ions	As, Arsenic	0.54	0.004	5.8	500	2 000	0.01	0.5	1	4	Type 4
	B, Boron	<10	<0.025	150	15 000	60 000	0.5	25	50	200	Type 4
	Ba, Barium	757.6	0.036	62.5	6 250	25 000	0.7	35	70	280	Type 3
	Cd, Cadmium	<0.400	<0.001	7.5	260	1 040	0.003	0.15	0.3	1.2	Type 4
	Co, Cobalt	<10	<0.025	50	5 000	20 000	0.5	25	50	200	Type 4
	CrTotal, Chromium Total	194.8	<0.025	46 000	800 000	N/A	0.1	5	10	40	Type 4
	Cr(VI), Chromium (VI)	<5	<0.010	6.5	500	2 000	0.05	2.5	5	20	Type 4
	Cu, Copper	<4.00	<0.010	16	19 500	78 000	2	100	200	800	Type 4
	Hg, Mercury	<0.400	<0.001	0.93	160	640	0.006	0.3	0.6	2.4	Type 4
	Mn, Manganese	166.4	0.102	1 000	25 000	100 000	0.5	25	50	200	Type 4
	Mo, Molybdenum	<10	<0.025	40	1 000	4 000	0.07	3.5	7	28	Type 4
	Ni, Nickel	<10	<0.025	91	10 600	42 400	0.07	3.5	7	28	Type 4
	Pb, Lead	23.1	<0.001	20	1 900	7 600	0.01	0.5	1	4	Type 3
	Sb, Antimony	<0.400	<0.001	10	75	300	0.02	1	2	8	Type 4
	Se, Selenium	<0.400	<0.001	10	50	200	0.01	0.5	1	4	Type 4
	V, Vanadium	<10	<0.025	150	2 680	10 720	0.2	10	20	80	Type 4
	Zn, Zinc	29.2	<0.025	240	160 000	640 000	5	250	500	2 000	Type 4
Inorganic Ions	Total Dissolved Solids*	-	56	N/A	N/A	N/A	1 000	12 500	25 000	100 000	Type 4
	Chloride as Cl	-	<2	N/A	N/A	N/A	300	15 000	30 000	120 000	Type 4
	Fluoride as F	262	<0.2	100	10 000	40 000	1.5	75	150	600	Type 3
	Nitrate as N	-	<0.1	N/A	N/A	N/A	11	550	1 100	4 400	Type 4
	Sulphate as SO_4	-	2	N/A	N/A	N/A	250	12 500	25 000	100 000	Type 4

Table 7-57: Waste Classification Table for Inorganic Determinants in the DBR Carb Shl Sample from the Dunbar Coal Mine.

	Determinant	Measured Concentrations		Threshold Levels (GNR 635)							Waste Type
		Total Concentration (TC)	Leachate Concentration (LC)	TCT0	TCT1	TCT2	LCT0	LCT1	LCT2	LCT3	
		mg.kg^{-1}	mg.L^{-1}	mg.kg^{-1}			mg.L^{-1}				
Metal Ions	As, Arsenic	2.38	<0.001	5.8	500	2 000	0.01	0.5	1	4	Type 4
	B, Boron	<10	<0.025	150	15 000	60 000	0.5	25	50	200	Type 4
	Ba, Barium	356.4	0.138	62.5	6 250	25 000	0.7	35	70	280	Type 3
	Cd, Cadmium	0.4	<0.001	7.5	260	1 040	0.003	0.15	0.3	1.2	Type 4
	Co, Cobalt	12	<0.025	50	5 000	20 000	0.5	25	50	200	Type 4
	CrTotal, Chromium Total	225.6	<0.025	46 000	800 000	N/A	0.1	5	10	40	Type 4
	Cr(VI), Chromium (VI)	<5	<0.010	6.5	500	2 000	0.05	2.5	5	20	Type 4
	Cu, Copper	22	<0.010	16	19 500	78 000	2	100	200	800	Type 3
	Hg, Mercury	<0.400	<0.001	0.93	160	640	0.006	0.3	0.6	2.4	Type 4
	Mn, Manganese	69.2	<0.025	1 000	25 000	100 000	0.5	25	50	200	Type 4
	Mo, Molybdenum	<10	<0.025	40	1 000	4 000	0.07	3.5	7	28	Type 4
	Ni, Nickel	27.2	<0.025	91	10 600	42 400	0.07	3.5	7	28	Type 4
	Pb, Lead	29.4	0.004	20	1 900	7 600	0.01	0.5	1	4	Type 3
	Sb, Antimony	<0.400	<0.001	10	75	300	0.02	1	2	8	Type 4
	Se, Selenium	<0.400	<0.001	10	50	200	0.01	0.5	1	4	Type 4
	V, Vanadium	74	<0.025	150	2 680	10 720	0.2	10	20	80	Type 4
	Zn, Zinc	101.2	0.323	240	160 000	640 000	5	250	500	2 000	Type 4
Inorganic Ions	Total Dissolved Solids*	-	50	N/A	N/A	N/A	1 000	12 500	25 000	100 000	Type 4
	Chloride as Cl	-	<2	N/A	N/A	N/A	300	15 000	30 000	120 000	Type 4
	Fluoride as F	410	<0.2	100	10 000	40 000	1.5	75	150	600	Type 3
	Nitrate as N	-	<0.1	N/A	N/A	N/A	11	550	1 100	4 400	Type 4
	Sulphate as SO_4	-	<2	N/A	N/A	N/A	250	12 500	25 000	100 000	Type 4

Table 7-58: Waste Classification Table for Inorganic Determinants in the INDB08/4L/2 Sample from the Dunbar Coal Mine.

	Determinant	Measured Concentrations		Threshold Levels (GNR 635)							Waste Type
		Total Concentration (TC)	Leachate Concentration (LC)	TCT0	TCT1	TCT2	LCT0	LCT1	LCT2	LCT3	
		mg.kg^{-1}	mg.L^{-1}	mg.kg^{-1}			mg.L^{-1}				
Metal Ions	As, Arsenic	6.08	<0.001	5.8	500	2 000	0.01	0.5	1	4	Type 4
	B, Boron	51.2	<0.025	150	15 000	60 000	0.5	25	50	200	Type 4
	Ba, Barium	381.2	0.056	62.5	6 250	25 000	0.7	35	70	280	Type 4
	Cd, Cadmium	<0.400	<0.001	7.5	260	1 040	0.003	0.15	0.3	1.2	Type 4
	Co, Cobalt	<10	<0.025	50	5 000	20 000	0.5	25	50	200	Type 4
	CrTotal, Chromium Total	77.6	<0.025	46 000	800 000	N/A	0.1	5	10	40	Type 4
	Cr(VI), Chromium (VI)	<5	<0.010	6.5	500	2 000	0.05	2.5	5	20	Type 4
	Cu, Copper	7.6	<0.010	16	19 500	78 000	2	100	200	800	Type 4
	Hg, Mercury	0.4	0.03	0.93	160	640	0.006	0.3	0.6	2.4	Type 4
	Mn, Manganese	116.8	<0.025	1 000	25 000	100 000	0.5	25	50	200	Type 4
	Mo, Molybdenum	<10	<0.025	40	1 000	4 000	0.07	3.5	7	28	Type 4
	Ni, Nickel	11.2	<0.025	91	10 600	42 400	0.07	3.5	7	28	Type 4
	Pb, Lead	26.44	<0.001	20	1 900	7 600	0.01	0.5	1	4	Type 4
	Sb, Antimony	<0.400	<0.001	10	75	300	0.02	1	2	8	Type 4
	Se, Selenium	<0.400	<0.001	10	50	200	0.01	0.5	1	4	Type 4
	V, Vanadium	24.4	<0.025	150	2 680	10 720	0.2	10	20	80	Type 4
	Zn, Zinc	16	<0.025	240	160 000	640 000	5	250	500	2 000	Type 4
Inorganic Ions	Total Dissolved Solids*		54	N/A	N/A	N/A	1 000	12 500	25 000	100 000	Type 4
	Chloride as Cl		<2	N/A	N/A	N/A	300	15 000	30 000	120 000	Type 4
	Fluoride as F	267	<0.2	100	10 000	40 000	1.5	75	150	600	Type 4
	Nitrate as N		<0.1	N/A	N/A	N/A	11	550	1 100	4 400	Type 4
	Sulphate as SO_4		6	N/A	N/A	N/A	250	12 500	25 000	100 000	Type 4

7.18.7 Recommendations

The evaluation presented above indicates that the waste rock and coal materials from the Dunbar Coal Mine of which samples were analysed classify as a Type 3 waste. As it was assumed that the sample of coal (INDB08/4L/2) is representative of the discard coal that will be generated from the washing process, this classification is therefore accepted to apply also to coal discard materials which may be stockpiled at the Dunbar Coal Mine. However, the classification was based on the analysis of single samples of drill cores, each collected from only a small band of the overall Dunbar stratagraphic succession. As such the samples can hardly be considered representative of the materials which will eventually be stockpiled on site.

It is therefore recommended that this classification be confirmed once samples of overburden materials become available from the Dunbar Coal Mine operations. Representative, composite samples of overburden and discard coal materials can be submitted at a suitable laboratory for leach testing and compositional analysis, and the results compared to the results used in this classification assessment. Nevertheless, the presented data provides a good preliminary indication of the geochemical behaviour of the waste rock and coal discard likely at the Dunbar Coal Mine, and findings of this assessment can be applied in the preliminary planning and design of the materials management facilities.

Based on this Type 3 classification, the waste rock and coal discard from the Dunbar Coal Mine must be managed at an area that is designed in accordance with requirements of a Class C Landfill. The Class C landfill containment barrier requirements include several protective layers of compacted clay and geotextile, as well as an under drainage and monitoring system at the base. This is to contain leachate draining from material. The intention of applying such extensive containment for disposal of a Type 3 waste, is to protect the health of humans and aquatic ecosystems that may be exposed to groundwater and surface water resources impacted by leachate from a landfill.

However, the available laboratory test results indicate that none of the materials tested (i.e. waste rock or coal discard) is potentially acid generating, and does not induce a low pH in water. Furthermore, it was shown that very few elements were actually mobilised from any of the materials during leach testing. The only elements leaching, which also exceeded LCT0 threshold values, is Mercury from the coal discard. The measured concentration of mercury in the leachate, although exceeding the LCT0 threshold value, is far below the LCT1 threshold. The waste rock and coal discard materials from the Dunbar Coal Mine therefore represent a comparatively low risk to water resources, even without containment applied.

Another aspect that has to be considered is that during the operational period any contaminated seepage which may occur from the waste rock or coal discard stockpiles will be captured and directed to the PCD via the GN704 compliant water management system, which is designed to separate all clean and dirty water on site. Any contaminated seepage from the waste rock or coal discard stockpiles will therefore most likely not reach any off site groundwater or surface water resources.

Furthermore, any stockpiled waste rock or coal discard will not remain in the environment indefinitely. At the end of life of the mine, both the waste rock and coal discard is planned to be used in the backfill and rehabilitation of the mining excavation. It is therefore concluded that there is a low likelihood of detrimental effect on water resources from the waste rock or coal discard at the proposed Dunbar Coal Mine. Application of containment suitable for a Class C landfill is therefore considered to be unnecessarily severe and a **Class D barrier can be considered adequate** for the protection of the environment from the overburden materials stockpile.

8 ITEM 3(G)(V): IMPACTS AND RISKS IDENTIFIED INCLUDING THE NATURE, SIGNIFICANCE, CONSEQUENCE, EXTENT, DURATION AND PROBABILITY

This section aims to list the potential impacts of the listed activities associated with the project, rate the significance of the identified potential impacts pre-mitigation and post-mitigation, and identify the probability and duration of the impacts. The potential impacts identified in this section are a result of both the environment in which the project activity takes place, as well as the activity itself. The identification of potential impacts is performed by determining the potential source, possible pathways and receptors. In essence, the potential for any change to a resource or receptor brought about by the presence of a project component or by a project-related activity has been identified as a potential impact.

The potential impacts are discussed per environmental or socio-economic aspect and according to each phase of the project i.e. the Construction, Operational and Decommissioning/ Rehabilitation Phases.

The significance, probability and duration of these potential impacts have been assessed based on the detailed specialist studies undertaken on the sensitivity of the receiving environment. The extent to which the impact can be reversed or may cause irreversible loss of resource, and whether it can be avoided, mitigated or managed is indicated in Table 8-1 below.

Table 8-1: Potential impacts of the listed activities associated with the project and proposed mitigation measures.

Impact	**Status of Impacts Prior to Mitigation**	**Proposed Mitigation/ Improvement Measures**
Terrestrial Ecology		
Displacement of flora and fauna species including species of conservation concern (SCC)	Negative	• SCC should either be relocated or protected *in situ*, depending on the species under question and the decision of the competent authority. • Set aside areas allowing continued existence of SCC such as the watercourse which should be well buffered against mining activities. • The layout design for the proposed mine should be adjusted to exclude sensitive areas including appropriate buffer areas. • Keep the footprint of the disturbed area to the minimum and designated areas only. • An environmental induction for all staff members must be mandatory to discuss these impacts such as the presence of SCC which may not be damaged, caught or removed without a permit.

The clearance for the construction of the proposed infrastructure will result in habitat loss and loss of agricultural land	Negative	• Keep the footprint of the disturbed area to the minimum and designated areas only. • Unnecessary indigenous vegetation clearing should be avoided. • Ensure rehabilitation plans are initiated during and after construction in areas not affected by the mining operations. • Vegetation clearing on slopes should be minimised and where necessary, appropriate stormwater management should be put in place to limit erosion potential of exposed soil. • An environmental induction for all staff members must be mandatory to discuss the potential of fire e.g. only smoking in designated areas, no open cooking fires etc. • Rehabilitation post-mining should ensure that the land s returned to baseline conditions as far as possible. • Keep out of surrounding natural areas including watercourses
Accidental introduction of alien species and invaders	Negative	• Eradication and/ or control of alien invasive plants and weeds as per the alien and invasive species monitoring programme. • Disturbance of natural areas should be avoided as far as possible and the spread of alien flora into natural areas should be controlled. • Continuous monitoring of the growth and spread of alien and invasive flora coupled with an adaptive management approach to identify suitable control mechanisms (e.g. mechanical, chemical or biological control). Mechanical control is usually preferred. • Cleaning of vehicles and equipment before entering the site to remove large deposits of foreign soils and plant material sourced from elsewhere.
Faunal mortalities	Negative	• An environmental induction for all staff members must be mandatory in which specific issues related to the killing and/or disturbance of faunal species should be avoided. Several staff members should complete a snake handling course in order to safely remove snakes from designated areas. • Road mortalities should be monitored by both vehicle operators (for personal incidents only) and the ECO (all road kill on a periodic monitoring basis as well as specific incidents) with trends being monitored and subject to review as part of the monthly reporting. Monitoring should occur via a logbook system where staff takes note of the date, time and location of the sighting/incident. This will allow determination of the locations where the greatest likelihood

		exists of causing road mortality and allow mitigation against it (e.g. fauna underpasses, and seasonal speed reductions). Finally, mitigation should be adaptable to the onsite situation which may vary over time. • All staff operating motor vehicles must undergo an environmental induction training course that includes instruction on the need to comply with speed limits, to respect all forms of wildlife (especially reptiles and amphibians) and, wherever possible, prevent accidental road kills of fauna. Drivers not complying with speed limits should be subject to penalties. • The proposed activities will result in the deaths of numerous fauna species. It is suggested that construction and mining operations occur from a predetermined area and move along a gradient to allow fauna species to relocate. • The ECO should monitor live animal observations in order to monitor trends in animal populations and thus implement proactive adaptable mitigation of vehicle movements. • Should holes or burrows be located on site, contact a zoological specialist to investigate and possibly remove any species located within them. • Where possible, barriers around excavation sites should be erected to prevent fauna from falling into the excavations. • The area surrounding the mining pit needs to be demarcated and fenced off to restrict animals from moving into this area, which will reduce fauna mortalities.
Surface and Groundwater		
Hydrology patterns	Negative	• Make use of permeable materials for pavements and walk-ways. • The planned reduction in catchment size will be managed to ensure that there will not be a dramatic reduction in catchment size.
Water quality	Negative	• Baseline water quality needs to be established. • Ongoing water monitoring during the construction phase and post-mining to demonstrate compliance and ensure reactive measures in case of pollution events. • Clean and dirty water separation must be undertaken and clean water areas must be maximised. Reuse of inpit/dirty water needs to be maximised.
Potential reduction of catchment yield of the aquifers through dewatering	Negative	• Conduct regular monitoring of groundwater levels as per the recommendations of the geohydrological report.

Washing plant	Negative	• All runoff from the plant area must be collected and treated as dirty water.
Destruction of wetlands and watercourses	Negative	• Construction of infrastructure located close to local streams should take place in the dry season, when possible. • Minimise the planning of mining activities within 100 m or 1:100 year flood event of watercourses, or as determined by qualified specialist.
Ground and Surface water contamination	Negative	• Prevention of contaminated surface runoff which might impact to the water resource used by downstream users. • All hazardous chemical must be stored in a bunded facility. Handling of such chemicals must be undertaken on a non-permeable surface. • All hydrocarbons, lubricants and explosives should be adequately stored and bunded off to prevent any contamination to the groundwater during an accidental spill. • All water that may collect in an area used for the storage of hydrocarbons must pass through an oil water separator before been discharged as dirty water. • Spillages on open soil must be contained and removed and treated as hazardous waste. • Emergency response plan to be put in place if spillages occur. • Regular inspection should be conducted of storage facilities • Implement effective concurrent rehabilitation of the opencast pit area. • Long-term management of mine affected water including potential decant to form part of the mine's water management strategy.
Excavated materials that are stockpiled incorrectly can interfere with the natural drainage, cause sedimentation and water pollution	Negative	• The areas excavated should have berms / barriers that are vegetated in order to separate dirty and clean water systems, and as an erosion control measure. • The stockpiles must be vegetated to prevent erosion and subsequent siltation of clean and dirty water streams as well as surface water resources. • Upslope diversion and down slope silt containment structures should be constructed. • Monitoring of surface water resource pre-mining and during construction must be implemented as per the monitoring programme.
Geology and Soils		
Land use change which will affect the soil and land use capability both during construction phase and post-mining operations. Loss of	Negative	• Compensate landowners. • Rehabilitate areas disturbed by mining with the intention to return land to arable land where feasible. If not, other land uses at the time (decommissioning phase) deemed socially, economically or

agricultural soils and land expected.		environmentally applicable should be considered. • Government to ensure that high agricultural land is protected by identifying agricultural hubs in the country where mining activities should be limited.
Site clearance and levelling during the construction phase will cause some additional exposed areas and could trigger erosion and siltation, especially during rainy periods	Negative	• Prevent soil loss through erosion. • Develop appropriate storm water management system to control surface run off over exposed areas. • Preserve soil fertility for later use. • Ensure all vehicles stay within the designated areas (for example, away from watercourses). • Plan to construct the majority of development during the dry winter months. • Have in place temporary erosion and sedimentation trapping control measures during the construction phase
Storage of topsoil	Negative	• Remove and stockpile topsoil from roads, building platforms, stockpile and dam areas prior to construction. • Preserve topsoil and store in an appropriate manner to maintain viability and seed bank for future rehabilitation. • Store away from watercourses to prevent sedimentation and erosion. • Protect from alien plant establishment.
Social		
Recruitment strategies for the mine	Positive	• Where it is practical, labour-intensive construction methods should be promoted. Aspects of construction that could potentially be amenable to such methods include earthworks, construction of access roads, etc.; • If required, the local resident status of job applicants should be verified in consultation with community representatives, traditional leaders, municipal structures and landowners in order to ensure local recruitment; • Vandabyte and appointed contractors should identify its required core skills (both for the construction and operational phases) and extend employee skills audits to investigate the prevalence of required s kills in nearby communities within the secondary study area, and structure its skills development endeavours accordingly. • It is recommended that recruitment during the construction phase should not take place on site but should be coordinated through the appropriate institutions such as the provincial Department of Labour

		or institutions recommended by the local authorities (where applicable). However, care must be taken that recruitment practices are fair and transparent and are not unduly influenced by pressure groups, such as political parties
Advantage to previously disadvantage individuals	Positive	Promote the creation of employment opportunities for locals, especially disadvantage individuals, women and youth, above the targets set out in the Mining Charter;
Community development programmes	Positive	NA
Upgrades and expansion of services will benefit local area	Positive	NA
Influx of people	Negative	• The design of effective in-migration management strategies requires an understanding of the dynamics and potential impacts of the phenomenon, taking into account specifics of the locations and areas in which the in-migration will occur; • The recruitment of employees and contractors should be executed as already discussed above (especially in terms of preferentially employing from local labour sending areas), thereby discouraging loitering near the proposed mine; • o Ensure that the intention of giving preferential employment to locals is clearly communicated, in order for locals to have a fair opportunity and reduce potential conflict situations
Increase in crime and social pathologies	Negative	• Acode of conduct for the construction workers should be compiled, and the information provided to and signed by all relevant stakeholders in order to provide guidance on what behaviour is or is not permitted or acceptable; • Implement HIV/AIDS and alcohol abuse prevention campaigns in the communities; • A voluntary counselling and testing programme must be introduced during construction and continued during operation; • Construction workers should be clearly identifiable by wearing proper construction uniforms displaying the logo of the construction company; • Liaison structures are to be established with local police to monitor social changes in crime patterns during the construction phase as well as the operation phase of the mine

Economic		
Increased income generation for local community	Positive	NA
Increased job opportunities for local mining communities	Positive	• Promote procurement from local and HDSA enterprises above the targets set out in the Mining Charter; • If any subcontractors are appointed, Vandabyte should give preference to suitable subcontractors/SMMEs located in nearby towns, then elsewhere in the secondary study area and then only to contractors located in areas elsewhere in Mpumalanga; • Where appropriate SMMEs do not exist locally, Vandabyte should investigate the possibility of aligning/updating their current SLP to develop this service capacity among local, preferably HDSA, suppliers; • Local procurement targets and procedures should be formalised in the mine's procurement policy, which is currently in a draft format, with reasonable penalties to the contractors who do not meet their targets. Such penalties (if monetary), could be used for capacity building and SMME development initiatives
Economical injection to the area and Mpumalanga	Positive	NA
Loss of agricultural jobs	Negative	• Recruit and train farm labourers no longer employable due to cessation/reduction of agricultural activities. • Alternatively, assist in the employment of these farm workers within the agricultural industry elsewhere.
Noise		
Noise emanating from heavy machinery and transport vehicles	Negative	• Noise barriers in the form of berms should be constructed as close to the noise sources as possible. • Mining-related machine and vehicles must be serviced on a regular basis to ensure noise suppression mechanisms are effective e.g. installing exhaust mufflers where possible. • Noisy machinery to be used predominately during daylight hours. • Grievance mechanism to record complaints should be kept on site and investigated. • Regular monitoring of noise to take place.
Noise from blasting	Negative	• Blasting operations are generally intermittent and should be limited to daylight hours when ambient noise levels are highest.

		• Communicate time of blasting with surrounding community / landowners
Visual		
Infrastructure (e.g. Contractor's yard, weighbridge, workshop and stores)	Negative	• To reduce the visual impact of permanent structures, colours for roofing, walls etc. should be of a matt finish to reduce reflection. • Infrastructure should be located away from sensitive and elevated areas.
Location of stockpiles, pollution control dams and tailing dams	Negative	• Locate away from roads and settlements as far as possible. • Topsoil stockpiles will need to be vegetated as soon as possible, to reduce the risk of erosion and decrease the visual disturbance. • Height of stockpiles to be kept as low as possible to reduce visual impact. • Plant vast growing indigenous trees around the dams to enhance sight.
Lighting pollution	Negative	• Avoid up-lighting of structures but rather direct the light downwards and focused on the object to be illuminated. • Use non-UV lights where possible, as light emitted at one wavelength has a low level of attraction to insects. This will reduce the likelihood of attracting insects and their predators specifically in the site camps.
Heritage and Cultural		
Heritage resources disturbed / destroyed	Neutral	None identified
Paleontological sites disturbed / destroyed	Neutral	None identified
Cultural places disturbed / destroyed	Neutral	None identified
Traffic		
Increased traffic volumes on the existing road networks	Negative	• Speed limits must be implemented on site as well as safety controls. • Construction of access roads within safety limits from other crossings. • Possible road upgrades where required. • Create safe environment for pedestrians, animals and motorists. • Create fauna underpasses where necessary (example bridge crossings).
Blasting and Vibration		
Blasting and Vibration	Negative	• Pre-blast survey of all structures identified surrounding the mining

		area. • Ground vibration survey in the form of signature trace study to be done for determination of ground vibration constants that can be used for accurate prediction of ground vibration. • Investigate the possibility of alternative methods to blasting. • Communicate time of blasting with surrounding community / landowners
Safety		
Blasting	Negative	• Areas to be clearly demarcated and signs to be erected indicating blasting zones.
Roads and vehicles	Negative	• Speed limits must be in place on site and before access roads on a provincial or national road. • Ensure drivers are trained in road safety.
Surrounding neighbours	Negative	• Personnel are not permitted on other properties without permission. • Avoid conflict with surrounding landowners.
Air Quality		
Dust pollution	Negative	• The removal of vegetation will be minimised during stripping to reduce the effects of dust pollution as a result of exposed soil. • Water or dust control agents should be used in working areas, and roads will be sprayed for dust suppression on a regular basis in designated susceptible areas during heavy usage. • Dust monitoring must be undertaken in accordance to the monitoring programme. • It is recommended that topsoil stockpiles should be vegetated to sustain biological components as well as prevent dust emissions. • Reduction of dust fallout levels and particulate matter. • All coal haul trucks must be covered by a tarpaulin. • The overland conveyor belt should be covered and coal on the conveyor should be sprayed to reduce emissions. • Monitor dust effects on watercourse and respond accordingly.

Table 8-2: Description of activities and associated impacts to be assessed.

Project Phase	Activities	Impacts
Construction	• Site establishment; • Site clearing, including the removal of topsoil and vegetation; • Construction of mine related infrastructure, including haul roads, pipes, PCD, offices; • Construction of crushing, screening and washing plant; • Blasting and development of initial box-cut for mining, including stockpiling from initial box-cuts; and • Temporary storage of hazardous products, including fuel and explosives.	• Loss of topsoil as a resource • Soil compaction from heavy machinery and vehicles • Soil erosion due to wind and surface water runoff • Loss of land use and capability • Increased erosion and compaction • Loss of Habitat and species • Increased habitat fragmentation and edge effects • Increased alien vegetation • Sedimentation leading to siltation and deteriorated water quality • Reduced surface water infiltration and baseflow as a result of soil compaction and impervious surfaces • Alteration in surface water drainage patterns • Increased velocity in surface water runoff leading to erosion and sedimentation • Construction and development activities within a greenfield site are a negative impact to functioning watercourse and the catchment

Operational	• Stripping topsoil and soft overburden; • Removal of overburden, including drilling and blasting of hard overburden; • Loading, hauling and stockpiling of overburden; • Development and operation of surface infrastructure; • Drilling and blasting of coal; • Load, haul and stockpiling of ROM coal; • Use and maintenance of haul roads for the transportation of coal to the washing plant; • Water use and storage on-site; and • Storage, handling and treatment of hazardous products (including fuel, explosives and oil) and waste.	• Loss of topsoil as a resource • Soil compaction from heavy machinery and vehicles • Soil erosion due to wind and surface water runoff • Loss of land use and capability • Increased erosion and compaction • Loss of Habitat and species • Increased habitat fragmentation and edge effects • Increased alien vegetation • Increased runoff resulting in water contamination and/or the deterioration of the water quality • Reduction of Catchment Yield as runoff water contained in PCD • Water level lowering due to dewatering of mining blocks • Groundwater contamination due to seepage from the PCD • Groundwater contamination due to seepage from overburden stockpiles, slurry and discard deposition • Perforation of rock and groundwater reserves leading to severe hydrological and geomorphological impacts to wetlands and the catchment • Potential for acid mine drainage if not implemented properly

Decommissioning	• Dismantle and removal of all infrastructure, including transporting materials off site; • Rehabilitation, including spreading of topsoil, revegetation and profiling or contouring as per original landscape features; • Environmental monitoring of decommissioning activities; and • Storage, handling and treatment of hazardous products and waste. • Post-closure monitoring and on-going rehabilitation	• Mine decanting causing groundwater and possibly stream contamination • Potential surface water contamination • Significant potential negative impacts to functioning watercourses and catchment if not done correctly • Spread of alien invasive vegetation • Increased soil compaction erosion and subsequent sedimentation into the wetland ecosystems. • Post-mining water decant is predicted to occur once the final void has been rehabilitated and groundwater levels are allowed to return back to natural level. It is anticipated that this decant might be acid forming • Rehabilitation and returning land back to baseline conditions

8.1 POTENTIAL IMPACTS

8.1.1 Surface Water

8.1.1.1 Construction Phase

8.1.1.1.1 Impact Description

Activities that could potentially contribute to a deterioration in water quality during the construction phase are assessed below and include the following:

- Spills and leakages of hydrocarbons (i.e. fuel, oil, grease etc.) from construction vehicles and machinery and storage facilities;
- Spills, leakages or inadequate treatment and disposal of sewage effluent; and
- Spills, leakages or inadequate disposal construction materials (i.e. bitumen and cement).

8.1.1.1.2 Mitigation measures

- Develop and implement environmental management and auditing systems to ensure that pollution prevention and impact minimization plans developed in the design and feasibility stages are fully implemented;
- All potentially hazardous substances should be stored in secure facilities in an appropriately bunded area that falls within an appropriate storm water management network to ensure that contaminants are not released to water resources through storm water runoff. The bund height of the bund wall should be able to contain 110 % of any stored volume;
- Storage containers for hazardous substances should be regularly inspected to prevent leaks and unnecessary seepage or contamination of storm water;
- Vehicle maintenance and refuelling should only take place within the delineated 'dirty' area of the mine (i.e. designated workshop and wash-bay);
- Mixing and/or decanting of all chemicals and hazardous substances must take place on a tray, shutter boards or on an impermeable surface and must be protected from the ingress and egress of stormwater;
- Cement/concrete mixing is to be located in an area of low environmental sensitivity away from water courses;
- An emergency spill response procedure must be formulated and staff is to be trained in spill response. All necessary equipment for dealing with spills of fuels/chemicals must be available at the site. Spills must be cleaned up immediately and contaminated soil/material disposed of appropriately at a registered site;
- Portable toilets should be provided at a rate of 1 toilet per 10 users and use of the surrounding environment should be discouraged. Toilets must be located outside of the 1:100 year flood line or further than 100 m or from any delineated watercourse. Waste from chemical toilets must be disposed of regularly (at least once a week) and in a responsible manner by a registered waste contractor;
- Contaminated water containing fuel, oil or other hazardous substances must never be released into the environment and should be disposed of at an appropriate waste facility by a registered waste contractor.

8.1.1.1.3 Impacts Rating

Table 8-3: Assessment of Construction Phase impacts on water quality

Impact Description			No Mitigation					With Mitigation				
Activity	Impact	Aspect	Intensity	Duration	Extent	Probability	Significance	Intensity	Duration	Extent	Probability	Significance
Refuelling and maintenance of construction vehicles	Local spillages of hydrocarbons and chemicals	Contamination of surface water by hydrocarbons	Moderate	Short term	Limited	Probably	Minor (-)	Low	Short term	Limited	Unlikely	Negligible (-)
Construction of infrastructure	Generation of solid waste.	Contamination of water resources by solid waste	Moderate	Long term	Limited	Probably	Minor (-)	Low	Long term	Limited	Unlikely	Negligible (-)
Sewage handling facilities	Spillage or inadequate management of sewage	Microbiological and nutrient contamination of surface water	Moderate	Short term	Limited	Probably	Minor (-)	Low	Short term	Limited	Unlikely	Negligible (-)

8.1.1.2 Operational Phase

8.1.1.2.1 Impacts description

Activities that could potentially contribute to a deterioration in water quality during the operational phase are assessed below and include the following:

- Large opencast mines have high potential for water to accumulate within the pit (from groundwater recharge and surface precipitation) which creates the opportunity for water to come into contact with high sulphide content ore bodies which further leads to contamination with high concentrations of salts and possibly metals. This is exacerbated in pits that have a significant rehabilitation backlog. Dewatering of the pit increases the potential of this water to contaminate surface water resources;
- Frequent utilization of haul roads by heavy vehicles creates a high potential for the generation of significant storm water impacts and erosion from these roads. Water quality problems could also arise where such roads contain sulphide waste material;
- Pollution from hydrocarbons remains a potential impact due to storage of fuels on site and the maintenance of a large heavy vehicle fleet at refueling depots, workshops and wash-bays and operation of the vehicles throughout the mine;
- Waste and product stockpiles generally contain high sulphide-bearing materials which oxidise upon exposure to the atmosphere and therefore also liberate high concentrations of salts and metals following mixture with water (i.e. from rainfall). These inherent geochemical characteristics in combination with the hardening and compaction of surfaces (e.g. haul roads and mining operations areas) results in the potential to generate large quantities of contaminated storm water;
- Dust from mine residue deposits could contain significant levels of sulphide minerals that pose a risk of becoming a secondary source of pollution in the area that they are deposited; and

- Product loading facilities, such as coal stockpiles, sidings, etc. are a potential source of pollution, especially in cases where the material is stored directly on the ground.

8.1.1.2.2 Mitigation measures

- All operational planning and activities should be undertaken with eventual mine closure in mind, such that mining operations can end in a manner that minimizes the final risks and liabilities in the post-closure phase. To this end a mining plan that explicitly considers mine closure and rehabilitation must be prepared and approved before mining begins. The plan should be updated regularly (every 3 to 5 years) as mining progresses;
- During the mine planning phase, a detailed geochemical characterisation of the coal and soft and hard overburden should be undertaken and handling and placement strategies for the material should then be based on the geochemical characterization of the material, with the aim of placing the material such that the long-term pollution potential is minimized;
- Develop a comprehensive Storm Water Management Plan that complies to guidelines stipulated in GN704. The plan should *inter alia* separate dirty areas (any area at a mine or activity which causes, has caused or is likely to cause pollution of a water resource) from clean areas, minimize the footprint of the dirty area and divert contaminated storm water to correctly sized and located pollution control dams water by means of an appropriately designed storm water network. Clean runoff volume should be maximized and diverted away from dirty areas and straight to natural water bodies;
- Storm water channels should be maintained and cleaned regularly to ensure that their capacity to convey contaminated runoff from stockpiles and other mine infrastructure areas are not compromised;
- Detailed water and salt balances that take account of climatic and operational variability should be developed and used as a planning tool to ensure that all pollution control dams are adequately sized and are integrated into a robust water reuse and reclamation strategy to ensure that captured contaminated water is effectively reused within the mining operations and that system spillages to the environment are avoided;
- Operate and concurrently rehabilitate opencast pits to minimize the exposed, excavated area of the pit at any moment in time;
- Rehabilitated sections of the pit should be free-draining away from the pit such that water drainage to the pit is reduced;
- Water collection and pumping systems that are capable of rapidly pumping accumulated water (i.e. from groundwater recharge and rainfall) out of the pit should be installed to minimize the contact time between water and geochemically reactive materials;
- Ensure that the mine plan includes contingency planning, equipment and training to enable operators to deal with common and foreseeable process upsets, leaks and releases as well as extreme climatic events;
- Develop detailed water quality monitoring systems that are capable of early detection of potential water quality problems at all facilities where potential for contamination of water resources exists. This monitoring system should also be extended to watercourses that could potentially receive contaminated water. The monitoring programme

should lead to rapid and effective management actions aimed at addressing the source of pollution source and minimizing it to the full extent possible;

- Proper storage and handling and monitoring of fuel and chemicals used on site to minimize the risk of spillages to the environment;
- Reduction of dust by early revegetation and by good maintenance of roads and work areas. Specific dust suppression measures, such as minimizing drop distances and covering equipment and storage piles, may be required for ore and product handling and loading facilities. Release of dust from crushing and other ore processing and beneficiation operations should be controlled; and
- The structural integrity of diversion berms that separate the clean and dirty water areas must be regularly monitored and maintained for the duration of the operational phase.

8.1.1.2.3 Impacts Rating

Table 8-4: Assessment of Operational Phase impacts on water quality

Impact Description			No Mitigation					With Mitigation				
Activity	**Impact**	**Aspect**	**Intensity**	**Duration**	**Extent**	**Probability**	**Significance**	**Intensity**	**Duration**	**Extent**	**Probability**	**Significance**
Refuelling and maintenance of mining machinery and vehicles	Local spillages of hydrocarbons and chemicals	Contamination of surface water	Moderate	Ongoing	Local	Probably	Minor (-)	Very low	Medium term	Limited	Unlikely	Negligible (-)
Storage of hydrocarbons and chemicals	Local spillages of hydrocarbons and chemicals	Seepage of contaminants into groundwater	Moderate	Ongoing	Local	Probably	Minor (-)	Very low	Medium term	Limited	Unlikely	Negligible (-)
Wash-bays and Workshops	Dirty water runoff	Contamination of surface water	Moderate	Ongoing	Local	Probably	Minor (-)	Very low	Medium term	Limited	Unlikely	Negligible (-)
Run of Mine and Waste Rock Stockpiles	Weathering and oxidation of exposed waste rock	Runoff of contaminants in surface runoff	High	Ongoing	Local	Almost certain	Moderate (-)	Low	Ongoing	Local	Unlikely	Minor (-)
Undeveloped catchment area	Dirty runoff mixing with clean runoff	Contaminants in surface runoff	High	Ongoing	Local	Almost certain	Moderate (-)	Low	Ongoing	Local	Unlikely	Minor (-)
Sewage handling facilities	Overflow of septic tanks	Microbiological and nutrient contamination of surface water	Moderate	Ongoing	Local	Probably	Minor (-)	Low	Ongoing	Limited	Unlikely	Negligible (-)
Mine residue dust	Off site deposition of high sulphide content material	Contamination of surface water	Moderate	Ongoing	Local	Probably	Minor (-)	Low	Ongoing	Local	Probably	Minor (-)

8.1.1.3 Rehabilitation and Closure Phase

8.1.1.3.1 Impacts description

Mining operations tend to exhibit serious long-term residual water impacts and can act as sources of pollution for long after mining has been completed. The primary reason for this is mining activities expose geochemically active minerals to water and oxygen, which lead to chemical and microbiological oxidation processes that liberate a wide range of contaminants (which can include acid mine drainage and associated contaminants, including sulphate and dissolved metals). Activities that could potentially contribute to a deterioration in water quality during the closure phase are assessed and include the following:

- Backfilled and rehabilitated opencast pits that fill up with water and discharge contaminated water at one or more decant/seepage points into the surface or ground water resource;
- Waste residue deposits that produce contaminated runoff, seepage and/or dust that enters the water resource;
- Footprints from reclaimed waste deposits that continue to provide a secondary source of contaminants after the primary source (the waste deposit itself) has been removed; and
- Spillages or seepage from pollution control dams that remain after closure as part of the environmental management system.

8.1.1.3.2 Mitigation measures

- Design and construct a waste deposit in a manner that ensures that geochemically active material is isolated as far as possible from water and oxygen;
- Design and implement a waste deposit cover on the basis of an assessment of its long-term performance in preventing or minimizing pollution of the water resource. Once the cover performance characteristics have been specified, ensure that the cover is designed to be sustainable in terms of erosion by employing suitably qualified persons to assess cover erodability. Concurrent rehabilitation allows for the actual performance of the cover to be monitored and validated;
- Minimize water ingress into mine voids or backfilled pits by designing water management measures to maximize clean water diversion directly to the water resource;
- Remove potential sources of pollution such as hydrocarbon-contaminated soils and dispose of at an authorised disposal facility; and
- Implement as many of the closure measures as possible during the operational phase of the mine and institute appropriate monitoring programmes in order to demonstrate the actual performance of the various management actions during the life of mine, rather than after decommissioning.

8.1.1.3.3 Impacts Rating

Table 8-5: Assessment of Rehabilitation and Closure impacts on water quality

Impact Description			No Mitigation					With Mitigation				
Activity	Impact	Aspect	Intensity	Duration	Extent	Probability	Significance	Intensity	Duration	Extent	Probability	Significance
Waste Stockpiles	Oxidation of geochemically active minerals	Seepage and runoff of contaminants into surface and groundwater	High	Ongoing	Local	Likely	Minor (-)	Moderate	Long term	Limited	Probably	Minor (-)
Rehabilitated opencast pits	Oxidation of geochemically	Decant of contaminated	Very high	Ongoing	Local	Almost certain	Moderate (-)	High	Ongoing	Limited	Likely	Minor (-)

	active minerals	mine water											
Contaminated soils	Long-term source of pollutants	Seepage and runoff of contaminants into surface and groundwater	Moderate	Ongoing	Local	Probably	Minor (-)	Low	Short term	Limited	Unlikely	Negligible (-)

8.1.2 Aquatics and Wetlands

Impacts to aquatic habitats during the construction and operational phase are largely associated with the physical disturbance of instream aquatic habitat or associated riparian zone through activities that include the clearing of vegetation, placement and construction of infrastructure and intentional or unintentional operation of vehicles through watercourses (e.g. rivers and wetlands). Establishment of and adherence to appropriate buffer zone areas are therefore key to mitigating against these impacts. Proliferation of alien vegetation also has the potential to establish in watercourses and alter habitat through modifications to in-stream and riparian species assemblages.

Possible ecological consequences associated with this impact may include:

- Reduction in representation and conservation of freshwater ecosystem/habitat types;
- Reduction in the supply of ecosystem goods & services;
- Reduction/loss of habitat for aquatic dependent flora & fauna; and
- Reduction in and/or loss of species of conservation concern (i.e. rare, threatened/endangered species).

8.1.2.1 Construction Phase

8.1.2.1.1 Impacts description

Impacts to aquatic habitats during the construction phase are largely associated with activities that include the clearing of vegetation, placement and construction of infrastructure and intentional or unintentional operation of vehicles through watercourses.

8.1.2.1.2 Mitigation measures

- During the construction phase of the development, all wetland areas other than the immediate areas of road crossings are to be demarcated as no-go areas for vehicles and construction personnel. In this respect recommended buffer zones should be strictly adhered to. The map presented in the report should be used to guide the footprint of the mine layout in this respect.
- Solid waste generated during the operational phase should be disposed of as per the requirements for the waste class.
- An alien invasive plant management plan needs to be compiled and implemented prior to construction to control and prevent the spread of invasive aliens.

For wetland road crossings:

- The design of the bridge crossing must ensure that the creation of turbulent flow in the system is minimised, in order to prevent downstream erosion;
- No support pillars should be constructed within the active channel of the wetland;
- The crossing must take place at right angles to the course of the channel;
- Stabilisation of river-banks in the vicinity of the bridge crossing by employing one or a combination of the following individual techniques:
    - Re-sloping of banks to a maximum of a 1:3 slope;
    - Revegetation of re-profiled slopes;
    - Temporary stabilisation of slopes using geotextiles; and
    - Installation of gabions and reno mattresses.
- It must be ensured that flow connectivity along the channel is maintained and that road crossing will not result in any barriers preventing biota (i.e. fish) moving upstream and downstream of the crossing.

8.1.2.1.3 Impacts Rating

Table 8-6: Assessment of Construction Phase impacts on aquatic habitats.

Impact Description			No Mitigation					With Mitigation				
Activity	**Impact**	**Aspect**	**Intensity**	**Duration**	**Extent**	**Probability**	**Significance**	**Intensity**	**Duration**	**Extent**	**Probability**	**Significance**
Site Clearing	Increased anthropogenic activity within the wetland feature	Loss of habitat and biological integrity	High	Long term	Local	Likely	Minor (-)	Low	Short term	Local	Unlikely	Negligible (-)
Site Clearing	Disturbance of soils	Proliferation of alien plants in sensitive wetland and riparian habitats.	High	Long term	Local	Likely	Minor (-)	Moderate	Long term	Local	Probably	Minor (-)

8.1.2.2 Operational Phase

8.1.2.2.1 Impacts description

Operational phase impacts are similar to those that are likely during the construction phase.

8.1.2.2.2 Mitigation measures

During the operational phase of the development, all wetland areas are to be demarcated as no-go areas for vehicles and construction personnel. In this respect recommended buffer zones should be strictly adhered to. The map presented in the report should be used to guide the footprint of the mine layout in this respect.

Any areas where active erosion within wetland features are observed must be immediately rehabilitated to ensure that the hydrology of the area is reinstated to conditions which are as natural as possible;

A routine biomonitoring programme using appropriate habitat and biotic indicators should be established to identify any changes to ecosystem health in potentially affected wetlands.

8.1.2.2.3 Impacts Rating

Table 8-7: Assessment of Operational Phase impacts on aquatic habitats.

Impact Description			No Mitigation					With Mitigation				
Activity	Impact	Aspect	Intensity	Duration	Extent	Probability	Significance	Intensity	Duration	Extent	Probability	Significance
Routine operation and maintenance activities	Increased anthropogenic activity within watercourses	Deterioration of habitat and biological integrity	Moderate	Ongoing	Local	Likely	Minor (-)	Very low	Ongoing	Local	Unlikely	Negligible (-)
Opencast mining	Mining into wetland habitats	Loss of habitat and biological integrity	Moderate	Ongoing	Local	Likely	Minor (-)	Very low	Ongoing	Local	Unlikely	Negligible (-)

8.1.2.3 Rehabilitation and Closure Phase

8.1.2.3.1 Impacts description

Impacts to aquatic habitats during the closure phase are largely associated with the removal of infrastructure and the intentional or unintentional operation of vehicles through watercourses.

8.1.2.3.2 Mitigation Measures

During the operational phase of the development, all wetland areas are to be demarcated as no-go areas for vehicles and construction personnel. In this respect recommended buffer zones should be strictly adhered to. The map presented in the reprot should be used to guide the footprint of the mine layout in this respect.

8.1.2.3.3 Impacts Rating

Table 8-8: Assessment of Rehabilitation and Closure Phase impacts on aquatic habitats.

Impact Description			No Mitigation					With Mitigation				
Activity	Impact	Aspect	Intensity	Duration	Extent	Probability	Significance	Intensity	Duration	Extent	Probability	Significance
Removal of infrastructure	Increased anthropogenic activity within watercourses	Deterioration of habitat and biological integrity	Moderate	Short-term	Local	Likely	Minor (-)	Very low	Short-term	Local	Unlikely	Negligible (-)

8.1.2.4 Cumulative Impacts

The upper Olifants River catchment is the most important source of coal in South Africa, and the introduction of high concentrations of total dissolved salts (particularly sulphate) and metals associated with wastewater and seepage from existing active mines and acid mine drainage (AMD) from old, abandoned mines has been identified as one of the major long-term water quality impacts in the catchment (Hobbs et al., 2008). As a result, Water Quality Planning Limits (WQPLs) are generally exceeded for most water quality parameters across the catchment (DWS, 2016). Furthermore, the complete or partial loss of wetlands throughout the catchment continues to impact on the water resources of the catchment and the valuable ecosystem services provided by wetlands. The cumulative impacts of coal mining on water quality and aquatic ecosystem health in the upper Olifants River are therefore significant and it is essential that a stormwater management plan that adheres to GN704 regulations be designed. In addition, minimum recommended buffer zones must be implemented so as to avoid loss of wetland habitat

8.1.3 Groundwater

8.1.3.1 Construction Phase

During the construction phase at the Site, the activities would include the removal of vegetation and compaction of soil. The potential impacts on the receiving groundwater environment during the construction phase include localized groundwater dewatering (if groundwater is used to supply construction activities), contamination from hydrocarbon spills (if any) and domestic waste from the onsite barracks, contractors and staff.

Should groundwater be used to supply the construction activities (e.g. drinking water or dust suppression), localized dewatering at the borehole(s) could occur. This would be a low impact both before and after management measures are put in place due to the localized extent of dewatering and the short duration of the impact. Borehole abstraction (if any) should be managed effectively and borehole water levels and abstraction volumes from the borehole should be recorded at regular intervals, ideally monthly.

The clearing of vegetation and topsoil, as well as compaction of soil, may result in increased runoff at the Site and decreased recharge to groundwater, which is a low impact prior to management measures being put in place. The areas to be cleared and compacted should be minimised and done according to best practices, which will maintain a low impact rating.

Hydrocarbon spills from construction vehicles and/or fuel storage areas could result in localised groundwater contamination, which is a medium impact on the receiving environment. In order to manage these impacts all staff and supervisors at workshops, yellow metal laydown areas and fuel storage areas should be trained in hydrocarbon spill response and each of these areas should be equipped with the appropriate spill response kits and any contaminated soil must be disposed of correctly at a suitable location. Should these management measures be put in place the impact on the receiving environment would be reduced to a low impact.

Domestic waste will be generated by contractors and staff. This would be a low impact both before and after management measures are put in place. Domestic waste should be disposed of at a dedicated, suitable landfill site and managed according to the applicable legislation and Standard Operating Procedures (SOP’s) of the mine.

The construction phase impacts on groundwater quantity and quality with no mitigation and/or management measures in place are presented below, with Table 8-10 presenting the impacts on the groundwater environment following the implementation of management and/or mitigation measures.

Table 8-9: Groundwater Impacts during Construction Phase (before Management/Mitigation).

Description of Activity	Impact Description	M	S	D	P	Risk	
Groundwater Quantity							
Vegetation Clearing	Clearing of vegetation and topsoil may result in increased runoff and reduced recharge to the groundwater system.	2	5	1	3	24	Low
Groundwater Dewatering	Groundwater abstraction at the Site borehole may result in localised dewatering.	2	2	1	2	10	Low
Groundwater Quality							
Hydrocarbon Spills	Hydrocarbon spills from construction vehicles and/or laydown areas and workshops may enter the groundwater system.	6	2	1	4	36	Medium
Domestic Waste Generation	During construction domestic waste will be generated by contractors and staff.	2	2	3	4	28	Low

Table 8-10: Groundwater Impacts during Construction Phase (after Management/Mitigation).

Description of Activity	Mitigation/Management Measures	M	S	D	P	Risk	
Groundwater Quantity							
Vegetation Clearing	Areas to be cleared should be limited as far as possible.	2	5	1	3	24	Low
Groundwater Dewatering	Water levels and abstraction volumes should be monitored and recorded. Borehole pump schedules should always be adhered to and water reclaimed within the system where possible to reduce usage.	2	2	1	1	5	Low
Groundwater Quality							
Hydrocarbon Spills	Workshop and Laydown areas should be properly compacted and bunded. Appropriate spill kits should always be available and contaminated soil should be removed as soon as possible and disposed of at an accredited facility.	2	2	1	2	10	Low
Domestic Waste Generation	Domestic waste should be disposed of at a dedicated, suitable landfill site and managed appropriately.	2	1	3	2	12	Low

8.1.3.2 Operational Phase

8.1.3.2.1 Groundwater Quantity Impacts

During mining operations at the Site groundwater is likely to flow into the opencast mining areas at both Opencast 1 and Opencast 2. The simulated inflows at the Opencast 1 area for the Base Case and model Scenarios 2, 3 and 4 was ~350 m$_3$/day, with the average simulated inflows for Scenarios 5 and 6 (i.e. where a grout curtain is installed at the western pit boundary) was ~260 m$_3$/day. Where the base case mining schedule is followed (i.e. Base Case, Scenario 1, Scenario 3), initial simulated pit inflows at Opencast 1 were between 400 and 500 m$_3$/day up to year 7, where inflows decreased to ~250 m$_3$/day. For model scenarios 2 and 4, where mining at Opencast 1 proceeded east to west, inflows were initially 200-300 m$_3$/day, increasing to ~550 m$_3$/day as mining approached the perennial river west of the Site. Simulated inflows for Opencast 1 for Scenarios 5 and 6 (i.e. where a grout curtain is installed ahead of mining at the western boundary of Opencast 1) were consistently between 200 and 300 m$_3$/day throughout the LoM at Opencast 1. Model Scenario 1 showed an average simulated inflow value of ~900 m$_3$/day for Opencast 1, increasing steadily over the LoM which was most likely due to the cumulative effect of groundwater inflows over the entire mining area.

Simulated inflows to Opencast 2 were ~600-650 m$_3$/day for all model scenarios. The simulated daily inflows per model scenario over the LoM are shown in Figure 8-1.

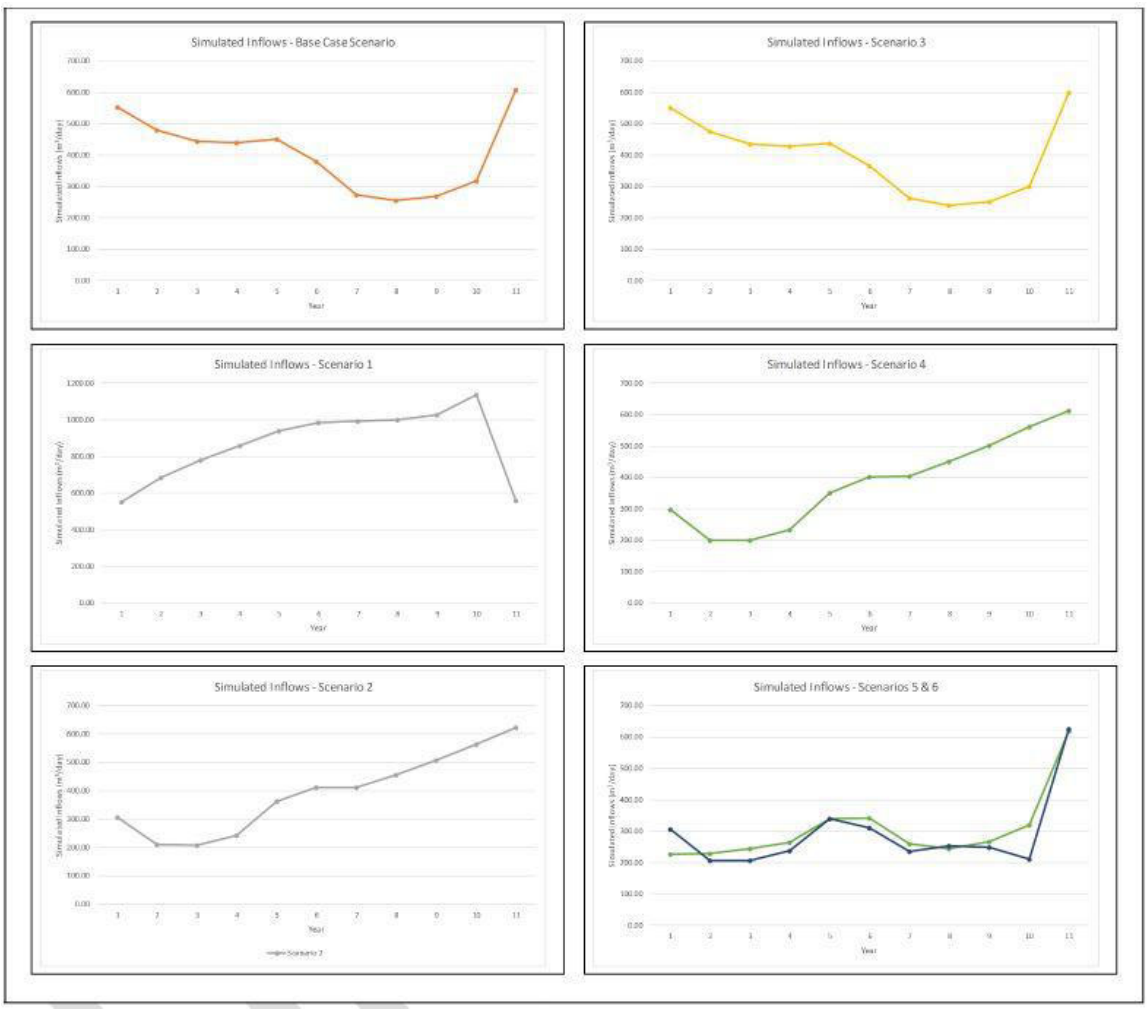


Figure 8-1: Simulated Inflows to Opencast 1 and Opencast 2 during the Operational Phase.

The simulated drawdown extent for Opencast 1 extended ~250 m from the pit boundary for all of the model scenarios, except for model Scenario 1 where the drawdown extent reached a maximum of 300-350 m at the end of LoM. Where concurrent rehabilitation took place at the Site, drawdown was limited to the surroundings of the active mining cut and rehabilitated cuts showed recovery of water levels within 2 years after rehabilitation. The simulated drawdown extent at Opencast 2 extended ~200-250 m from the pit boundary, reaching a maximum of ~400 m at the south eastern pit extent, for all of the model scenarios.

Sensitive receptors near to the Opencast 1 and Opencast 2 areas were various wetlands at the Site and the privately-owned borehole DBR01 (west of Opencast 2). None of the simulated drawdown extents interacted with borehole DBR01, however, the simulated drawdown extent for the Base Case model scenario and Scenarios 2, 3 and 4 showed a short-term (<3 years, then groundwater levels rebounded) lowering of groundwater levels by 3-5 m at the wetland areas north, south and west of Opencast 1, as well as major lowering of water levels at the wetland north of Opencast 2 (>20 m drawdown) and an extended drawdown extent south east of the Opencast 2 pit. The impact from these model scenarios prior to management measures being implemented was medium.

Model Scenario 1 showed continuous interaction with the wetland areas surrounding Opencast 1 and Opencast 2 during the LoM, which resulted in the assignment of a high impact rating (Table 9.3) prior to management measures. Scenarios 5 and 6 showed interaction with the wetland west of Opencast 1 was negligible due to the installed grout curtain, with interactions with the northern and southern wetland areas also reduced during the LoM. Water levels at the wetland north of Opencast 2 showed >20 m drawdown during mining and an extended drawdown extent simulated south east of the Opencast 2 pit. Due to the reduced interaction with the wetlands at Opencast 1 the impact from these model scenarios prior to management measures being implemented was low, as shown in Table 9.3.

The simulated drawdown extents for the Base Case Scenario and Scenarios 1, 2, 3, 4, 5 and 6 are shown below.

Table 8-11: Groundwater Quantity Impacts - Operational Phase (prior to Management/Mitigation).

Description of Activity	Model Scenario	Impact Description	M	S	D	P	Risk	
Groundwater Quantity								
Groundwater Dewatering	Base Case Scenario	Groundwater inflows to the active mining area may result in dewatering of the surrounding aquifer system(s).	4	3	2	4	36	Medium
	Scenario 1		8	3	4	5	75	High
	Scenario 2		4	3	2	4	36	Medium
	Scenario 3		4	3	2	4	36	Medium
	Scenario 4		4	3	2	4	36	Medium
	Scenario 5		2	2	2	3	18	Low
	Scenario 6		2	2	2	3	18	Low

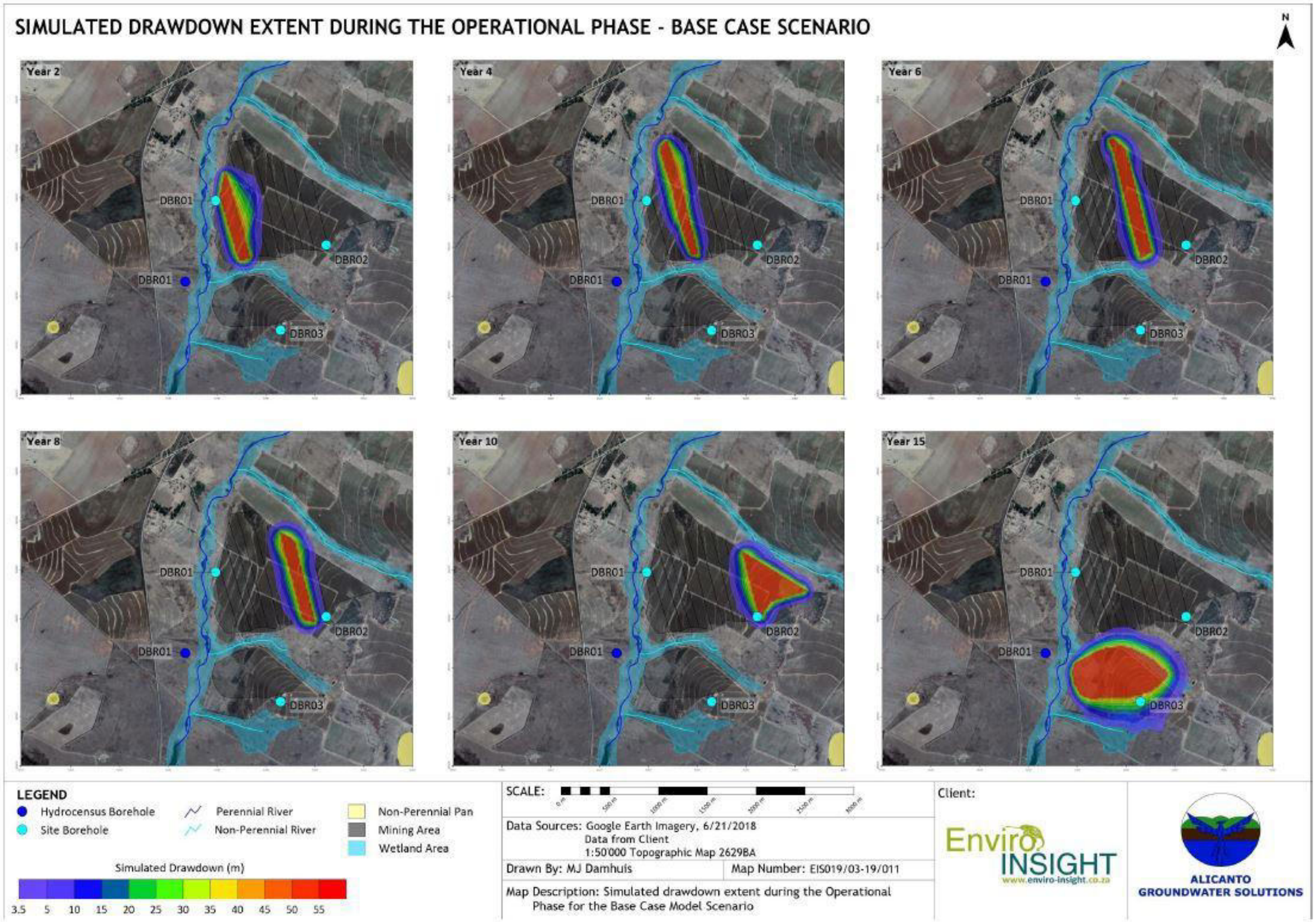


Figure 8-2: Simulated Drawdown Extent (Operational Phase) - Base Case Scenario.

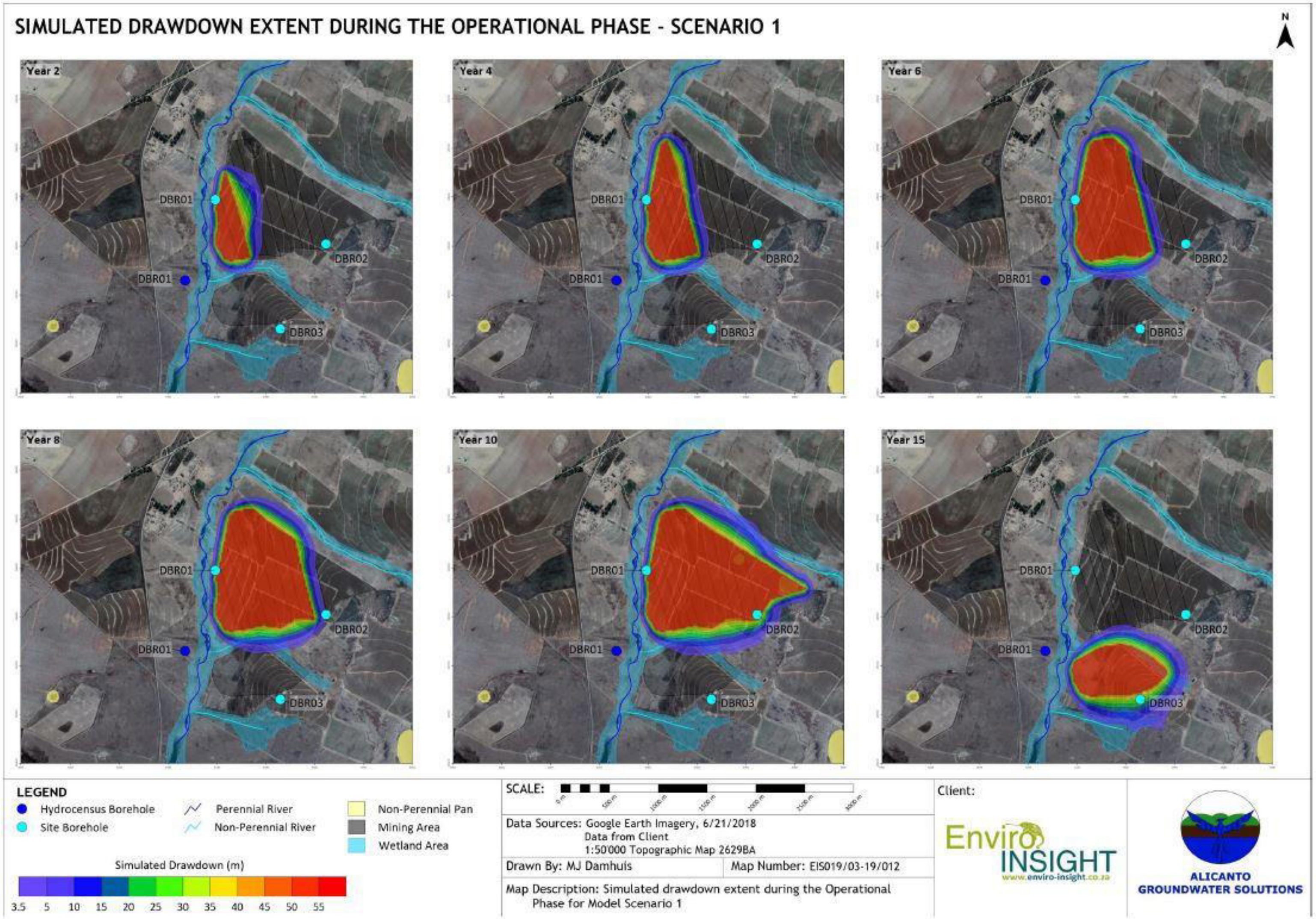


Figure 8-3: Simulated Drawdown Extent (Operational Phase) - Scenario 1.

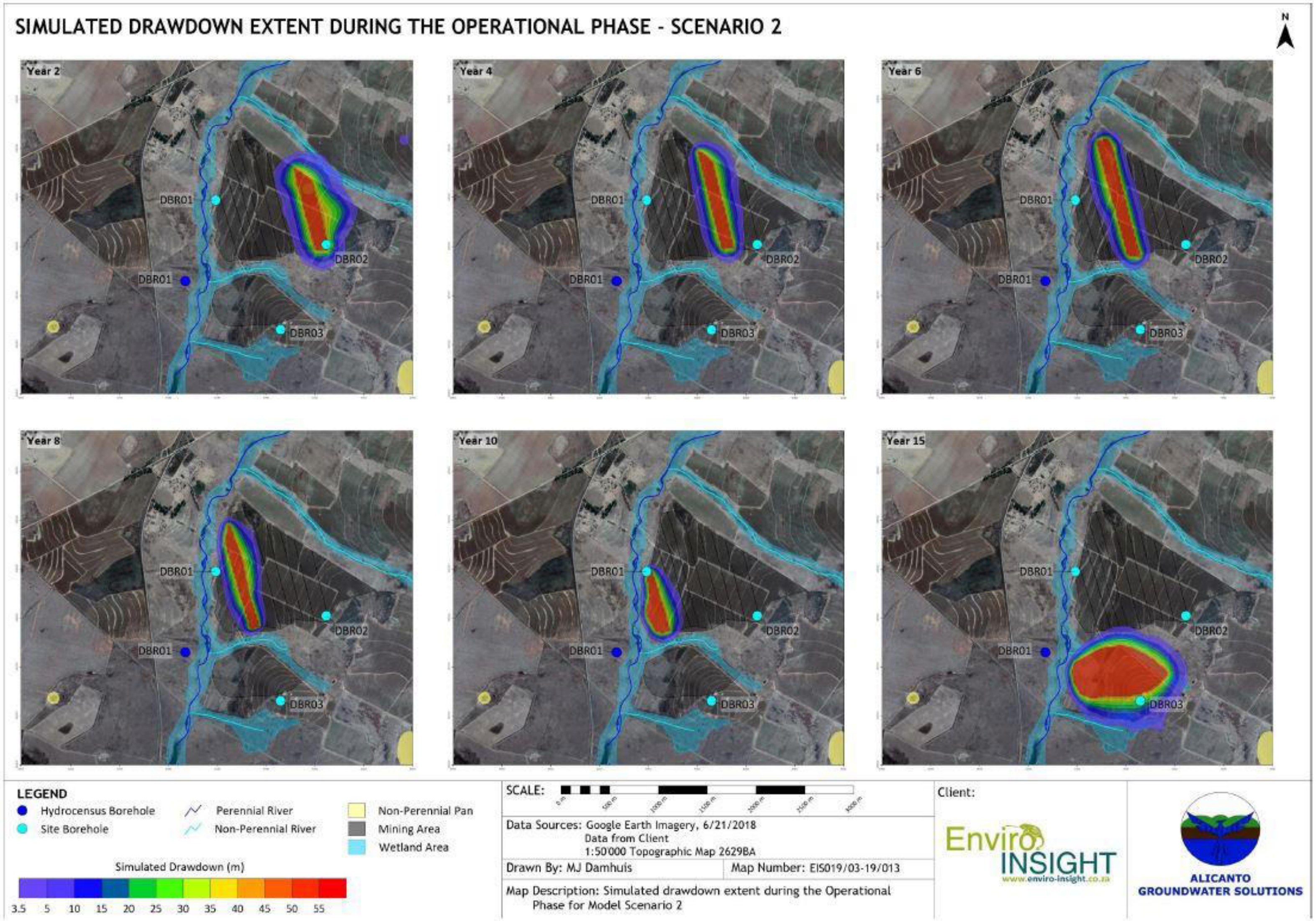


Figure 8-4: Simulated Drawdown Extent (Operational Phase) - Scenario 2.

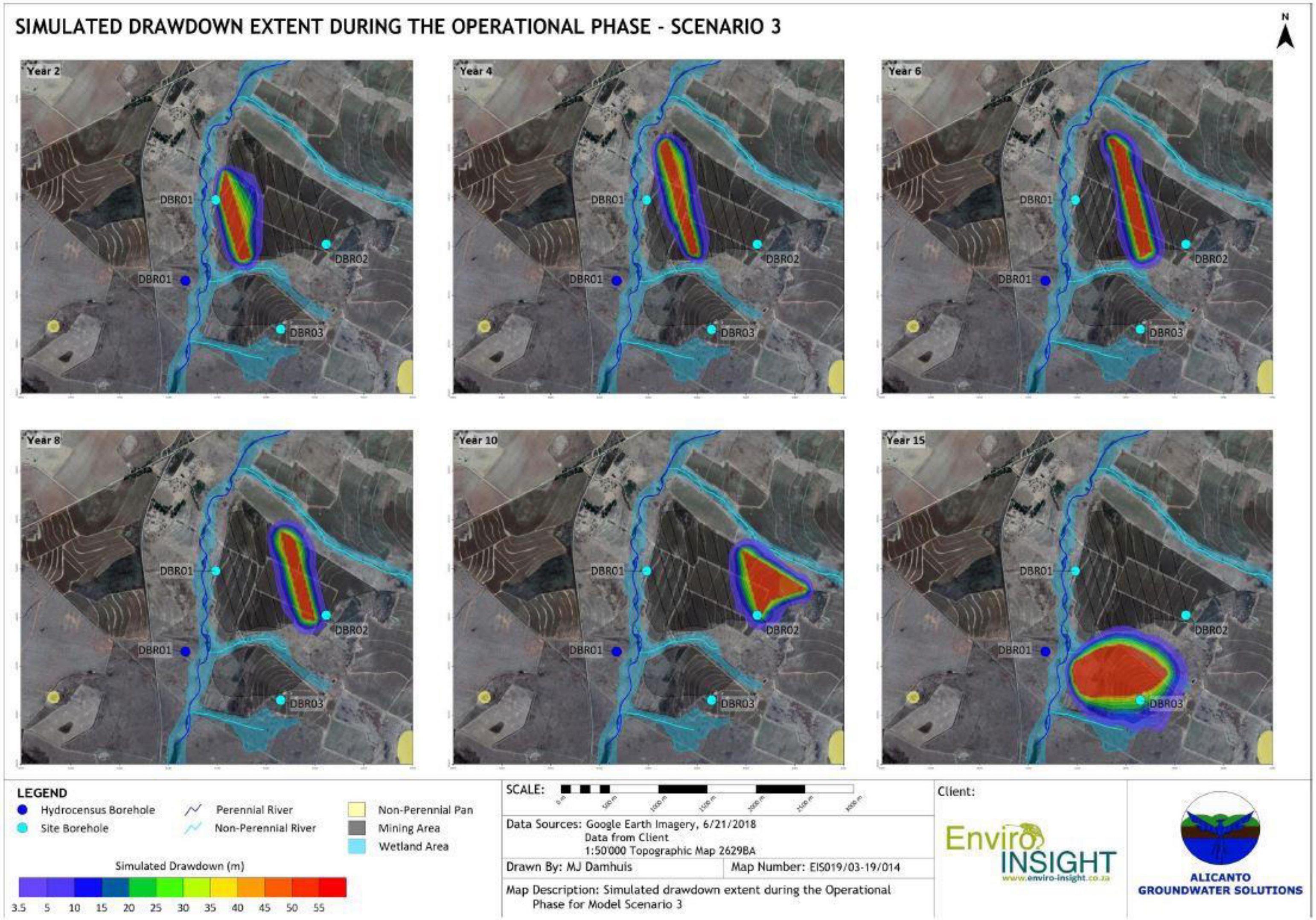


Figure 8-5: Simulated Drawdown Extent (Operational Phase) - Scenario 3.

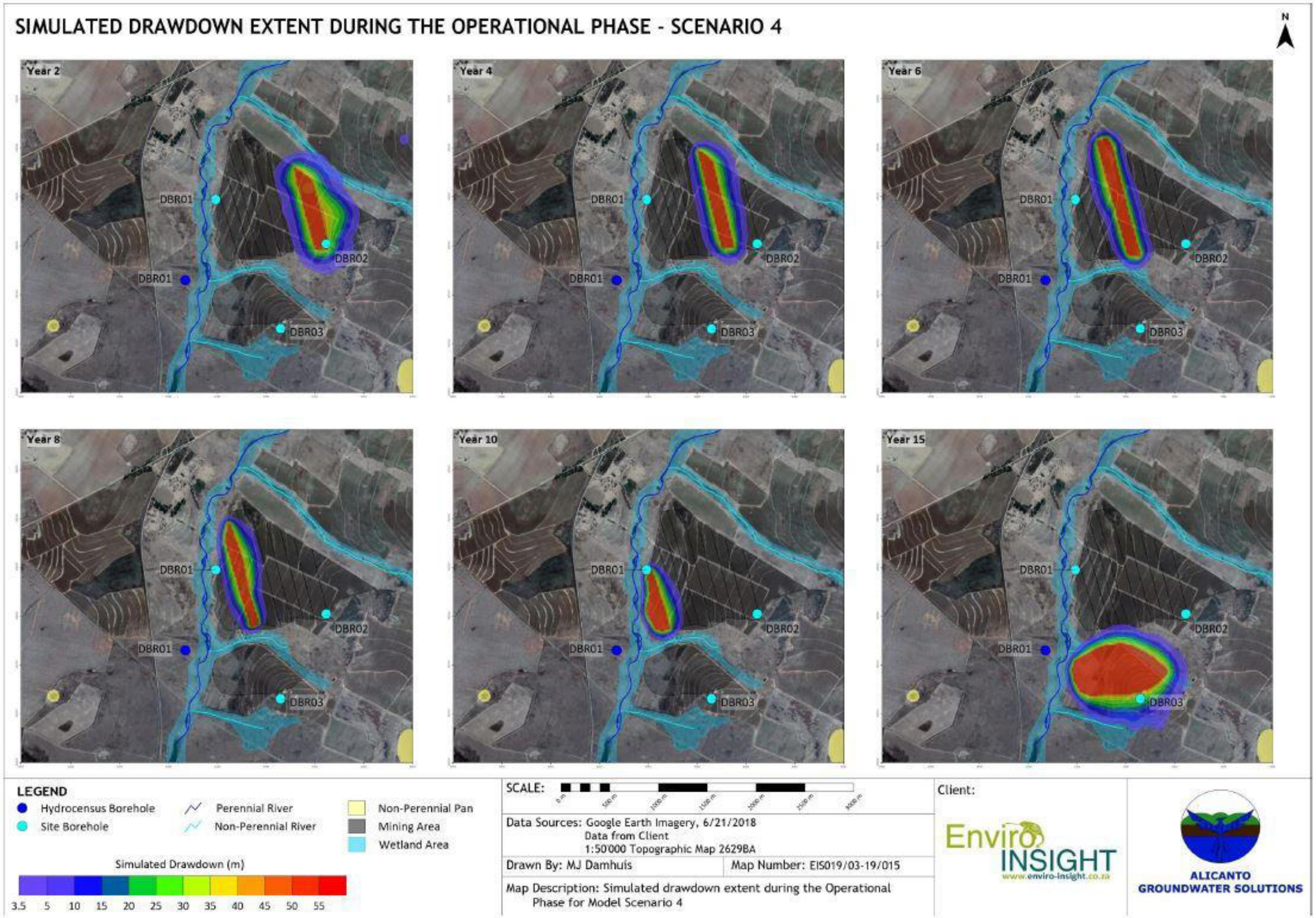


Figure 8-6: Simulated Drawdown Extent (Operational Phase) - Scenario 4.

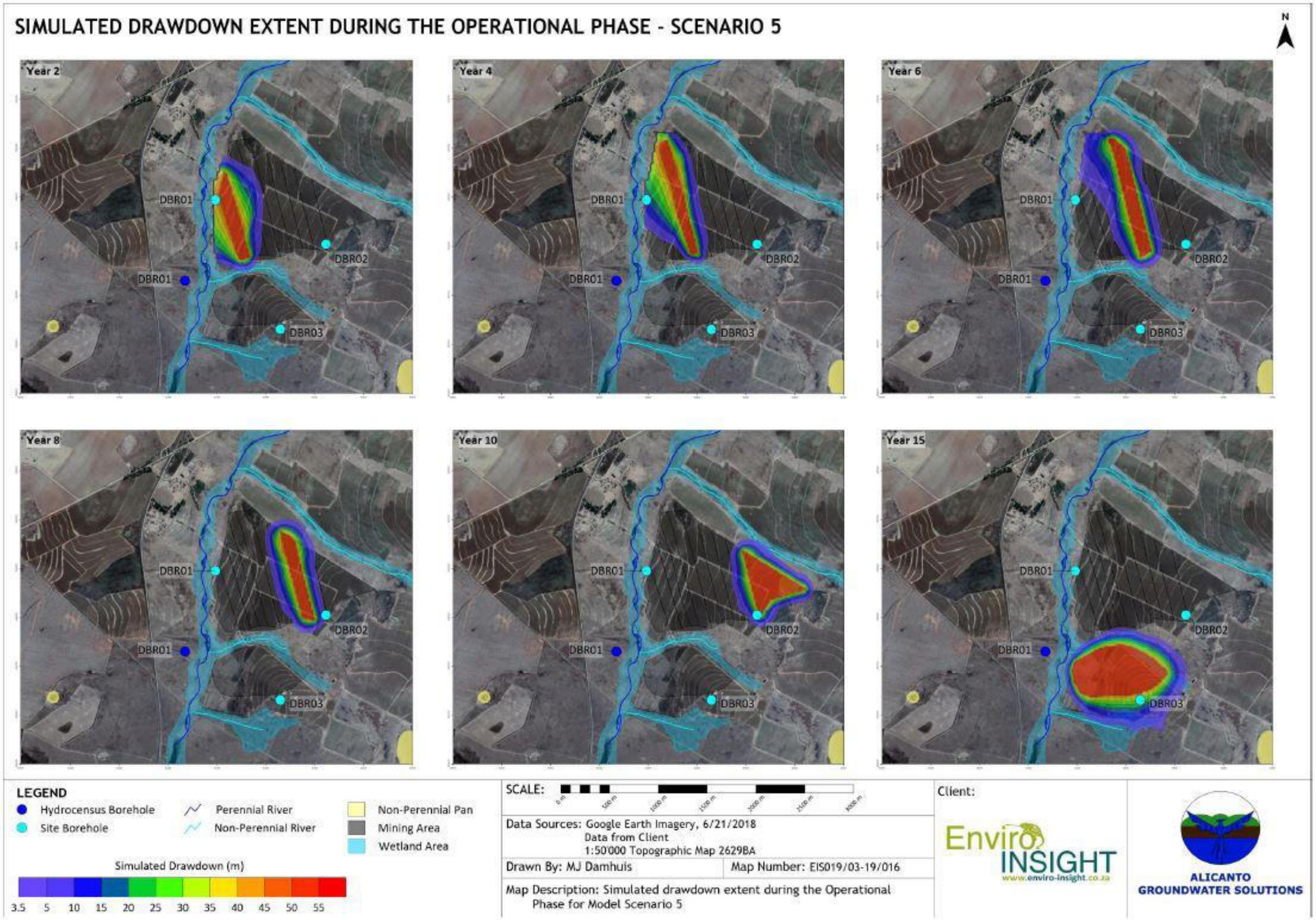


Figure 8-7: Simulated Drawdown Extent (Operational Phase) - Scenario 5.

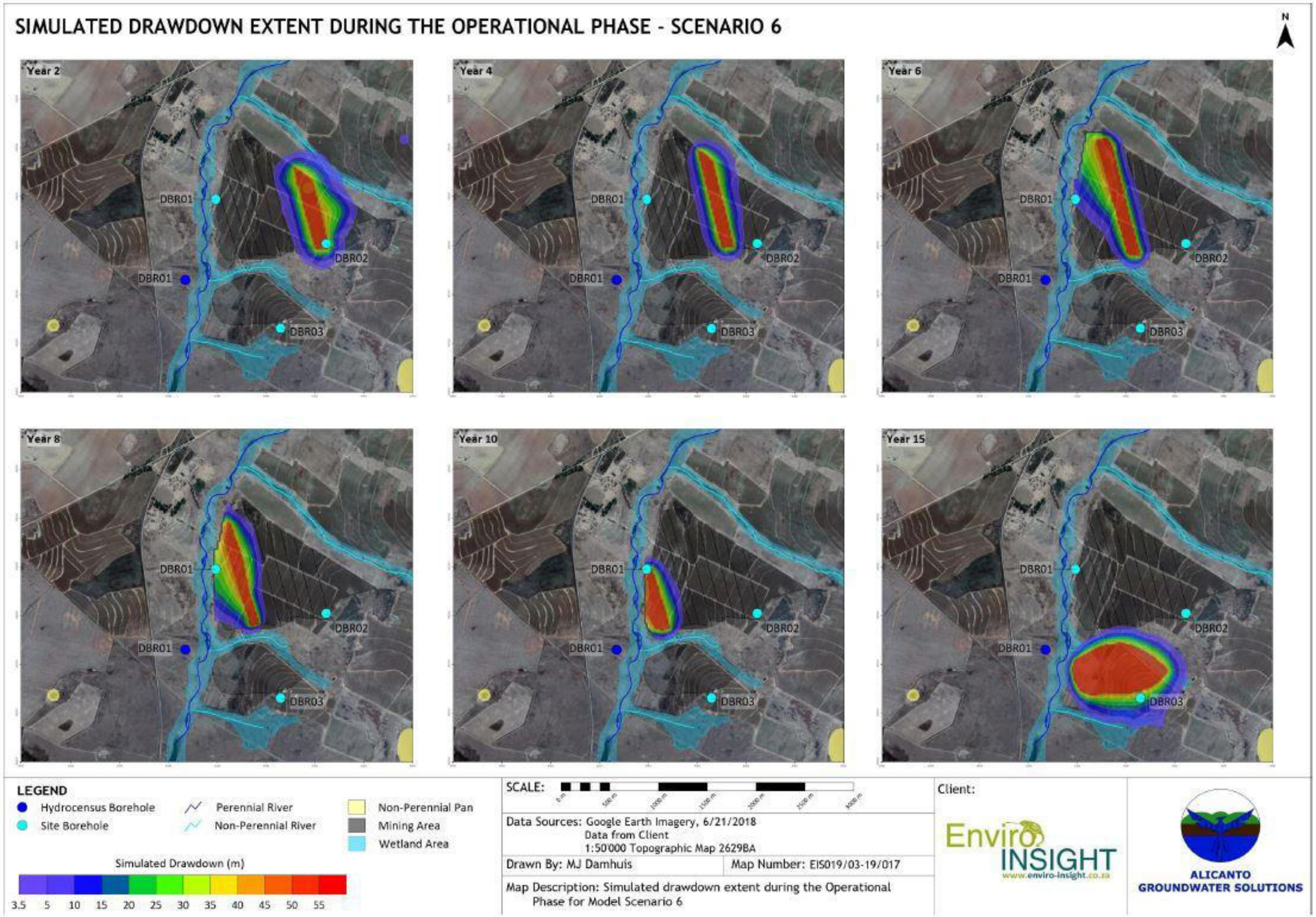


Figure 8-8: Simulated Drawdown Extent (Operational Phase) - Scenario 6.

In order to limit the extent of dewatering due to pit inflows at the Site, water levels should be taken quarterly at monitoring boreholes around the Site. Should any impact be observed in privately owned boreholes the owner shall be suitably compensated and an alternative water supply provided by the mine during operations. Following the implementation of these management measures the impact rating for model Scenario 1 was medium and the remaining model scenarios were low, as shown in **Error! Reference source not found.**.

Table 8-12: Groundwater Quantity Impacts - Operational Phase (after Management/Mitigation).

Description of Activity	Mitigation/Management Measures	M	S	D	P	Risk	
Groundwater Quantity							
Groundwater Dewatering	No Mitigation Possible. Groundwater levels at the Site and surroundings should be monitored on a quarterly basis in order to determine any negative trends that may occur due to dewatering of the mining area. Should mining activities negatively impact any surrounding groundwater users, the mine should compensate the affected parties accordingly and provide alternative water supply for the duration of mining operations.	4	2	2	3	24	Low
		6	3	4	4	52	Medium
		3	2	2	3	21	Low
		4	2	2	3	24	Low
		3	2	2	3	21	Low
		2	2	2	3	18	Low
		2	2	2	3	18	Low

8.1.3.2.2 Groundwater Quality Impacts

The potential impacts on groundwater quality during the operational phase were potential poor-quality water leaching into the groundwater environment from the Site waste rock dumps and PCD, as well as poor quality groundwater emanating from the backfill material used during backfilling of the pits. The impact of seepage at the PCD was low, with the simulated contaminant plume showing concentrations of less than 50-75 mg/l. The simulated contaminant plume emanating from the waste rock dump and coal stockpile areas at the Site was captured by the drawdown cone at the Site and thus contributed little to the overall contaminant plume at the Site. The impact rating for the PCD, stockpile areas and waste rock dump was low, as shown in Table 9.5.

Simulated contaminant plumes from the rehabilitated opencast areas for all model scenarios (except Scenario 1 where no backfilling took place during the operational phase) was localised to within the mining extents and simulated concentrations did not exceed ~300-400 mg/l. During mining at Opencast 2, the simulated plume interacted with the wetland area south of Opencast 1, with concentrations at the wetland being ~250-350 mg/l. A medium impact rating was assigned due to the high probability of the impact occurring and interaction with the wetland area south of Opencast 1, despite the limited extent of the contaminant plume.

Table 8-13: Groundwater Quality Impacts - Operational Phase (prior to Management/Mitigation).

Groundwater Quality								
Backfill Material Leachate	All Model Scenarios	Poor quality leachate generated within the backfill material used at the Site during concurrent rehabilitation may enter the groundwater system.	6	1	4	4	44	Medium
Poor Quality Seepage from the PCD	All Model Scenarios	Poor quality water stored at the Site PCD may seep into the groundwater system at the Site.	4	1	4	2	18	Low
Waste Rock/Coal Stockpile Leachate	All Model Scenarios	Poor quality leachate from the Site waste rock dump and coal stockpile areas may enter the groundwater system.	4	1	4	3	27	Low

The simulated contaminant plume extents for the Base Case Scenario and Scenarios 2, 3, 4, 5 and 6 are shown in Figure 9.9, Figure 9.10, Figure 9.11, Figure 9.12, Figure 9.13 and Figure 9.14, respectively.

A clay liner should be installed at the PCD, with the liner always inspected for any leakages and the free bord maintained during the LoM to prevent overflow. Water quality sampling should be done regularly at the PCD during the LoM. With these management measures in place the impact rating remained low (Table 9.6).

Carbonaceous material reporting to the waste rock dump areas should be covered where possible to prevent oxidation and the dumps contoured (where possible) to promote runoff and limit infiltration to the materials.

Material at the coal stockpiles should have limited standing time and surface water management at the stockpile should be maintained to promote runoff and limit standing water at the areas. Groundwater monitoring boreholes near to the dump and stockpile areas need to be regularly sampled. With these management measures in place the impact rating remained low.

Sulphide-bearing material used during concurrent rehabilitation should be placed at the base of the backfilling and covered with neutral material as soon as possible, with a 200 mm clay layer placed on top of the backfill to prevent washout of material. Following the implementation of these management measures the impact rating was low.

Table 8-14: Groundwater Quality Impacts - Operational Phase (after Management/Mitigation).

Groundwater Quality							
Backfill Material Leachate	Sulphide-bearing material should be placed at the base of the backfilling and covered as soon as possible with more neutral material to prevent oxidation. A 200 mm clay layer should be placed on top of the backfill material to limit water ingress.	4	1	4	3	27	Low
Poor Quality Seepage from the PCD	The liner at the PCD should be maintained and regularly inspected for any tears and/or leakage. The freebord at the PCD should be maintained at all times to avoid overflow and water quality sampling should be taken regularly at the PCD.	2	1	4	2	14	Low
Waste Rock/Coal Stockpile Leachate	Carbonaceous material stored at the waste rock dumps should be covered where possible to limit the oxidation of sulphide-bearing materials, with the dumps contoured, where possible, to encourage runoff. Material stored at the coal stockpiles should be removed as soon as possible to prevent oxidation of the material and sufficient surface water management infrastructure put in place to limit standing water at the stockpiles. Groundwater monitoring boreholes should be installed at the dump and stockpile areas and water quality samples taken regularly.	2	1	4	2	14	Low

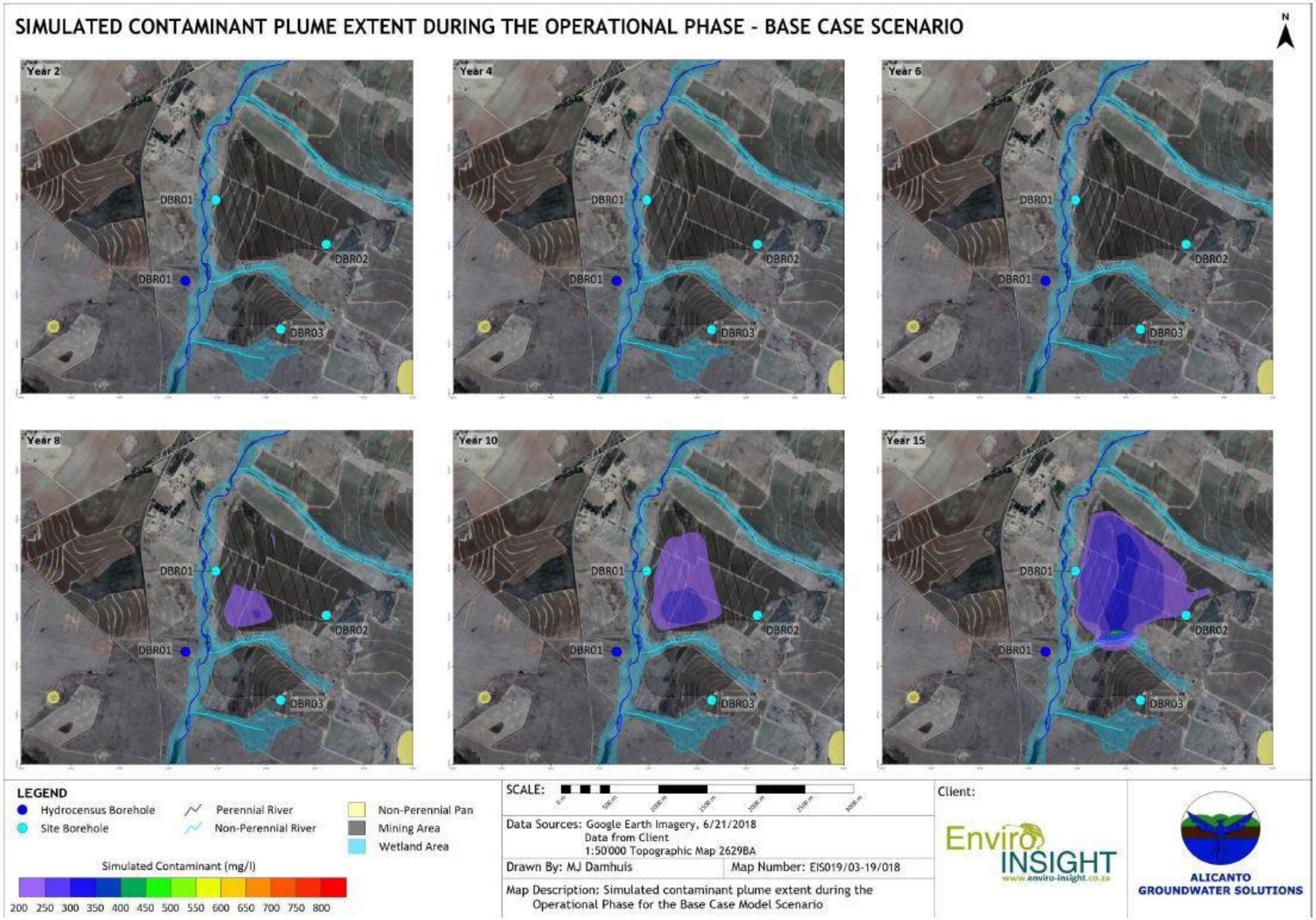


Figure 8-9: Simulated Contaminant Plume Extent (Operational Phase) - Base Case Scenario.

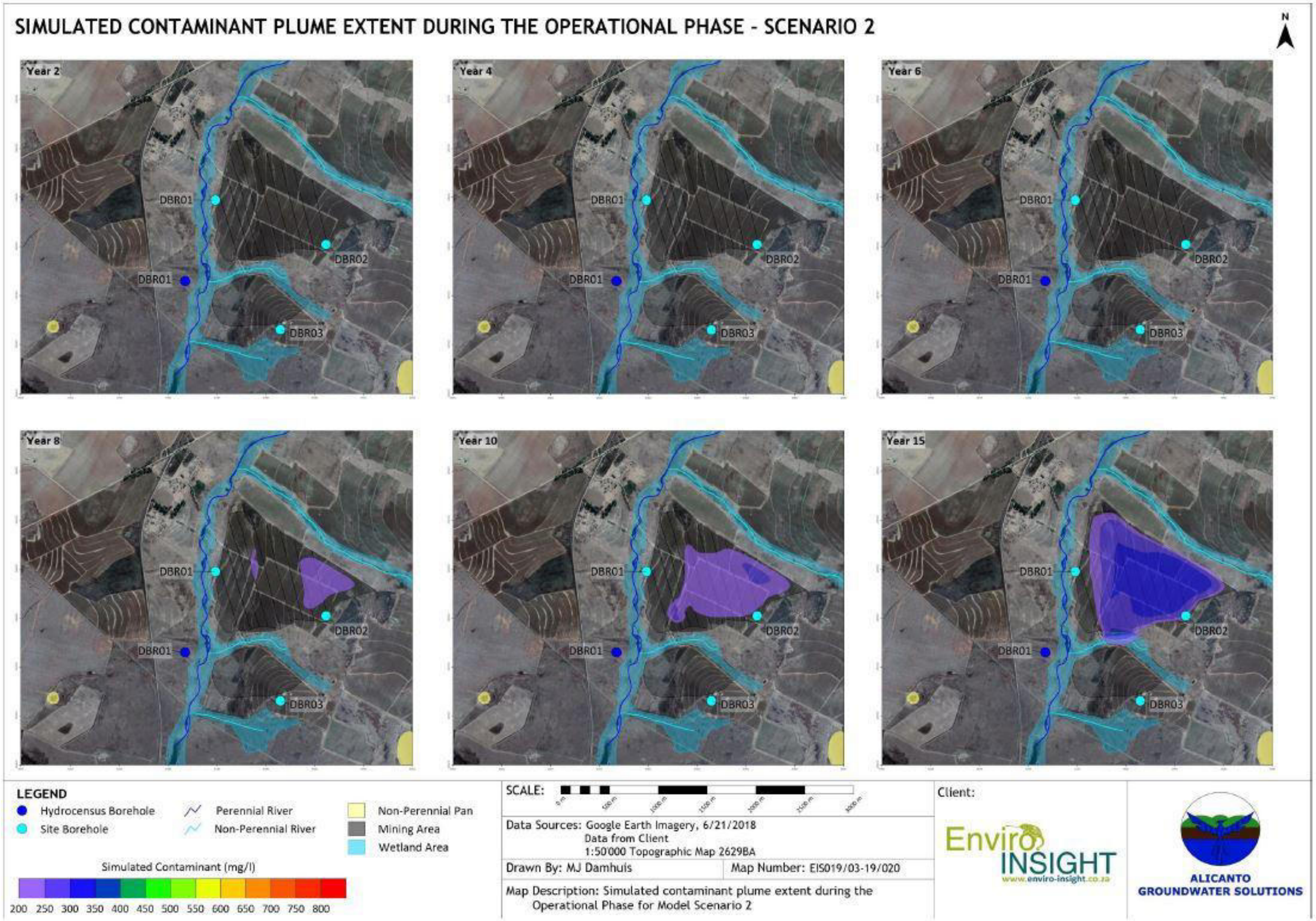


Figure 8-10: Simulated Contaminant Plume Extent (Operational Phase) - Scenario 2.

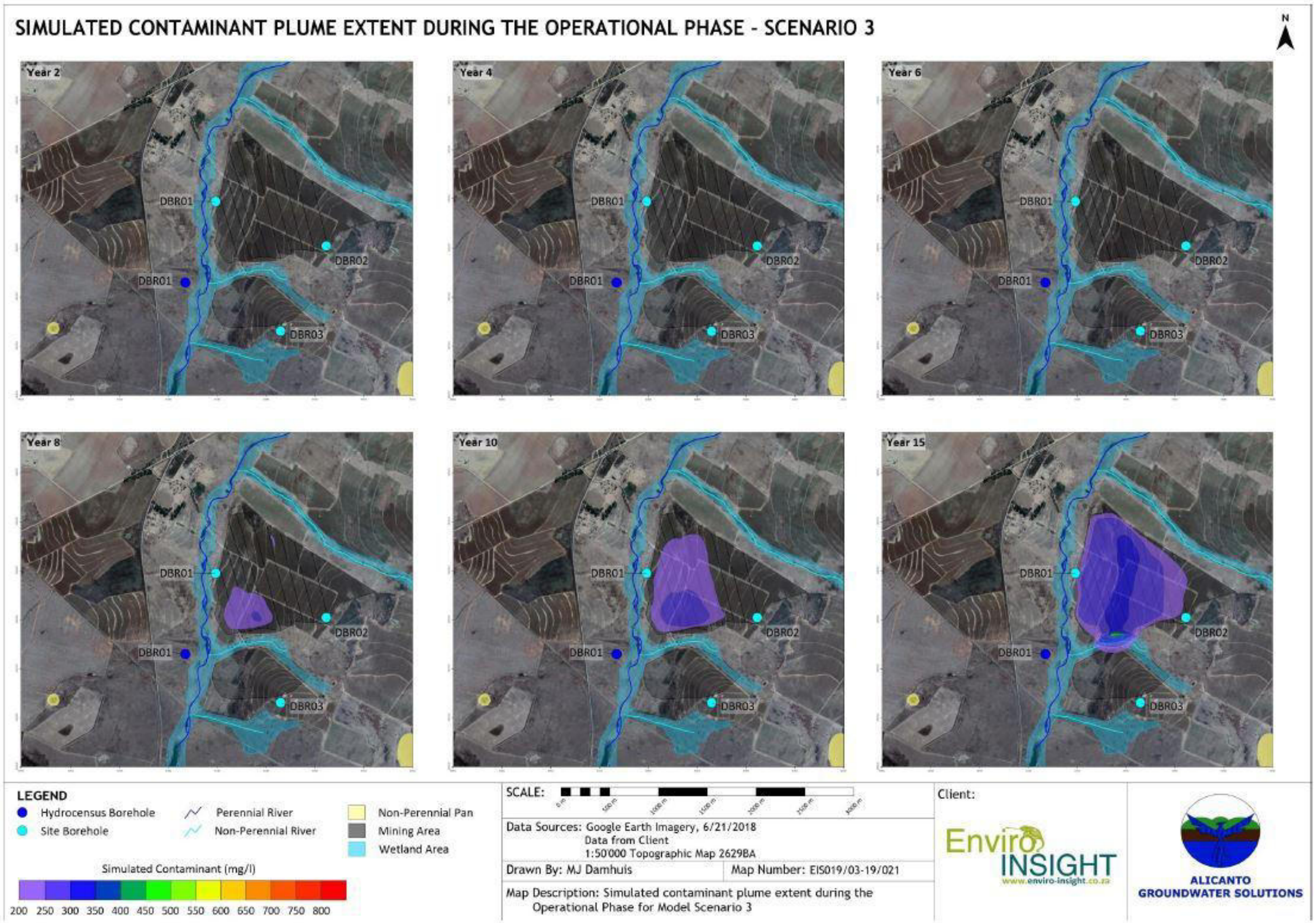


Figure 8-11: Simulated Contaminant Plume Extent (Operational Phase) - Scenario 3.

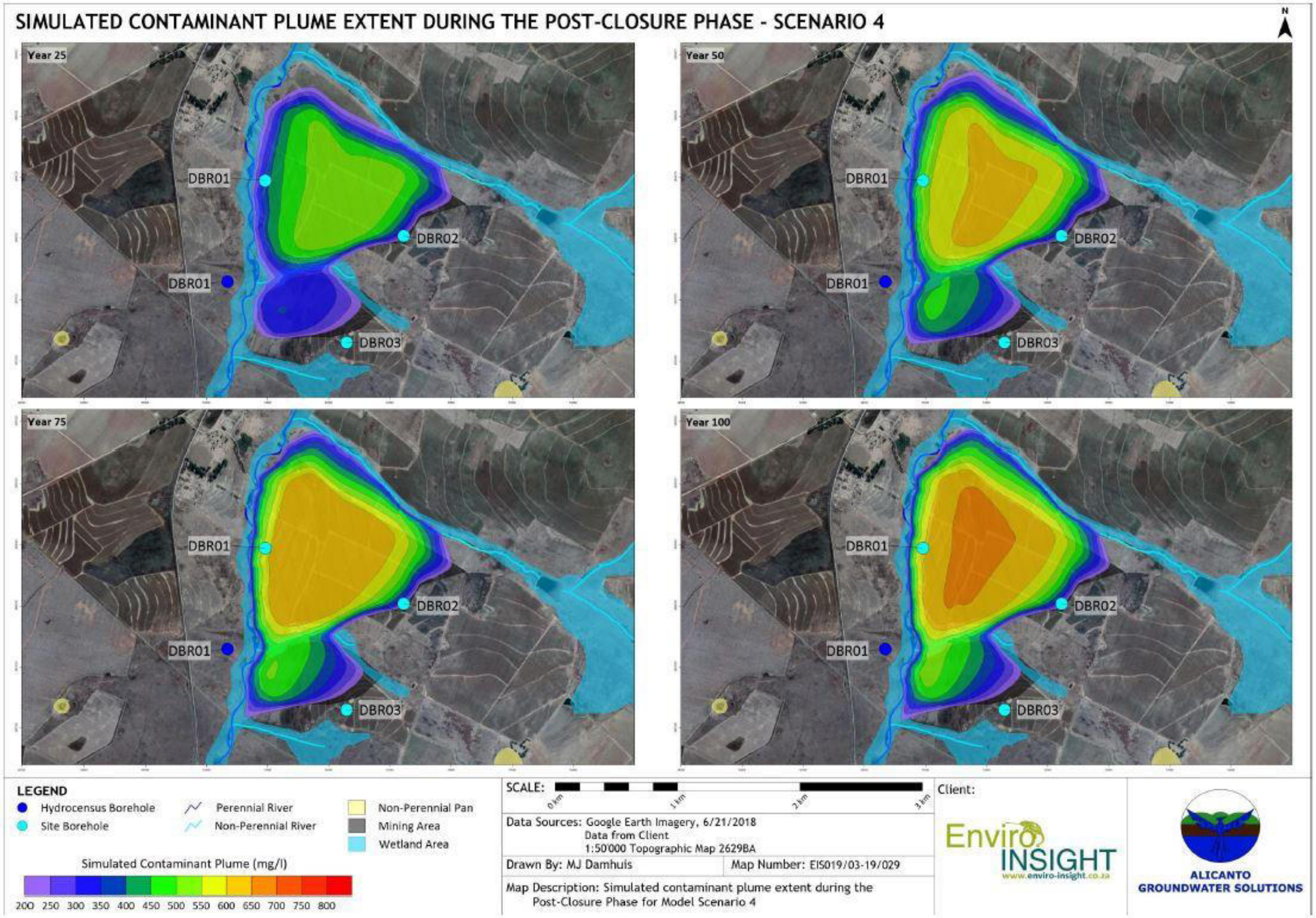


Figure 8-12: Simulated Contaminant Plume Extent (Operational Phase) - Scenario 4.

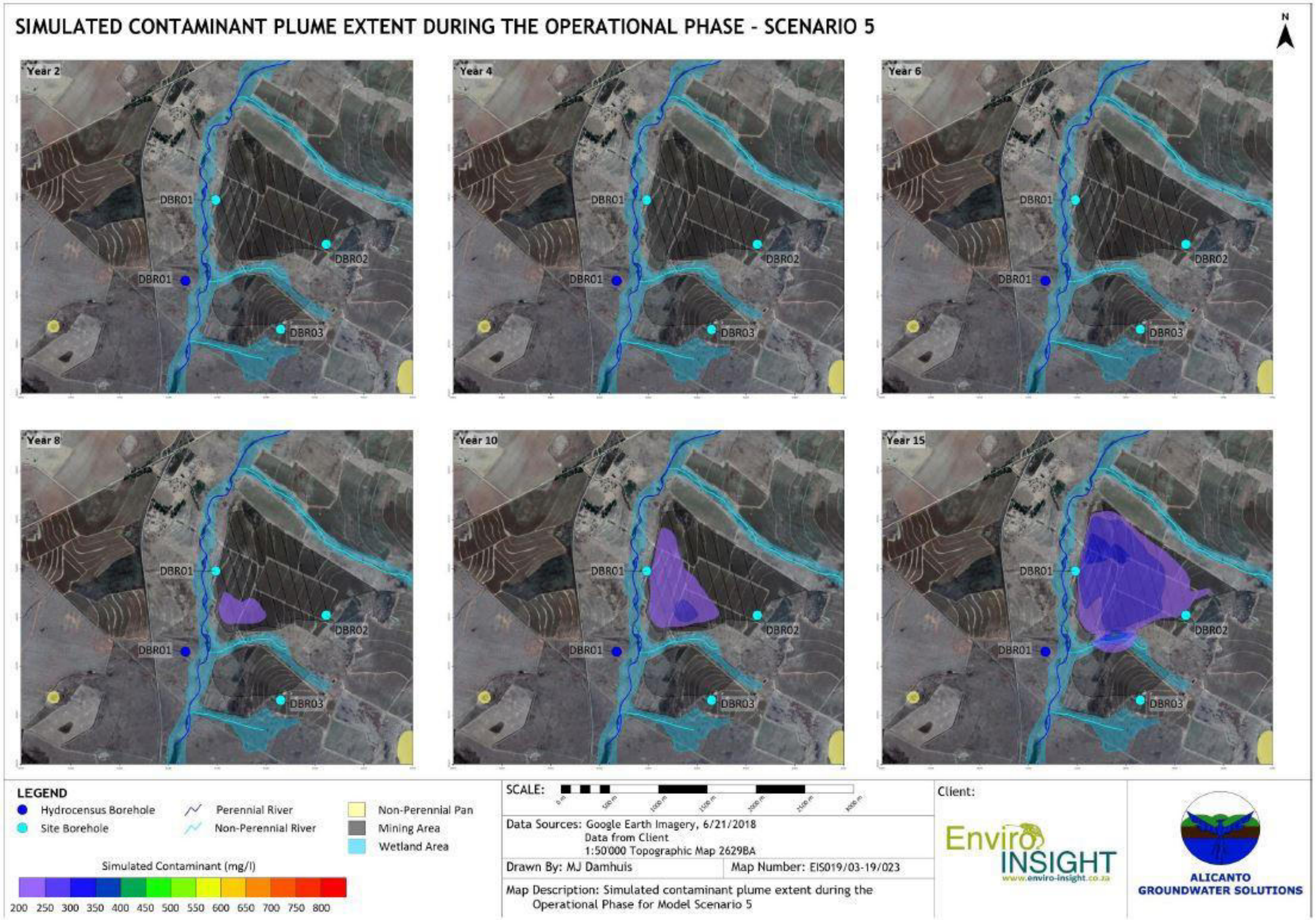


Figure 8-13: Simulated Contaminant Plume Extent (Operational Phase) - Scenario 5.

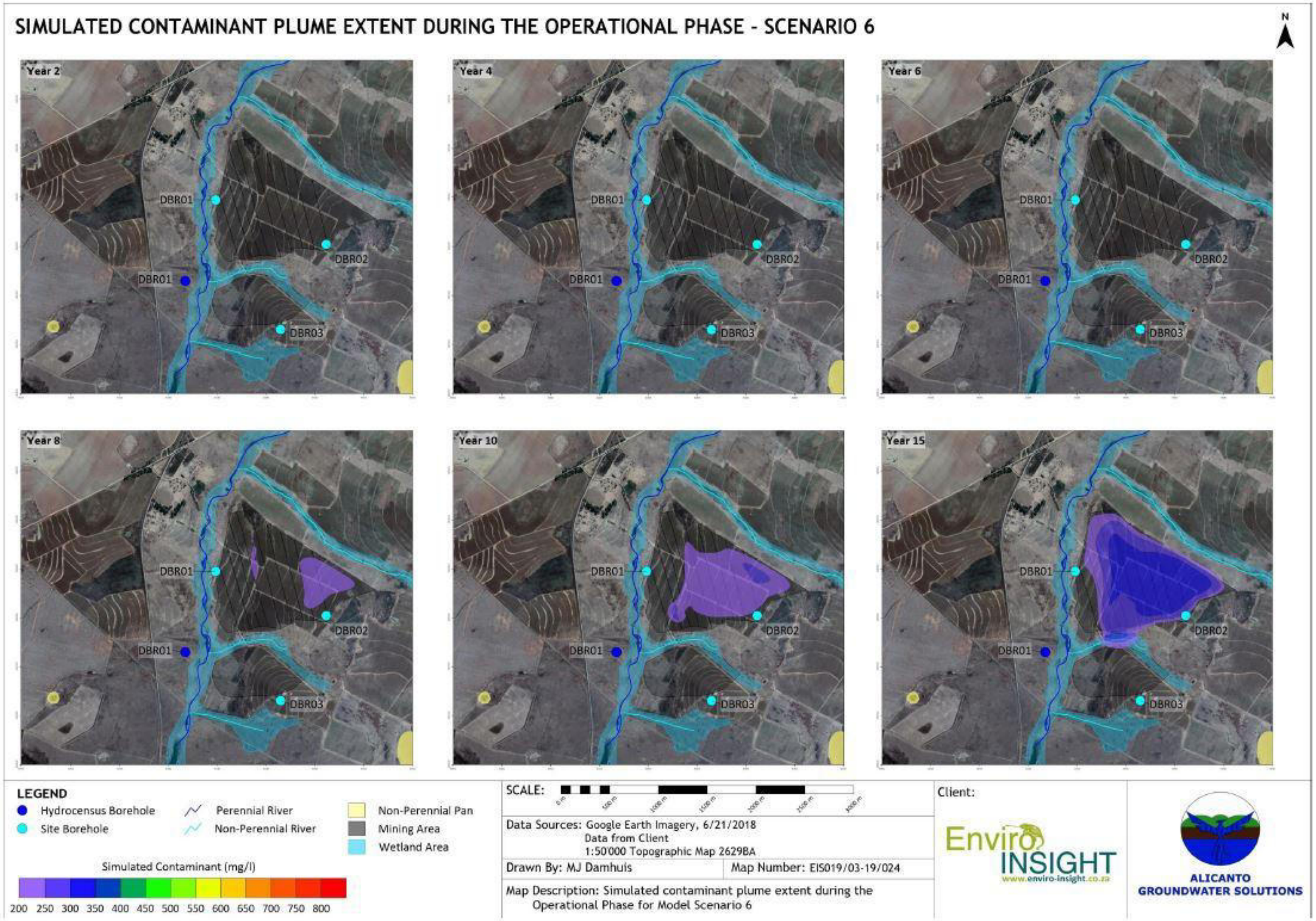


Figure 8-14: Simulated Contaminant Plume Extent (Operational Phase) - Scenario 6.

8.1.3.3 Closure/Post-Closure Phase

Following the cessation of mining activities at the Site, the opencast mining area would be the only remaining potential impact source with the other mining areas having undergone non-commissioning and rehabilitation during the closure phase of the LoM.

8.1.3.3.1 Groundwater Quantity Impacts

Following the cessation of mining activities at the Site, groundwater levels will rebound towards their natural water levels, which is a low impact for all model scenarios (Table 9.7). Based on simulations, decant is possible at the central region of Opencast 1 (Figure 9.15), with decant volumes of ~250-300 m^3/day simulated. The decant product (if any) would likely flow towards the perennial river west of the Site, therefore a medium impact rating was assigned to the Site regarding decant during the post-closure period due to the potential impact of decant on the river and wetland west of Opencast 1.

Groundwater monitoring boreholes at the Site should be monitored quarterly during the early stages of post-closure in order to identify groundwater level trends, following the implementation of which the impact rating remained low. Should decant occur at the Site, a suitable capture and treat system should be implemented and the water treated to levels suitable for discharge to the environment. The implementation of these measures will result in the impact remaining low.

Table 8-15: Groundwater Quantity Impacts during Post-Closure prior to Management/Mitigation (All Scenarios).

Description of Activity	Model Scenario	Impact Description	M	S	D	P	Risk	
Groundwater Quantity								
Groundwater Level Rebound	All Scenarios	Following the end of mining operations at the Site groundwater levels will rebound to pre-mining water levels.	2	1	4	3	21	Low
Decant	All Scenarios	Decant may occur at the Site during the rebound of water levels.	8	3	5	2	32	Medium

Table 8-16: Groundwater Quantity Impacts during Post-Closure after Management/Mitigation (All Scenarios).

Description of Activity	Model Scenario	Mitigation/Management Measures	M	S	D	P	Risk	
Groundwater Quantity								
Groundwater Level Rebound	All Scenarios	No Mitigation Required. Groundwater levels at the Site should be measured quarterly to identify groundwater level trends.	2	1	4	2	14	Low
Decant	All Scenarios	Should decant occur at the Site, a suitable capture and treat system should be implemented and the water treated to levels suitable for discharge to the environment.	6	2	5	2	26	Low

8.1.3.3.2 Groundwater Quality Impacts

During the post-closure phase, the simulated contaminant plume migrated outwards from the mining extent towards the non-perennial river west of the Site and the wetland area north of Opencast 1. The simulated concentrations were highest at the central sector of Opencast 1, reaching a maximum of ~700-750 mg/l but remaining within the mining extent throughout the simulation period. The contaminant plume extended to ~500 m west of the mining area, with no privately-owned boreholes impacted on during post-closure. The contaminant plume was fairly limited in its extent, but due to the interaction with wetland features surrounding the mining area a medium impact was assigned.

Table 8-17: Groundwater Quality Impacts during Post-Closure prior to Management/Mitigation.

Groundwater Quality								
Poor Quality Leachate	All Scenarios	Poor quality leachate generated within the backfill material used at the Site during concurrent rehabilitation may enter the groundwater system.	6	2	4	3	36	Medium

During rehabilitation at the Site, sulphide-bearing material should be placed at the base of the backfilling and covered as soon as possible with more neutral material to prevent oxidation, with a 200 mm clay layer placed on top of the backfill material to limit washout of material through water ingress. If possible, the material should be covered/inundated as soon as possible to limit oxidation potential. The implementation of these management measures would lower the impact rating to low.

Table 8-18: Groundwater Quality Impacts during Post-Closure after Management/Mitigation.

Groundwater Quality								
Poor Quality Leachate	All Scenarios	Sulphide-bearing material should be placed at the base of the backfilling and covered as soon as possible with more neutral material to prevent oxidation and a 200 mm clay layer should be placed on top of the backfill material to limit washout of material through water ingress. If possible, the material should be covered/inundated as soon as possible to limit oxidation potential.	4	2	3	3	27	Low

The simulated contaminant plume for the Base Case Scenario and Model Scenarios 1-6 are shown below.

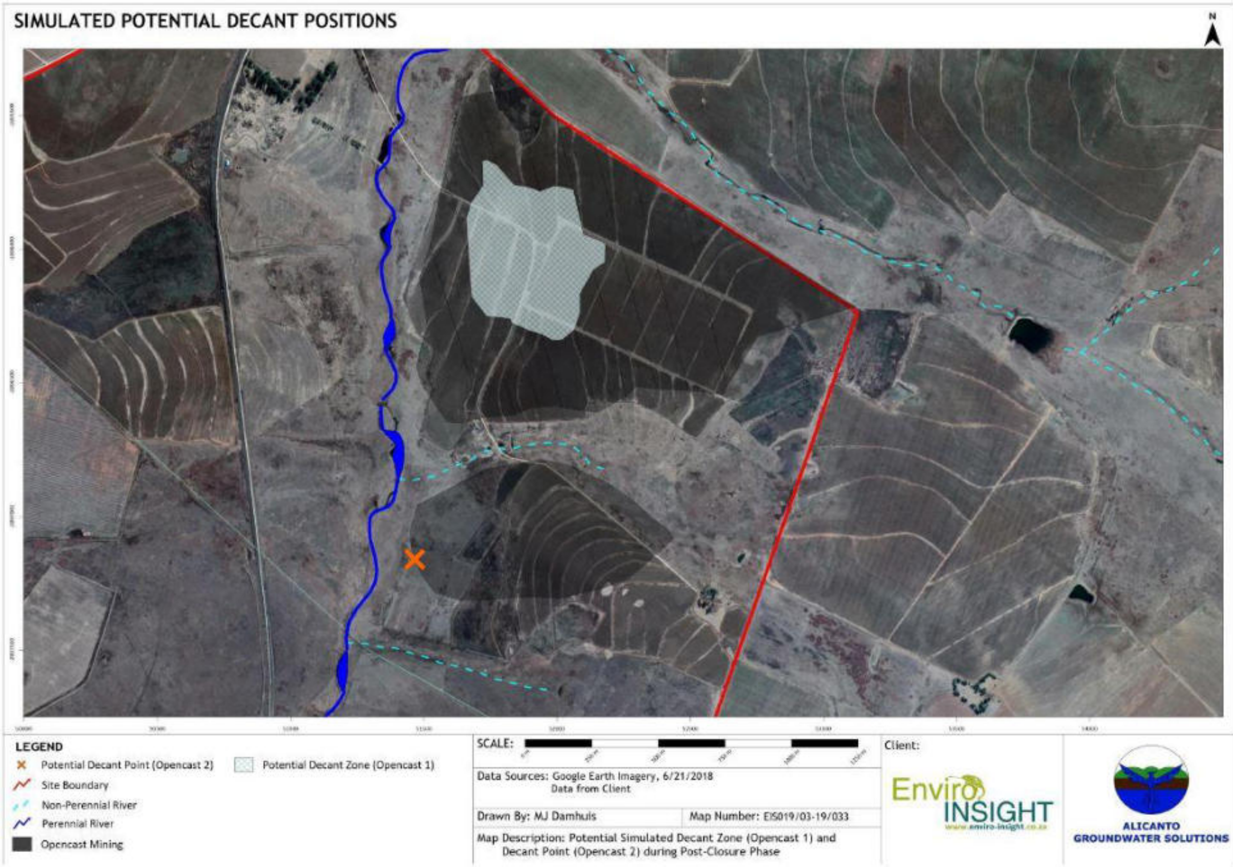


Figure 8-15: Simulated Decant Positions.

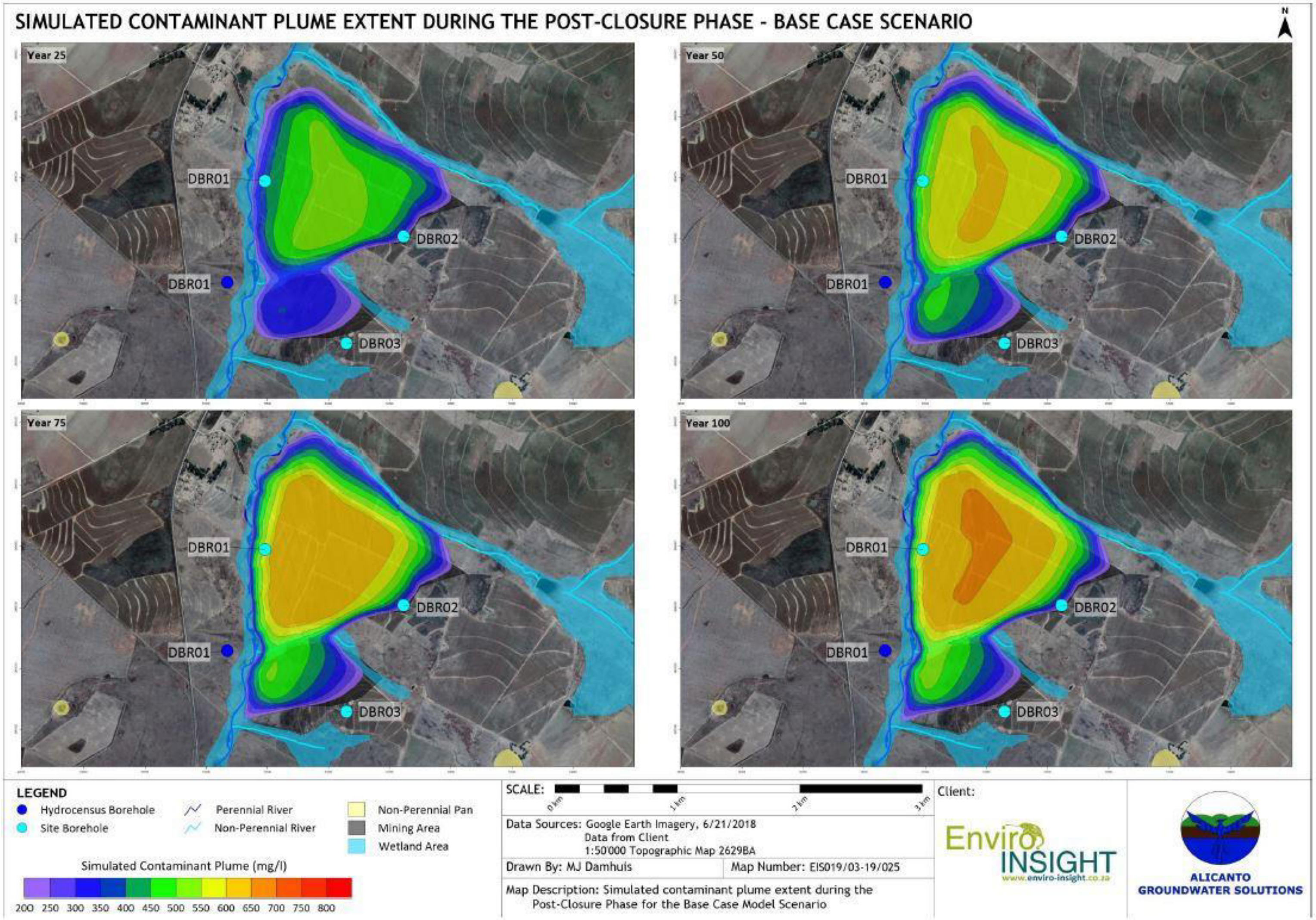


Figure 8-16: Simulated Contaminant Plume Extent (Post-Closure Phase) - Base Case Scenario.

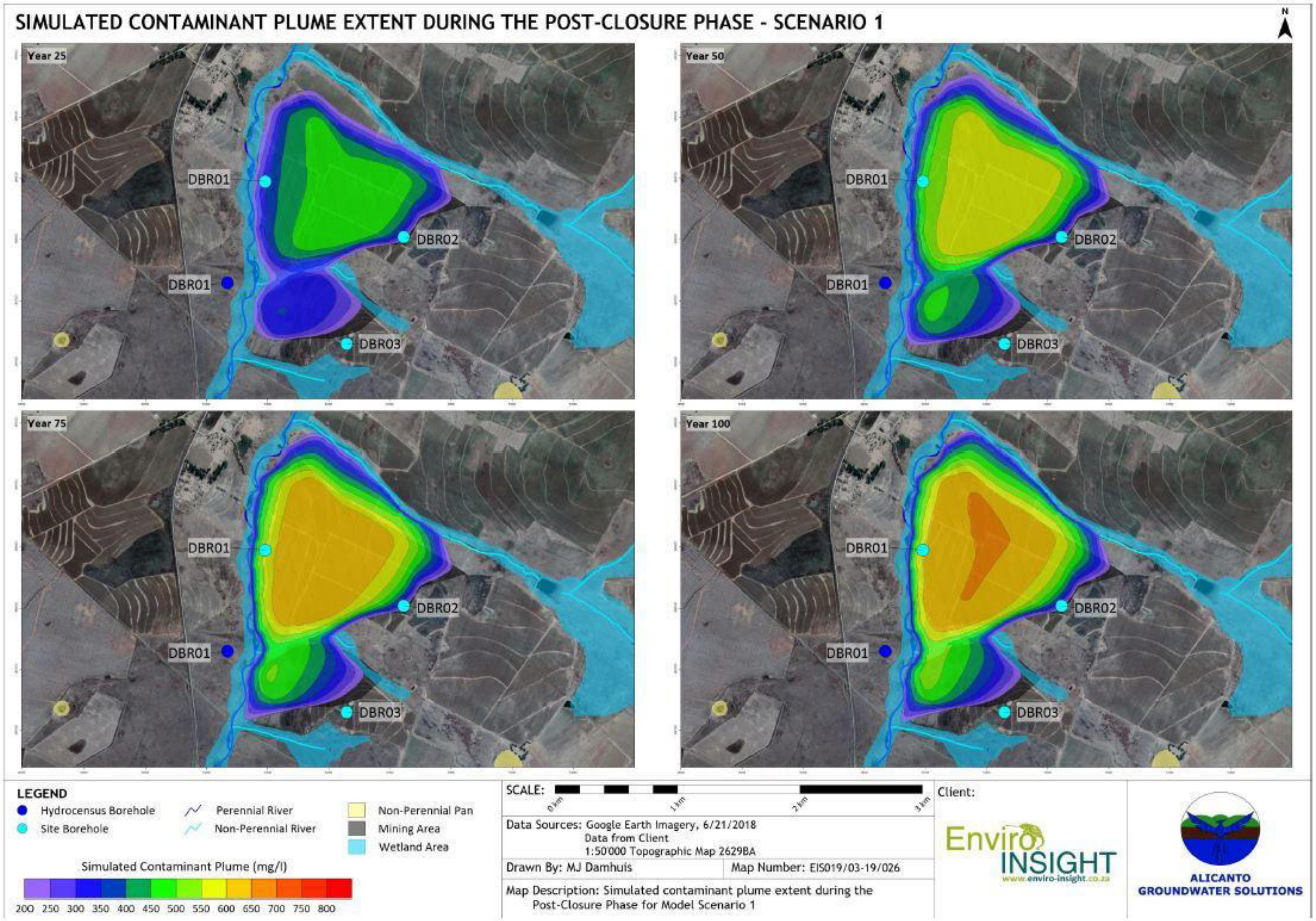


Figure 8-17: Simulated Contaminant Plume Extent (Post-Closure Phase) - Scenario 1.

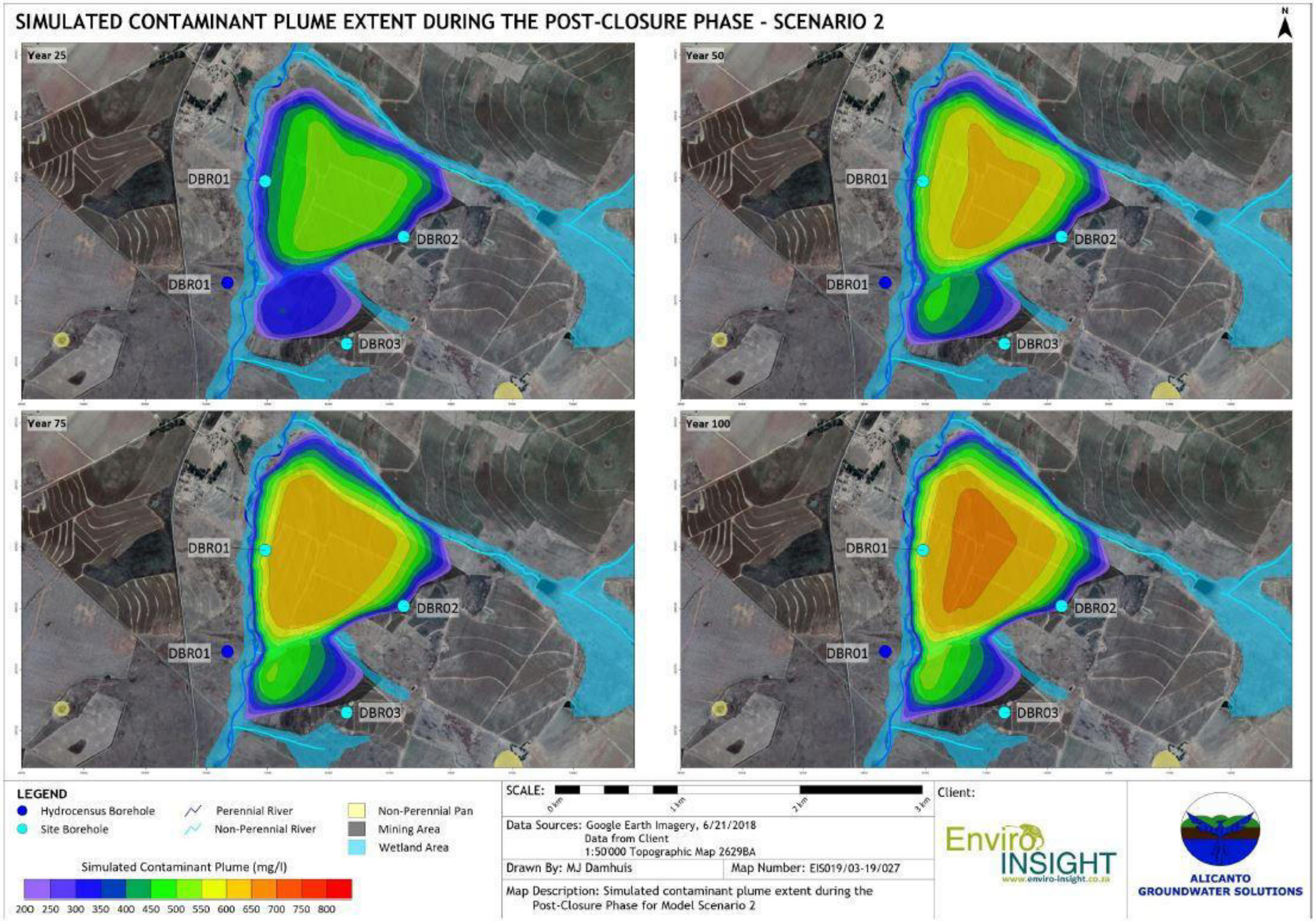


Figure 8-18: Simulated Contaminant Plume Extent (Post-Closure Phase) - Scenario 2.

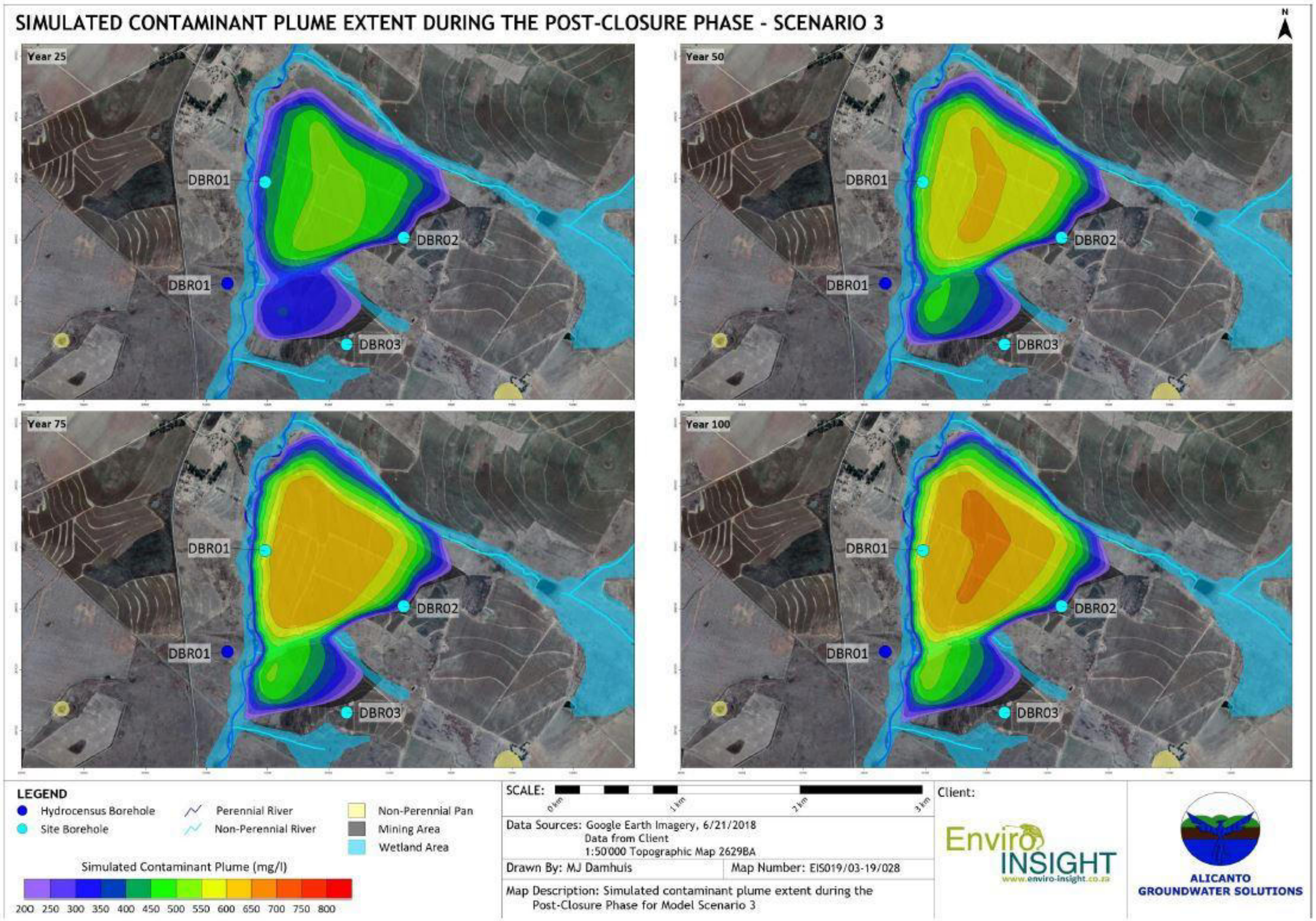


Figure 8-19: Simulated Contaminant Plume Extent (Post-Closure Phase) - Scenario 3.

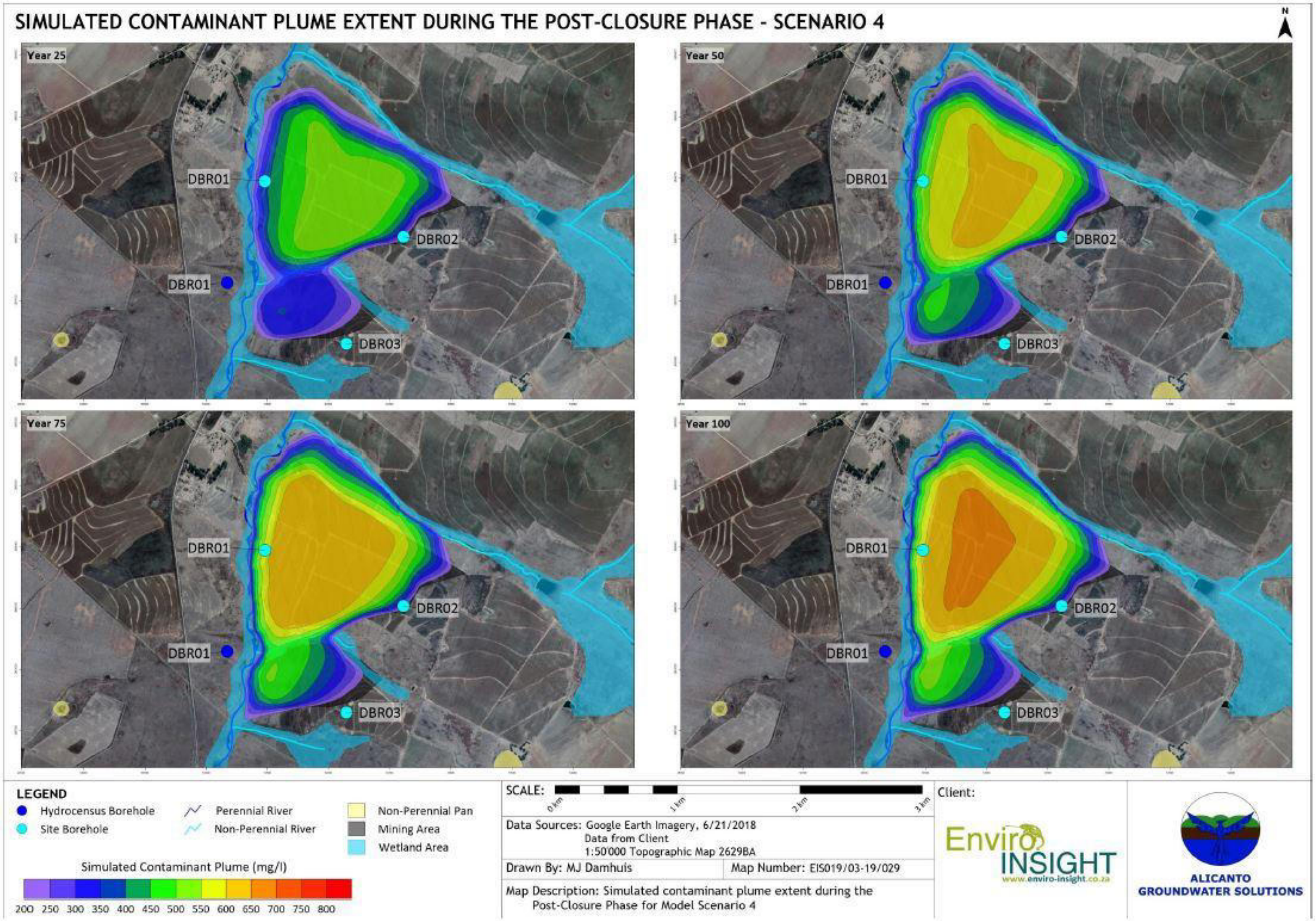


Figure 8-20: Simulated Contaminant Plume Extent (Post-Closure Phase) - Scenario 4.

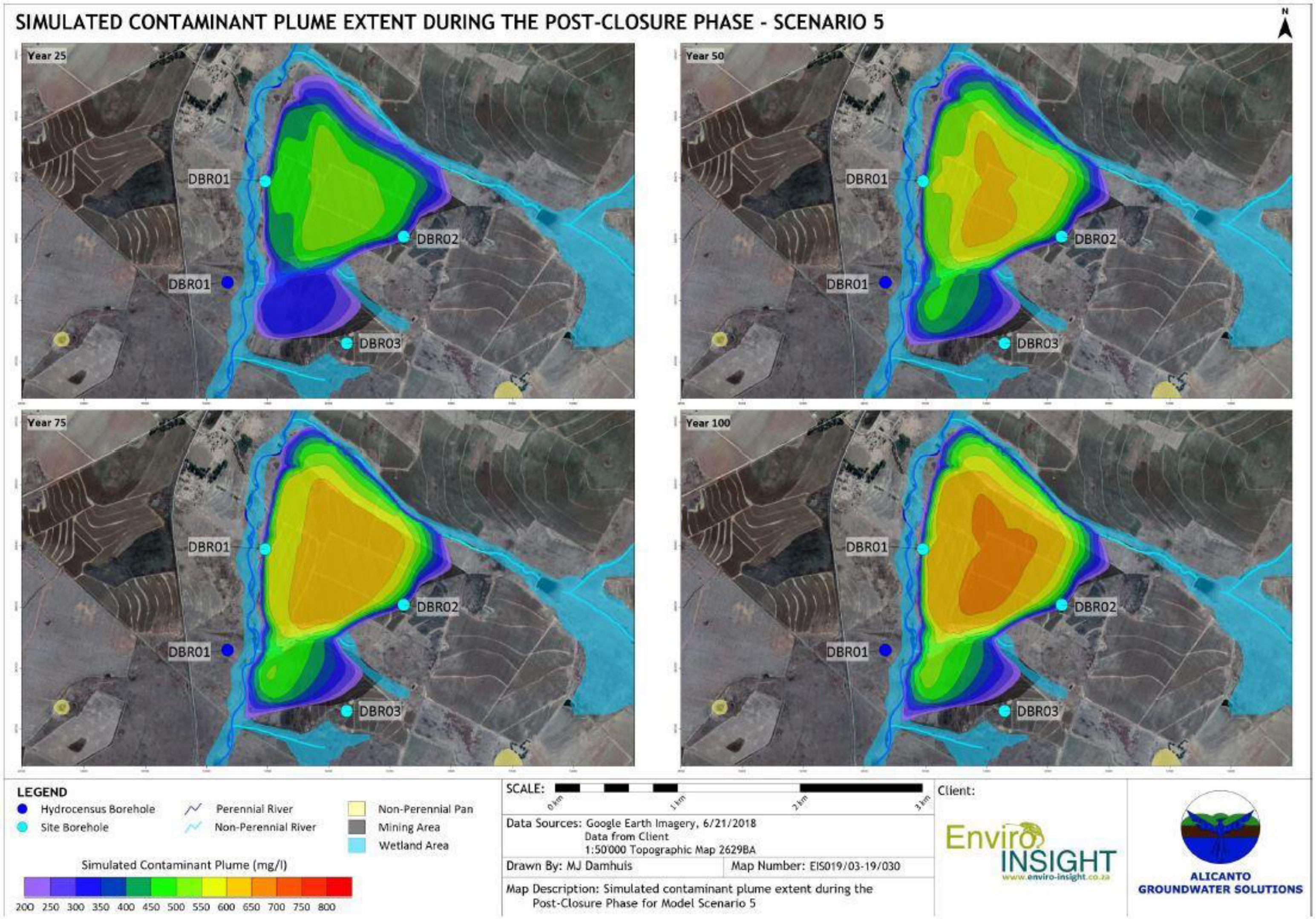


Figure 8-21: Simulated Contaminant Plume Extent (Post-Closure Phase) - Scenario 5.

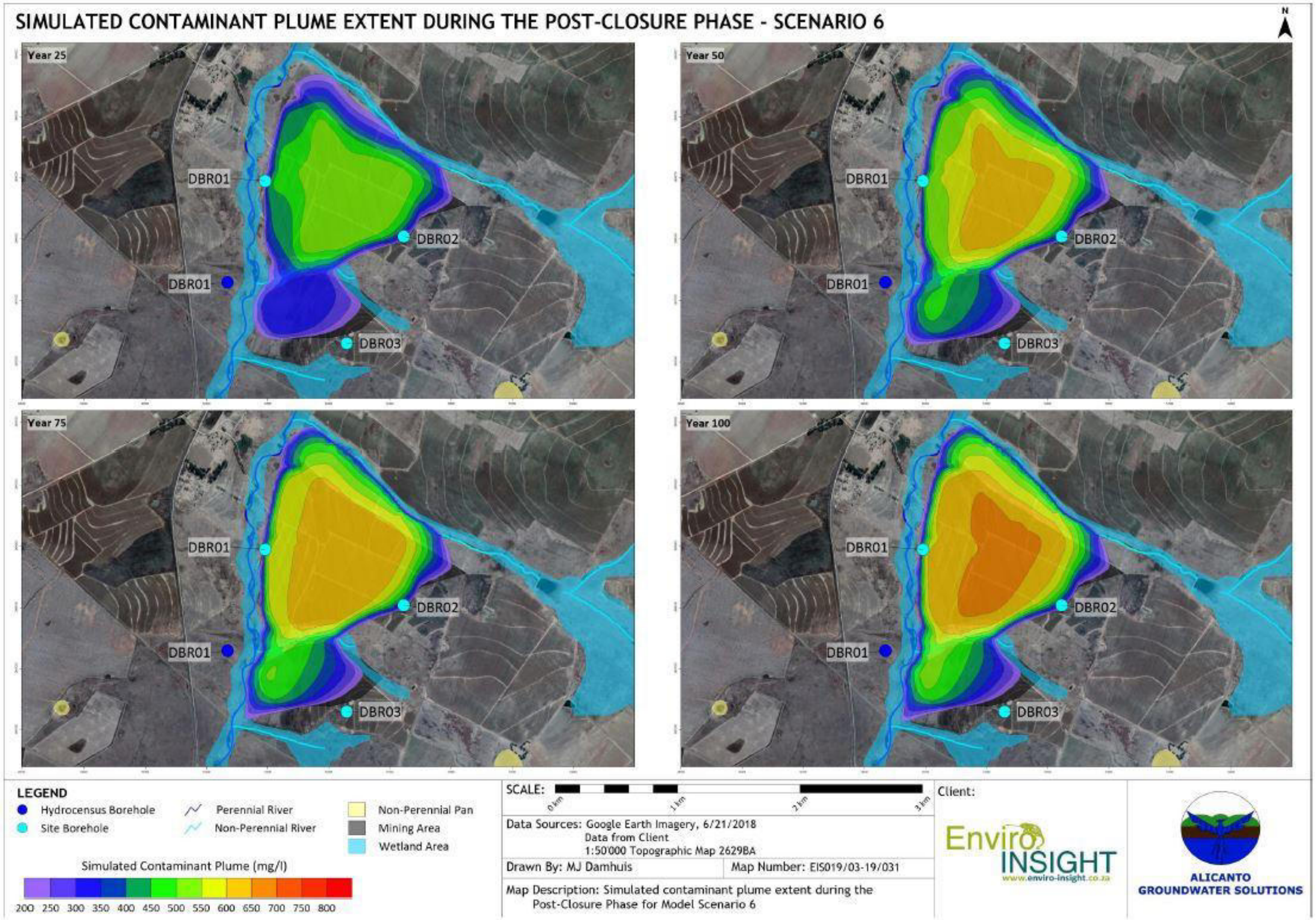


Figure 8-22: Simulated Contaminant Plume Extent (Post-Closure Phase) - Scenario 6.

8.1.4 Terrestrial Ecology

8.1.4.1 Loss of existing habitat due to clearing of vegetation

a. Physical removal of vegetation
   i. Digging and laying foundations for the mine processing plant, infrastructure (roads) and pits [Construction & Operation] – *direct habitat loss of grassland as vegetation and soil is removed, although the majority of the area is currently used for agriculture;*
   ii. Construction camps & laydown areas [Construction] - *these areas need to be cleared of vegetation for safe operation and therefore the available habitat for terrestrial fauna species will be reduced;* and
   iii. Stochastic events such as fire (e.g. cooking fires or cigarettes of workers) [Construction & Operation] - *careless discarding of lit cigarette butts and/or glowing embers from cooking fires being blown into surrounding vegetation may cause runaway fires to temporarily remove or alter habitat for terrestrial fauna.*
b. Secondary impacts associated with the loss of habitat and removal of vegetation
   i. Displacement/loss of flora & fauna (including rare or endangered species and important habitats) - *the removal of habitat, in particular vegetation, will directly result in the loss of flora species, and indirectly affect fauna reliant on this vegetation for foraging and/or refugia;*
   ii. Soil erosion due to vegetation clearing and earthworks [Construction] – soil *erosion caused by wind and rain will occur on bare earth. Such erosion undermines the stability of the habitat and reduces overall habitat quality for flora and fauna, including in aquatic habitats (due to siltation);* and
   iii. Establishment of alien and invasive vegetation – *alien and invasive flora may establish in areas cleared of natural vegetation and spread from these sites, reducing available natural habitat and habitat quality for flora and fauna.*
c. Impact Assessment (Pre-mitigation) – Refer to Table 8-19.
d. Mitigation and Enhancement Measures
   i. Clearings associated with construction and development area to occur in as small a footprint as possible;
   ii. Vegetation clearing close to the watercourse should be prevented from occurring within the 100 m buffer and where necessary, appropriate storm water management should be put in place to limit erosion potential of exposed soil. Sedimentation trapping should be in place to prevent exposed soils from spilling into the watercourse;
   iii. The watercourse and its buffer areas should be demarcated and fenced off prior to construction to exclude the watercourse from development activities;
   iv. Buffer zones are allocated to sensitive or important habitat features to alleviate the effect of habitat loss, habitat fragmentation, disturbances, increased isolation and edge effects. It is suggested that at least a 100 m buffer zone from the watercourse must be implemented as a wildlife support area;
   v. A further verification for SCC should take place after significant rains have fallen and prior to any construction activities followed by an updated evaluation of habitat sensitivities;
   vi. Earthworks and vegetation clearing should be left open for as short a time as possible. Temporary erosion control measures during the construction phase should be implemented to limit erosion;
   vii. Re-vegetation (with naturally occurring flora) where required after clearance should commence immediately after the construction phase;
   viii. Re-vegetation (with naturally occurring flora) as part of the rehabilitation phase post-mining is critical to re-establish the baseline environment pre-mining conditions;
   ix. Alien vegetation control should take place during all phases of the proposed operation, including the pre-construction phase (to limit the likelihood of seed dispersal) and rehabilitation phase (post-construction); and

x. An environmental induction for all staff members must be mandatory in which specific issues related to the potential of fire are addressed e.g. only smoking in designated areas, no open cooking fires etc.

e. Impact Assessment (Post-mitigation) – Refer to Table 8-20.
f. Residual impacts –
   i. A degree of erosion will take place during the construction phase but proper mitigation will reduce the residual impacts to acceptable levels and should not have an effect on sensitive habitats; and
   ii. The spread of alien species is likely to occur and should be continuously controlled.
   iii. Despite minimizing habitat loss an amount of habitat must be removed for the mining infrastructure during the of life of the mine; and
   iv. Disturbance of topsoil in the overburden will hamper restoration attempts after mine closure.
g. Uncertainty – The degree to which this development could impact on SCC and their habitat outside of the proposed mining infrastructure areas.

8.1.4.2 Direct mortality of fauna

- Project components that can cause direct mortality of fauna:
   i. Staff or construction workers poaching [Construction & Operational phase] - *Several fauna species could be hunted and consumed by staff to supplement their protein requirements*;
   ii. Direct mortality due to collisions with vehicles (roadkill) [Construction & Operational phase] - *Vehicles are defined as support vehicles (e.g. bakkies / pickups), staff vehicles (light passenger vehicles), large and slow moving construction vehicles (such as earth moving equipment/trucks) that will be either self-propelled or towed (construction phase). There will be increased traffic volumes during each phase of the project, and this will extend over multiple years. Reptiles, amphibians, small mammals and avifauna are prone to collisions with fast moving vehicles as they do not move out of the way upon approach by a vehicle. Furthermore, vehicle drivers rarely see small fauna on the road surface or avifauna flying across, and cannot avoid collisions with these animals while travelling at high speed;*
   iii. Intentional killing of fauna [Construction & Operation] - *In general people are either superstitious or extremely fearful of snakes which usually results in the death of the snake when it is encountered. Despite the beneficial ecological functions of snakes such as rodent control, snakes are usually considered to be dangerous (despite the many non-venomous species) and are therefore killed;*
   iv. Loss of SCC [Construction & Operation] – *If residing at the location of the mine pits or infrastructure, all individuals will either be killed or have to move away and face competition with conspecifics*; and
   v. Direct mortality due to vegetation clearing and ground preparation for construction [Construction] - *The clearing of vegetation with machinery followed by the preparation of ground surfaces for construction is expected to result in the direct mortality of fauna by mechanical action (cutting, grinding and crushing), especially for burrowing fauna.*
- Secondary impacts associated with direct mortality of fauna
   i. Changes in fauna population dynamics (e.g. rodent population explosion) – *for* example, *prolonged mortality or exclusion of predacious species such as snakes could significantly reduce the population density of these predators and allow prey species to undergo localised population explosions. This in turn can have major negative impacts on the surrounding ecology, including agricultural yields.*
- Impact Assessment (Pre-mitigation) – Refer to Table 8-19.
- Mitigation and Enhancement Measures

i. All vehicle speeds associated with the project should be monitored and should be limited to 40 km/h (maximum) while within the site during the construction and operation phases, or as prescribed by the Traffic Impact Assessment;
ii. Speed restriction bumps should be erected in the main road to reduce the speed of all vehicles making use of this road;
iii. The ECO should monitor live animal observations in order to monitor trends in animal populations and thus implement proactive adaptable mitigation of vehicle movements, especially in close proximity to any wetlands;
iv. Road mortalities should be monitored by both vehicle operators (for personal incidents only) and the ECO (all road kill on a periodic monitoring basis as well as specific incidents) with trends being monitored and subject to review as part of the monthly reporting. Monitoring should occur via a logbook system where staff takes note of the date, time and location of the sighting/incident. This will allow determination of the locations where the greatest likelihood exists of causing road mortality and allow mitigation against it (e.g. fauna underpasses, and speed reductions mentioned above). Finally, mitigation should be adaptable to the onsite situation which may vary over time;
v. Reduce direct mortalities by allowing for fauna to cross the roads. This can be achieved by constructing fauna underpasses under the roads (large culverts or large open-ended concrete pipes laid into the raised roads). These underpasses should be used in conjunction with "fauna barriers" which prevent the most susceptible small fauna from crossing the roads on the surface by directing them towards the underpasses where they can cross under the roads safely. It is important to note that utilization of underpasses is strongly dependent on animal body size (larger culverts are more successful) and the surrounding habitat;
vi. All staff operating motor vehicles must undergo an environmental induction training course that includes instruction on the need to comply with speed limits, to respect all forms of wildlife and, wherever possible, prevent accidental road kills of fauna. Snakes should only be handled after inductions have taken place due to the risks of envenomation. Drivers not complying with speed limits should be subject to penalties;
vii. A pre-construction survey must be conducted in order to verify the presence of Secretary Bird nesting locations;
viii. All potential African Grass Owl habitat will be subjected to rope flushing and intensive nest inspections in order to determine the presence/ absence of individuals within the mine footprint and the presence of breeding activity, leading to appropriate relocation procedures for chicks only if and where appropriate; and
ix. A wet season supplementary survey is required in order to determine the presence SCC and update the species inventory for monitoring purposes. This should include a Giant bullfrog assessment, updated flora species list, camera trapping and a follow-up avifaunal census.

- Impact Assessment (Post-mitigation) – Refer to Table 8-20.
- Residual impacts
  - It is not possible to avoid all faunal deaths but proper mitigation will reduce the residual impacts to acceptable levels.
- Uncertainty – The degree to which this development could impact on avifauna SCC breeding habitat.

8.1.4.3 Disruption / alteration of ecological life cycles (breeding, migration, feeding) due to the restriction of species movement (migration/dispersal)

a. Project components that can cause disruption/alteration of ecological lifecycles due to restricted movement:

i. Open trenches and other linear barriers [Construction & Operation] – *Deep trenches dug during the construction phase for the laying of foundations/pipelines will represent dispersal barriers for certain fauna and may also trap certain species;* and
ii. Infrastructure [Construction & Operation] – *The large development footprint will hinder fauna movement and may even trap some species in the pit (e.g. amphibians). As the infrastructure area is located close to a watercourse, aquatic species including reptiles, amphibians, mammals and birds could be affected. The open pit mine will also remove breeding and feeding habitat for numerous species, including Tyto capensis.*

b. Secondary impacts associated with disruption/alteration of ecological lifecycles
i. Reduced population viability [Construction] – *Restriction of movement and trapping of certain animals prevents genetic exchange and the ability to escape to more favourable habitats, ultimately leading to a reduction in population viability.*

c. Impact Assessment (Pre-mitigation) – Refer to Table 8-19.
d. Mitigation and Enhancement Measures
i. Excavated trenches must be left open for as short a time as possible to avoid acting as dispersal barriers or traps;
ii. All open excavated trenches for the infrastructure phase must have at least one of the slopes with an angle of less than 45° to allow for trapped fauna to crawl out;
iii. Barriers that restrict fauna from falling into the mining pit should be erected; and
iv. Pathways such as the Leeufonteinspruit watercourse serve as a migration corridor that ensures safe movement of species across the landscape and all activities within a 100 m buffer of this shall be prohibited;

e. Impact Assessment (Post-mitigation) – Refer to Table 8-20.
f. Residual impacts – None
g. Uncertainty – None

8.1.4.4 Disruption / alteration of ecological life cycles surrounding mining infrastructure (breeding, migration, feeding) due to noise, dust and lighting [Construction & Operation]

a. Project components that can result in increased noise, dust and lighting:
i. Access roads and construction works [Construction & Operation] – *Noise, dust and lighting generated from moving vehicles operating on access roads and from machinery on site can disrupt fauna populations by interfering with their movements and/or breeding activities. In particular, lighting at night is expected to attract insects which will attract geckos and amphibians which in turn can attract snakes (which might be venomous). Lighting at night may also disrupt flight paths of migrating birds and bats foraging at night which could cause collisions;* and
ii. Mining operations [Operation] - *Lighting at night may disrupt flight paths of migrating birds and bats foraging at night which could cause collisions. Also noise generated at night (especially from blasting) could disrupt nocturnal faunal activities, especially close to the watercourse. Fly-rock from blasting could also affect faunal species moving too close to the site, and damage the surrounding habitat where species forage or breed. In particular, dust from the actual mining operation will settle on the adjacent vegetation can reduce photosynthesis which may have indirect effects on fauna.*

b. Secondary impacts associated with disruption/alteration of ecological lifecycles
i. Increased probability of interaction with reptiles – *As described above, snakes may be attracted to potential prey due to lights and represent a potential health and safety threat. In addition, reptiles attracted to site such as snakes could be killed by staff on site.*

c. Impact Assessment (Pre-mitigation) – Refer to Table 8-19.

d. Mitigation and Enhancement Measures

i. Equipment with low noise emissions must be used;
ii. A dust monitoring system should be implemented during the construction phase;
iii. Water or dust control agents should be used in working areas and roads will be sprayed for dust suppression on a regular basis in designated susceptible areas during heavy usage;
iv. Reduce exterior lighting to that necessary for safe operation, and implement operational strategies to reduce spill light. Use down-lighting from non-UV lights where possible, as light emitted at one wavelength has a low level of attraction to insects. This will reduce the likelihood of attracting insects and their predators;
v. Keep noise levels suppressed as per the local municipality or national standards. Do not unnecessarily disturb faunal species, especially during the breeding season and those with juveniles;
vi. Where possible restrict blasting to daylight hours;
vii. Erect standard diamond mesh fences (2 -3 m high) as barriers to keep fauna species away from the mining operations to reduce impacts from blasting and habitat destruction, the fence must encompass the entire mine pit footprint as well as the Intact Grassland between the two pits, separating the watercourse from the mine activities. Where possible the fence should be separated from mining activities by up to 200 m;
viii. All staff should be subjected to an induction training program where appropriate conservation principles, safety procedures, snake bite avoidance and first aid treatment are taught. Several staff members should complete a snake handling course in order to safely remove snakes from construction areas; and
ix. Ongoing periodic avifaunal monitoring will take place at pre-determined monitoring points associated within highly sensitive habitats within the area of influence of the mine (e.g. *Imperata cylindrica* stands within 100 m of the mining operations).

e. Impact Assessment (Post-mitigation) – Refer to Table 8-20

f. Residual impacts –

- Despite mitigation reducing the severity of the impact, the long duration and high frequency of the impact will result in unavoidable residual impacts.

g. Uncertainty – The radius of the fly-rock, noise and vibration from blasting, i.e. the affected area.

8.1.4.5 Introduction and proliferation of alien and/or invasive flora affecting native flora and faunal assemblages

a. Project components that can result in increased densities of alien flora:
   i. Vehicles and machinery [Construction & Operation] – *Vehicles and machinery can spread alien plant seeds throughout the PAOI which could potentially spread into the adjacent (natural) areas. Alien plants can cause alterations to the environment which could affect local flora and fauna, especially since the PAOI is located within a threatened ecosystem;*
   ii. Soil Disturbance [Construction & Operation] – *Seeds lying dormant for years could germinate when the soil is disturbed, especially since Category 1 and 2 alien invasive species occur on site; and*
   iii. Stockpiles [Construction & Operation] – *the various stockpiles could accumulate alien and/or invasive flora species over the life of mine, which could spread into the surrounding natural areas.*
b. Secondary impacts associated with increased alien flora and fauna species
   i. Displacement of native species due to competition and/or unfavourable habitats due to alien establishment.

c. Impact Assessment (Pre-mitigation) – Refer to Table 8-19.
d. Mitigation and Enhancement Measures
   i. Alien flora on site should be eradicated prior to construction including all Category 1 and 2 alien invasive species. Any remaining alien flora post-construction should be monitored and removed as part of the management plan;
   ii. Disturbance of natural areas should be avoided and the spread of alien flora into natural areas should be controlled;
   iii. Continuous monitoring of the growth and spread of alien flora coupled with an adaptive management approach to identify suitable control mechanisms, preferably mechanical for such a small area. No chemical control should take place within a 50 m buffer of the watercourse;
   iv. No planting of alien invasive species as part of landscaping. Only trees indigenous to the vegetation unit and endemic to the area may be planted, even if only for visual purposes. This should be indicated prior to development and approved by the competent authority;
   v. Stockpiles to be vegetated with suitable indigenous species to prevent erosion and establishment of alien and invasive flora; and
   vi. Rehabilitation post-mining operations should include an Alien and Invasive species monitoring and eradication action plan, in order to ensure that the spread and establishment of Alien and Invasive species are controlled and monitored (starting from the operational phase of the mine) and that disturbances post-mining are minimal and mitigated where necessary. The site needs to be restored to its previous condition/ land-use.
e. Impact Assessment (Post-mitigation) – Refer to Table 8-20.
f. Residual impacts
   - Despite mitigation the establishment of aliena and invasive species will occur continuously and must therefore also be continuously managed to attempt to limit the degree and spread of infestation.
g. Uncertainty – The types of alien species that might be dormant within the soil seed bank. The management of alien flora remains a global issue with the success of control measures highly dependent on the management strategy as well as resources available (e.g. financial and intellectual).

8.1.4.6 Increase in erosion reduces habitat quality & quantity

a. Project components that can cause an increase in erosion:
   i. Vegetation clearing and earthworks [Construction and Operation] –*Vegetation clearing and earthworks will lead to erosion caused by wind and rain. Such erosion undermines the stability of the habitat and reduces overall habitat quality for fauna and flora.*
   ii. Water runoff [Construction and Operation] – *Increased erosion could occur from increased water runoff due to artificial surfaces, which could cause increased sedimentation build-up within the watercourses.*
b. Secondary impacts associated with increased erosion
   i. Establishment of alien and invasive vegetation – *as alien and invasive flora establish and spread across the site (due to disturbed soils) it reduces available natural habitat and habitat quality for fauna*.
c. Impact Assessment (Pre-mitigation) – Refer to Table 8-19
d. Mitigation and Enhancement Measures

   i. Earthworks and vegetation clearing should be left open for as short a time as possible during the construction phase. Erosion control methods during the construction phase should be implemented to limit erosion;
   ii. Re-vegetation after clearance should commence directly after the construction phase; and
   iii. An effective stormwater management plan with sedimentation traps implemented during the construction and operational phases of the project.

e. Impact Assessment (Post-mitigation) – Refer to Table 8-20
f. Residual impacts – A minor degree of erosion is unavoidable during the construction phase but proper mitigation will reduce the residual impacts to acceptable levels.
g. Uncertainty – The effective implementation of a stormwater management plan.

8.1.4.7 Watercourse contamination due to dust pollution

a. Project components that can cause increase dust pollution of watercourses:
   i. Mining operations [Operation] – *Dust spillage from trucks or cumulative siltation caused by prevailing winds, especially close to the watercourse, can cause dust to settle in watercourses, and their surrounding vegetation. This dust can cause siltation and eutrophication of the aquatic habitats and also alter the chemical composition thereof, particularly if coal dust blows into the surrounding landscape. Dust siltation could dramatically affect site suitability for avifauna and herpetofauna species utilising the watercourse as breeding and foraging habitat of this area is likely to have high species diversity and abundance.*
b. Secondary impacts associated with increased dust pollution:
   ii. Mining operations [Operation] – *Dust spillage from trucks or cumulative siltation caused by prevailing winds, especially close to the watercourse, can cause habitat loss and remove the effectiveness of it as a migratory corridor.*
c. Impact Assessment (Pre-mitigation) – Refer to Table 8-19
d. Mitigation and Enhancement Measures
   i. Windbreak (dust suppression) panels must be installed in order to line the entire western boundary of the mining pits to protect the Leeufonteinspruit watercourse adjacent to the project from excessive dust;
   ii. Dust impacts on the watercourse must be monitored and reduced to zero; and
   iii. A comprehensive monitoring program for both avifauna and amphibians must be implemented on a seasonal basis for life of mine.
e. Impact Assessment (Post-mitigation) – Refer to Table 8-20
f. Residual impacts –. It is unlikely that dust impacts can be completely negated by the mitigation measures proposed and therefore, some residual impacts can be expected from this impact. The severity of these residual impacts will require monitoring and adaptive mitigation.
g. Uncertainty – Watercourse fauna species affected (to be completed during wet season supplementary survey) and degree to which this impact can be effectively mitigated.

8.1.4.8 Watercourse contamination due to hydrocarbon pollution

a. Project components that can cause hydrocarbon contamination of watercourse:

i. *Hydrocarbon spillage from trucks and vehicles close to the watercourse can severely contaminate the associated watercourses. Serious spills (e.g. from tankers) can dramatically affect mortality rates of avifauna, mammals and herpetofauna species utilising the watercourse as breeding and foraging habitat. Standing vehicles and machinery may leak hydrocarbons which can be washed into the surrounding watercourses during rainfall events. Similarly, the spillage of hydrocarbons during the servicing of construction vehicles on site can lead to the pollution of watercourse and surrounding habitats.*

b. Secondary impacts associated with contamination of watercourse
    ii. Mining operations [Operation] – *Hydrocarbon spillage from trucks can cause habitat loss and remove the effectiveness of it as a migratory corridor; and*
    iii. *Pollution of water downstream.*

c. Impact Assessment (Pre-mitigation) – Refer to Table 8-19

d. Mitigation and Enhancement Measures
    i. Zero tolerance for hydrocarbon spillage next to the watercourse – all mining activities within 100 m of the watercourse to be prohibited;
    ii. No vehicles or machinery are allowed within the buffer areas of the watercourse. Predetermined areas should be indicated where vehicles and machinery are to be stored, repaired and refueled within a bunded area;
    iii. Use of drip trays positioned under stationary vehicles to collect hydrocarbons is mandatory at all times;
    iv. Implementation of rapid response emergency spill procedures to deal with spills immediately, including training of staff to deal with such instances; and
    v. Ongoing monitoring of presence of hydrocarbons in the watercourse should be done by an aquatic specialist as well as monitoring of the avifauna and herpetofauna assemblages within potentially affected watercourses.

e. Impact Assessment (Post-mitigation) – Refer to Table 8-20

f. Residual impacts – None

g. Uncertainty – fauna species affected (to be completed during wet season supplementary survey).

Table 8-19: The pre-mitigation impacts from the proposed development on fauna and flora.

Impact	**Impacts Status**	**Spatial scale**	**Duration**	**Frequency**	**Probability**	**Severity**	**Significance value**	**Significance rating**
Loss of existing habitat due to loss of vegetation								
Physical removal of vegetation	Negative	2	5	3	5	4	88	Medium – High
Construction camps & lay down areas	Negative	2	2	3	5	4	64	Low – Medium
Stochastic events such as fire	Negative	3	3	3	4	4	70	Low – Medium
Direct mortality of fauna								

Staff or construction workers poaching and hunting	Negative	3	4	2	3	3	50	Low
Collisions with vehicles	Negative	4	4	4	5	4	108	High
Intentional killing of fauna	Negative	3	4	3	4	3	70	Low – Medium
Vegetation and ground clearing	Negative	3	3	3	5	3	64	Low – Medium
Disruption/alteration of ecological life cycles due to the restriction of species movement (migration/dispersal)								
Open trenches and other linear barriers	Negative	1	4	4	4	4	72	Low – Medium
Infrastructure	Negative	3	4	5	3	2	72	Low – Medium
Open pit mine	Negative	3	4	5	4	4	99	Medium – High
Disruption/alteration of ecological life cycles (breeding, migration, feeding) due to noise, dust and lighting								
Access roads and construction works	Negative	3	4	5	4	4	99	Medium – High
Mining operations	Negative	3	4	5	5	4	110	High
Introduction of alien flora affecting native faunal assemblages								
Vehicles and machinery	Negative	4	5	5	2	4	91	Medium – High
Soil Disturbance	Negative	2	5	3	4	4	77	Medium – High
Stockpiles	Negative	2	5	5	2	4	77	Medium – High
Increase in erosion reduces habitat quality								
Vegetation clearing and earthworks	Negative	4	3	2	4	4	66	Low – Medium
Water runoff	Negative	4	5	2	4	4	78	Medium – High
Watercourse contamination due to dust pollution								
Mining operations	Negative	4	4	5	5	5	130	Very High
Watercourse contamination due to hydrocarbon spillage								
Spillage from trucks and vehicles	Negative	4	4	5	4	4	108	High

Table 8-20: The post-mitigation impacts from the proposed development on fauna and flora.

Impact	Impacts Status	Spatial scale	Duration	Frequency	Probability	Severity	Significance value	Significance rating
Loss of existing habitat due to loss of vegetation								
Physical removal of vegetation	Negative	1	4	3	5	4	72	Low – Medium
Construction camps & lay down areas	Negative	2	2	3	5	2	48	Low
Stochastic events such as fire	Negative	2	3	2	2	2	28	Low
Direct mortality of fauna								
Staff or construction workers poaching and hunting	Negative	3	4	1	2	3	21	Very Low
Collisions with vehicles	Negative	4	4	3	2	4	60	Low – Medium
Intentional killing of fauna	Negative	3	4	2	2	3	40	Low

Vegetation and ground clearing	Negative	3	4	3	5	4	56	Low – Medium
Disruption/alteration of ecological life cycles due to the restriction of species movement (migration/dispersal)								
Open trenches and other linear barriers	Negative	1	4	2	1	1	18	Very Low
Infrastructure	Negative	2	4	5	3	2	64	Low – Medium
Open pit mine	Negative	2	4	3	2	4	50	Low
Disruption/alteration of ecological life cycles (breeding, migration, feeding) due to noise, dust and lighting								
Access roads and construction works	Negative	2	4	5	4	1	63	Low – Medium
Mining operations	Negative	2	4	4	4	2	64	Low – Medium
Introduction of alien flora affecting native faunal assemblages								
Vehicles and machinery	Negative	1	4	5	2	2	49	Low
Soil Disturbance	Negative	1	4	3	2	2	35	Low
Stockpiles	Negative	1	4	5	2	2	49	Low
Increase in erosion reduces habitat quality								
Vegetation clearing and earthworks	Negative	2	3	2	2	2	28	Low
Water runoff	Negative	2	4	2	2	2	32	Low
Watercourse contamination due to dust pollution								
Mining operations	Negative	4	4	4	4	4	96	Medium – High
Watercourse contamination due to hydrocarbon spillage								
Spillage from trucks and vehicles	Negative	4	4	5	1	2	60	Low – Medium

8.1.5 Socio-economic

8.1.5.1 Construction Phase

8.1.5.1.1 Employment Creation during Construction

Impact Description

The proposed project will require the establishment of substantial surface infrastructure for the mining operations and therefore has the potential to provide direct employment to people within the secondary and primary study area during the construction phase.

Construction phase positions will only last for a relatively short period (approximately 12 months), and will likely involve skilled (e.g. engineers, land surveyors, project managers), semi-skilled (e.g. equipment operators, vehicle drivers) and non skilled (e.g. manual labourers) positions. The jobs created are mainly associated with the construction of various infrastructures that is required for the mine to be operational, e.g. internal and access roads, offices, stores, plants, pollution control dams, fences, etc. The acquisition of new skills during the construction period will make individuals more employable in the future phases of the project. Vandabyte will include people from STLM and GMLM during the construction phase of the project, particularly historically disadvantaged (HD) people.

In addition to creating job opportunities for construction workers, the project will also lead to indirect employment creation in the informal sector, for instance in terms of food stalls for the convenience of construction workers. Additionally, more informal employment opportunities may be created in the second economy through a multiplier effect from the proposed project's activities. The creation of employment opportunities during the construction phase of the Project can therefore be seen as a substantial positive impact on benefitting individuals and their dependants. It should be cautioned that, if not carefully mitigated, these potential positive effects may trigger significant price inflation, impacting both food and housing prices in surrounding communities. Significant food or housing price inflation can adversely impact existing vulnerable groups, with negative consequences on individual- and community-level socio-economic performance indicators (IFC, 2009).

Mitigation measure and Recommendations

Given that communities in the vicinity of the Mine will be mostly affected by the proposed project, it is consistent with national legislation (MPRDA; Mining Charter) and international good-practice standards (such as IFC PSs) that they should be given special consideration in terms of the benefits arising from the proposed project.

In addition to the above and in order to enhance the benefits of employment creation for other communities elsewhere in the secondary study area, it is recommended that the following measures be implemented:

- Promote the creation of employment opportunities for locals, especially disadvantage individuals, women and youth, above the targets set out in the Mining Charter;
- Where it is practical, labour-intensive construction methods should be promoted. Aspects of construction that could potentially be amenable to such methods include earthworks, construction of access roads, etc.;
- If required, the local resident status of job applicants should be verified in consultation with community representatives, traditional leaders, municipal structures and landowners in order to ensure local recruitment;
- Vandabyte and appointed contractors should identify its required core skills (both for the construction and operational phases) and extend employee skills audits to investigate the prevalence of required skills in nearby communities within the secondary study area, and structure its skills development endeavours accordingly.
- Where feasible, Vandabyte and appointed contractors should offer training and skills development to improve the ability of local community members, especially those residing within the primary study area, to take advantage of employment opportunities arising through the Project;
- Recruitment should take place using a registry of job-seekers and SMMEs, as opposed to lists of potential candidates and service providers compiled by an individual – this minimises the risk of nepotism or corruption tainting the recruitment process;
- It is recommended that recruitment during the construction phase should not take place on site but should be coordinated through the appropriate institutions such as the provincial Department of Labour or institutions recommended by the local authorities (where applicable). However, care must be taken that recruitment practices are fair and transparent and are not unduly influenced by pressure groups, such as political parties;
- A monitoring system should be established to ensure that Vandabyte and its subcontractors honour local employment policies and other measures to enhance local employment;
- Vandabyte and its subcontractors must compile a database of goods and services providers from the local community who comply with their procurement requirements before commencement of the tender process for acquiring various services and goods; and

- Once construction is completed, local persons employed on contract/ temporary basis during construction should be provided with reference letters that they can submit to gain employment elsewhere. Also, certificates of completion should be provided for in-house (on-the-job) training provided.

8.1.5.1.2 Economic impacts

Impact Description

The proposed project will result in several economic benefits through direct and multiplier effects stimulated by capital expenditure on construction and operational activities.

Firstly, large scale construction activities will increase the demand for a wide variety of goods and services, and as a result will stimulate and/or sustain growth within the regional manufacturing and service sectors; both these sectors are already well established within the regional and/or provincial economy. This economic environment will likely generate more opportunities for medium, small and micro businesses, provided they are formalised and able to meet the procurement requirements of the proposed mine.

Vandabyte intends to focus on increasing opportunities for local HDSA suppliers of goods and services to the proposed project, and is committed through the Mining Charter to procure 40% of capital goods, 50% of consumables and 70% of services from HDSA suppliers.

A considerable part of the mine's needs will be highly technical and unlikely to be found within the secondary study area, and may procure from businesses in the regional area of elsewhere in Mpumalanga Province (which has a highly developed coal mining sector as well as highly technical services and manufacturing sectors).

Local and regional procurement spend, which is expected to peak during construction, will enhance the positive economic impact of the Project, as the revenue accruing to enterprises will produce sustained beneficial downstream impacts on the economy within the secondary study area. In addition, the construction and operational workforce will be housed in the surrounding areas; this too will contribute positively towards the growth of these economic sectors. Given that a significant proportion of moneys derived from wages earned would likely be spent in the vicinity of the project area, it is expected to create additional flows of revenue within surrounding communities, thus acting as a potential catalyst for growth in the economy.

The Project will likely trigger some population influx into the primary and secondary study area, which is partially associated with negative socio-economic consequences. Disruption of existing family structures and social networks due to the in migration of workers and job seekers into the area. Furthermore, possible relocation of households that is too near the mine site. It will however, also have some positive effects on the local economy. Small businesses may experience improved markets and increased numbers of customers for consumable items they sell. Increased markets for local entrepreneurs will compound on existing economic multiplier effects.

Mitigation measures and Recommendations

The measures recommended in the Section above to maximise local employment during the construction phase through the project will also serve to maximise the positive impacts of the project on the local economy. In addition, the following measures are recommended:

- Promote procurement from local and HDSA enterprises above the targets set out in the Mining Charter;
- If any subcontractors are appointed, Vandabyte should give preference to suitable subcontractors/SMMEs located in nearby towns, then elsewhere in the secondary study area and then only to contractors located in areas elsewhere in Mpumalanga;
- Where appropriate SMMEs do not exist locally, Vandabyte should investigate the possibility of aligning/updating their current SLP to develop this service capacity among local, preferably HDSA, suppliers;
- Local procurement targets and procedures should be formalised in the mine's procurement policy, which is currently in a draft format, with reasonable penalties to the contractors who do not meet their targets. Such penalties (if monetary), could be used for capacity building and SMME development initiatives;
- Procurement practices of construction contractors should be monitored, and they must be reminded of the preference to procure locally. Where contracts are awarded to non-local service providers, contractors must demonstrate that reasonable action was taken to identify a local service provider;
- If such a register does not exist at the labour desk of the municipality, Vandabyte should consider developing a register of local SMMEs and the types of goods and services provided by them; and/or consult nearby mines to determine if they would be willing to make their business registers/ databases available for use by the Project;
- Investigate the feasibility of establishing linkages with institutions other than the local municipality involved in SMME development, such as neighbouring mines, community-based development projects and Non-Governmental Organisations (NGOs) active in the broader project area.

8.1.5.1.3 Displacement of households and workers

Impact Description

Any project with a physical footprint inevitably requires a land acquisition process. One of the most significant socio-economic impacts that may result from such land acquisition is the displacement of persons residing on or making use of the land.

Displacement-related impacts encompass both *physical* displacement (the loss of a home and the necessity of moving elsewhere) and/or *economic* displacement (the loss of income and productive assets such as cultivated fields or business stands) from the acquired land (IFC, 2012). In this case, only economic displacement is applicable as the current land use entails agricultural land where workers will lose their agricultural jobs. Based on the interviews with the landowners, this is mostly applicable to temporary seasonal employees.

Furthermore, indirect affected parties may be affected as motivated by international good practice advocates clearing a safety buffer of 500m around areas where blasting will take place in the open cast mining blocks (IFC, 2012), whereas the South African Mine Health and Safety Act allows for a smaller buffer of 100m around primary project infrastructure (e.g. mine shafts, stockpiles, open pits etc.). The closest community is located approximately 610 meter west of the proposed opencast pit, but are still located within the mining right area. This community is an informal settlement that existed prior to the current landowner buying the property.

It is anticipated that the impacts of surface infrastructure and open pit development could contribute to *indirect* economic displacement. Surrounding farming operations located on directly adjacent properties to the major infrastructure components and mining blocks would likely have to relocate or experience significant loss of produce due to blasting, vibration, noise, air quality, and health and safety risks. Neighbouring farmers indicated that this could affect daily farming operations and reduce crop yield. Such a trend could increase the number of occupants who would be negatively impacted on by indirect economic displacement of the owners as well as the individuals who are employed at these operations (and operations that are dependent on the affected operation), assuming it is not re-establish elsewhere.

Mitigation measures and Recommendations

Vandabyte should endeavour to minimise the extent of direct physical and economic displacement through informed project design and implementation, in particular revising infrastructure placement to maximise distance from residential and commercial land uses. In cases where displacement cannot be avoided, the following measures should be implemented to minimise the adverse impacts resulting from displacement impacts:

- The sales agreement of any land to be acquired by the Project should reflect the holistic value of the land prior to mining. It has been indicated that a professional property valuator has already determined the price of the farms should they be bought by the mine.
- Prior to finalising the sales agreement of land, it should be clear if the community currently residing on Portion 2 of the Farm Dunbar 189 IR will be relocated or compensated that is within 600 m of the mining operations. If resettlement is considered, it is recommended that the process be aligned to IFC PS 5, to ensure that households are not worse off afterwards. A Resettlement Action Plan (RAP) should be developed in consultation with the affected households, the mine, and local authorities.
- Where indirect displacement occurs, it is suggested that Vandabyte engage with adjacent landowners and compile the baseline as well as monitor the effects of the mining activity on the production at the potentially affected farms. In the event that the production is affected and proven to be the result of mining activities, engage with the respective landowner and investigate appropriate alternatives suitable for all the parties to ensure overall production is not affected.
- It is important to point out that based on other mining projects; employees on farms and other impacted businesses are often not compensated and/or provided with alternative accommodation by landowners if the farms on which they reside are acquired by the Project. Moreover, mining companies often insist that they are not responsible for the wellbeing of farm/domestic workers who may be directly affected following the sale of a property according to the willing buyer willing seller principle. International best practice, nevertheless, requires that these workers are compensated.

8.1.5.1.4 Community Development and Social Upliftment

Impact Description

Vandabyte will contribute to community development and social upliftment through the implementation of its SLP as well as carrying out commitments made in terms of its procurement and employment policy. These plans and policies have the potential to facilitate and catalyse socio-economic development within the project affected communities, as several of these communities have a relatively low socio-economic base. These initiatives – especially if implemented in consultation with those of other developmental role-players (such as the LLM, Non-governmental organisation, other mines in the area, and other existing development programmes e.g. Municipal LED programmes) – can contribute substantially towards socio-economic development, sustainable jobs and income stability within the study area.

Vandabyte SLP and procurement policy outlines several actions that will enhance socio-economic development among local communities, particularly the following:

- As part of Human Resource Development (HRD) by means of a skills development plan, career progression plan, mentorship, bursaries and learnerships. The skills development plan will include the development of mining-related skills, portable skills development, and ABET;
- As part of its LED strategy which will focus on communities affected by the proposed Project, it is recognised that, unless LED projects are designed to be sustainable beyond the LoM, they can also have negative long-term impacts by increasing economic dependency on the mine or their partners;
- Investments, which will include funding the development of key service delivery infrastructure as well as several SMME development programmes within the communities surrounding the proposed project; and
- As part of a procurement policy, the intention to empower and develop previously disenfranchised communities and individuals through preferential procurement from HDSA vendors. This will potentially allow these vendors, at the time of mine closure, to supply goods and services to non-mining enterprises.

Successful implementation of the aforementioned programmes will contribute to maximising the benefits of the proposed Project for communities within the primary and secondary study, as well as towards offsetting some negative impacts that these communities may experience as a result of the proposed project.

Mitigation measures and Recommendations

In order to maximise this positive impact and reduce negative impacts, the following measures are recommended:

- In order to ensure that future skills development, Corporate Social Responsibility (CSR) and LED initiatives addresses the needs of the beneficiary communities or individuals, the details of development projects should be finalised in consultation not only with local government, but also with the local community and employee representatives;
- Often there are already initiatives underway that are in need of financial and/ or technical support that the mine could provide, for instance programmes being implemented as part of the Comprehensive Sustainable Rural Development Programme, Municipal LED Projects, or LED projects at nearby mines. It is proposed that Vandabyte department responsible for Corporate Social Investment (CSI) or community development contact the CSR and/or community development departments of other enterprises (e.g. local and district municipalities, neighbouring mines and non-

governmental organisations) in the area to gauge whether they can align or synergise with any of their efforts to collaborate in some of the development initiatives already planned for the area;

- Vandabyte and its contractors should comply with the company's policy as well as the Mining Charter in terms of preferential HDSA procurement;
- Vandabyte should expand its skills development and capacity building programmes to non-employees, to include especially residents of communities within the primary study area. Programmes offered to non-employees and contractors must be geared towards making individuals employable in the mining industry, as well as enabling them to establish and manage SMMEs that will be able to meet the needs of the mining industry elsewhere in the region; and
- A record of training courses completed per individual should be kept in a skills database. Where training is offered to non-employees, their details should be shared with other industries in the area with the aim of finding them employment should the project be unable to offer them employment.

8.1.5.1.5 Influx of people

Impact Description

As news regarding the proposed mine spreads or when mining-related activities increase, expectations regarding possible employment opportunities at the mine will also increase. Consequently, the area surrounding the site and neighbouring settlements may experience an influx of job seekers. This trend is already evident in the secondary study area and is well known with other mining areas in Mpumalanga. The magnitude of this impact will, amongst others, be influenced by the severity of poverty and unemployment, as people will be more inclined to travel in search of better livelihoods through employment.

The movement of people, particularly males, into the local municipality may lead to incidences such as increased crime levels for those who are not able to secure employment, dilution of family values leading to behaviours such as prostitution, promiscuity, teenage pregnancies and alcohol and drug abuse, increased number of people infected with HIV/AIDs and Sexually Transmitted Diseases (STDs).

The socio-economic profile of the population within the secondary and primary study area indicates that poverty and unemployment are moderate throughout these areas. It can therefore be anticipated that job seekers (and sometimes whole families), as well as entrepreneurs and opportunists, will move to areas where new job opportunities are available. The portion of the workforce which will be recruited from outside the local area will constitute an additional influx of people. Furthermore, unsuccessful job seekers from outside the primary study area may decide to settle in the project area. This impact may commence prior to construction, and is likely to continue after construction has been completed. The influx of construction workers, job-seekers and others is expected to have a variety of social consequences; including:

- Increased pressure on local services, resources and facilities. The municipality cannot necessarily keep up with service delivery as there are existing shortages;
- Establishment and growth of informal settlements as there is a shortage of existing formal houses in the area;

- Increase in social pathologies such as substance abuse, prostitution, increased incidence of sexually transmitted diseases (STDs) and other communicable diseases (IFC, 2012);
- Higher demand and increased markets for food, especially fresh produce and meat. This scenario could inflate prices and result in increased poaching from livestock farmers within and surrounding the area as well as bush meat hunting;
- Conflict / competition between newcomers and current population, for example, perception among locals that the outsiders are taking up jobs that could have gone to unemployed members of the local community. Xenophobic attacks have increased in South Africa this year alone as unemployed and poverty-stricken people become more desperate;
- Perception of increased crime and safety risks to the area due to the newcomers.

Mitigation Measures

The following measures are recommended to address the aforementioned impacts:

- Measures to address population influx:
  - The design of effective in-migration management strategies requires an understanding of the dynamics and potential impacts of the phenomenon, taking into account specifics of the locations and areas in which the in-migration will occur;
  - The recruitment of employees and contractors should be executed as already discussed above (especially in terms of preferentially employing from local labour sending areas), thereby discouraging loitering near the proposed mine;
  - Ensure that the intention of giving preferential employment to locals is clearly communicated, in order for locals to have a fair opportunity and reduce potential conflict situations;
  - Involve local community structures (e.g. ward councillors and traditional leaders) to assist in communicating the intention to give preference to local labour, and also to assist in identifying the local labour pool (with this being said, ward councillors need to make an effort to be involved as the public do not trust or do not rely on them);
  - It is strongly recommended that Vandabyte liaise with the municipality throughout the construction and operational phases to ensure that expected population influx is taken into account in spatial and infrastructure development planning of the area; and
  - No poaching of livestock or bush meat may take place. All workers appointed by the mine should be prosecuted accordingly.
- The following management measures will serve to minimise the occurrence of social pathologies:
  - A code of conduct for the construction workers should be compiled, and the information provided to and signed by all relevant stakeholders in order to provide guidance on what behaviour is or is not permitted or acceptable.
  - Implement HIV/AIDS and alcohol abuse prevention campaigns in the communities;
  - Vandabyte should make their HIV/AIDS awareness and prevention programmes a condition of contract for suppliers and sub-contractors;

  - Vandabyte should provide an adequate supply of free condoms to workers;
  - A voluntary counselling and testing programme must be introduced during construction and continued during operation;
  - It is recommended that contractors undertake a HIV/AIDS and STD prevalence survey amongst its workers on a yearly basis. This will involve a voluntary test which is available to 100% of the workforce. The results of the survey will help to determine HIV/AIDS and STD prevention strategies. When, and if, statistically representative, the results of the survey should be made available to both management and workers at the same time. Results should be presented in statistical terms so as to ensure confidentiality;
  - Access at the construction site(s) must be controlled to prevent sex workers and petty traders from visiting and/or loitering at, or near, the construction camp/mine site; and
  - Financially support the appropriate government agencies, local clinics and NGOs involved in raising community awareness and education with regard to STDs and substance abuse.
- Measures to address crime:
  - Construction workers should be clearly identifiable by wearing proper construction uniforms displaying the logo of the construction company; this will decrease the number of opportunistic people wandering near the construction site under the guise of being Dunbar employees;
  - Liaison structures are to be established with local police to monitor social changes in crime patterns during the construction phase as well as the operation phase of the mine. Liaison should also be established with existing crime control organisations, such as local community policing forums, private security companies and other crime prevention organisations;
  - Through the abovementioned forum, identify if recorded criminal activities (e.g. violent crimes, housebreaking and stock theft) involved members of the mine's workforce, and act accordingly; and
  - Vandabyte should enforce clear rules and regulations for access to the project site to control loitering. The proponent should consult with the local police service to establish standard operating procedures for the control and/or removal of loiterers.
- Measures to address potential conflict between locals and non-locals:
  - The mine's recruitment and procurement policy must be fair, transparent and readily available to especially the local community;
  - Establish a community liaison office and grievance mechanism at a location that is accessible to members of the surrounding communities;
  - Mine security should be empowered in terms of resources and facilities to effectively manage security issues relating to incidents of community unrest at/near the mine site. However, great care should be taken that the human rights of all people involved are respected;
  - Develop standby procedures with the local police service to assist with crowd control; and
  - In the event of conflict between the locals and non-locals, a conflict management plan should be compiled.

8.1.5.2 Operational Phase

8.1.5.2.1 Dust generation from a social and health perspective

The community settled in an area where there are many sources of dust which include:

- dust created by vehicles travelling on dirt roads;
- dust from agricultural activities; and
- dust created by nearby existing mines.

The proposed project will intensify the dust that the community is exposed to through construction activities, from blasting and operational activities within the mine pits, and the added activities associated with the new crush, screening and wash facility. Small informal communities live very close to the mining area and the dust could not only impact on their health, but also on their quality of life. Vulnerable people such as the elderly, people with existing respiratory diseases, child-headed households and young children are a special concern.

8.1.5.2.2 Employment Creation during the Operational Phase

Impact Description

Employment during the operational phase has the potential of being over a medium period, which can have a major, long term (as opposed to short-term construction opportunities), positive impact for successful job applicants and their dependents.

With mining and quarrying being an established industry in the region, it is expected that a sufficient number of the unemployed will have appropriate skills to qualify them for at least semi-skilled positions at the mine. During the construction process potential candidates can also be identified to receive skills training, bursaries or internships preparing them for specific roles during the operational phase.

This means that local communities can potentially take maximum advantage of employment opportunities to be created by the proposed mine, and that Vandabyte will likely be able to meet its local recruitment target of 50%. It should be noted that some positions will require scarce skills, which will not necessarily be readily available in local labour sending areas, therefore a certain percentage of the mine's workforce will be recruited from elsewhere in Mpumalanga. Those who succeed in gaining employment on the Project would benefit substantially in terms of wages, training/skills development and income security. Local employment in the Project supply chain could further increase the benefits of the Project. However, the challenge will be to ensure that contractors comply with recruitment policies and relevant legislative requirements.

The operational phase of the proposed project could give rise to some indirect employment opportunities. These could include jobs in the informal sector and in the formal sector (for instance, by sourcing goods and service from enterprises elsewhere in the secondary area where possible or increasing the demand for commuter transport services).

Mitigation measures

Several measures can be implemented to increase the number of direct and indirect employment opportunities:

- Most of the measures recommended in the construction phase above, to maximise local employment during construction will also apply to the operational phase. In particular, training and capacity building programmes should be implemented to enhance the ability of local community members to take advantage of available operational employment opportunities. Such programmes can be tied into future iterations SLP or CSI programmes.

- It is also proposed that the type of skills necessary for plant operation should be established before operation starts. This will mean that local people can be trained part-time during the construction period to attain these skills to eventually qualify for employment opportunities during the operational phase; and
- The project's database of the local labour pool should be updated to include people who were employed by the project during the construction phase. This will assist with the recruitment of workers required during the operational phase of the project.
- It is suggested that all workers be trained on financial management to ensure that they spend their money prudently and thus eventually having a positive impact on their living conditions.

8.1.5.2.3 Stimulation and Growth of the Local and Regional Economies

Impact description

A positive effect of the project in terms of stimulation of domestic production, job creation, and government revenue could occur by implementing this project. More specifically the project will during its operational phase contribute to the GDP of the region and province, and will create both direct and indirect employment opportunities.

The State will receive royalty and tax payments for the permanent extraction of non-renewable commodities. Ideally a proportion of these funds should be used to stimulate regional economic growth by re-investing the funds into infrastructure development throughout the secondary study area.

The project will also be required to pay a considerable amount of rates and taxes. A proportion of these funds will be paid to local and district/metropolitan municipal structures. Such an injection into local municipal structures could contribute to the development of the municipal area including upgrading of services, thereby creating conditions which can be conducive to economic growth.

It is expected that the benefits of the proposed project will extend beyond members of the mine's workforce to suppliers through the procurement of products and services. Vandabyte preferential procurement strategy must adhere to the stipulations of the MPRDA and aim to achieve HDSA procurement targets set out in the Mining Charter. The strategy will increase opportunities for HDSA suppliers which will in turn be conducive to enterprise development and economic growth in communities within the secondary study area.

Mitigation measures

Measures recommended to enhance the benefits from local employment and economic multiplier effects, as well as community development; will also serve to maximise the positive impacts of the proposed project on the economy. In addition the following measures are recommended:

- Implementation of measures suggested in this Assessment and the SLP;
- Incorporate SMME capacity building programmes into future iterations of the mine's SLP, which will enable HDSA suppliers to take maximum advantage of opportunities provided through mine-related procurement;

- In order to maximise the empowerment of HSDA companies (and the sharing in project benefits by the disadvantaged communities in general), the project should attempt to establish long-term procurement contracts with local suppliers (where possible); and
- An independent monitoring system should be established to ensure that the mine and its contractors comply with government regulations and company policies related to HDSA procurement.

8.1.5.2.4 Blasting and vibrations from a social perspective

Impact description

Blasting is one of the greatest community concerns as damage to houses and injuries to people are a great possibility. If the blast radius is too close to existing houses, some people would need to evacuate their houses. The mine would likely have to move people in close proximity to the blasting due to safety issues associated with blasting. Blasting and vibrations impact on people's sense of safety, their quality of life and their material wellbeing. Any damage to goods will be difficult for most households to recover from blasting and associated vibration damage. Many people also live in traditional houses or shacks that cannot structurally deal with blasting, and as a result these houses are damaged often. Due to their socio-economic conditions they cannot afford better housing.

Mitigation measures

- The timing of blasting needs to be indicated and communicated to the community on a weekly basis;
- Relocation of households within 500 m of the blasting impact must be considered. Since no households have been identified within 500 m of the Project relocation is not considered necessary;
- A grievance mechanism should be in place, and all communication should be recorded and should be freely available to all parties;
- There must be a feedback mechanism to ensure that the person that laid the complaint is informed about how it was dealt with. Feedback should be given within a reasonable time;
- The mine should liaise with the STLM about formalising the houses in the area and provision of municipal services to all houses. The supply of housing and services is the responsibility of the government, but where the mine is liable consultation with the STLM should take place.

Table 8-21: Impact rating for socio-economic aspects pre-mitigation.

Impact	Status	Extent	Duration	Severity	Frequency	Probability	Significance
Construction Phase							
Direct employment creation	Positive	4	2	4	3	5	80 (MH)
Indirect employment creation	Positive	4	2	4	3	4	70 (ML)
Economic gain	Positive	4	3	4	3	5	88 (MH)
Displacement of households	Negative	3	5	5	5	5	130 (VH)
Loss of agricultural jobs	Negative	3	5	3	5	5	110 (H)

Impact	Status	Extent	Duration	Severity	Frequency	Probability	Significance
Community development and social upliftment	Positive	4	3	4	3	4	77 (MH)
Community safety	Negative	4	3	4	4	4	88 (MH)
Increased pressure on local services due to influx of people	Negative	4	3	4	3	4	77 (MH)
Increased informal settlements due to influx of people	Negative	4	3	4	3	4	77 (MH)
Conflict between newcomers and local community	Negative	4	3	4	4	5	99 (MH)
Operational Phase							
Direct employment creation	Positive	4	4	4	4	5	108 (H)
Indirect employment creation	Positive	4	4	4	4	4	96 (MH)
Paying rates and taxes	Positive	4	4	4	4	5	108 (H)
GDP injection	Positive	4	4	4	4	5	108 (H)
Royalty payments	Positive	4	4	4	4	5	108 (H)
Community development and social upliftment	Positive	4	4	4	4	5	108 (H)
Dust from a social and health perspective	Negative	3	4	5	4	5	108 (H)
Blasting and vibration from a social aspect.	Negative	3	4	4	4	5	99 (MH)
Water quality and quantity	Negative	4	5	4	4	5	117 (H)
Conflict between newcomers and local community	Negative	4	4	3	4	5	99 (MH)

Table 8-22: Impact rating for socio-economic aspects post-mitigation

Impact	Status	Extent	Duration	Severity	Frequency	Probability	Significance
Construction Phase							
Direct employment creation	Positive	4	2	4	3	5	80 (MH)
Indirect employment creation	Positive	4	2	4	3	4	70 (ML)

Impact	Status	Extent	Duration	Severity	Frequency	Probability	Significance
Economic gain	Positive	4	3	4	3	5	88 (MH)
Displacement of households	Negative	3	5	3	5	3	88 (MH)
Loss of agricultural jobs	Negative	3	5	3	5	4	99 (MH)
Community development and social upliftment	Positive	4	3	4	3	4	77 (MH)
Community safety	Negative	3	3	2	2	3	48 (L)
Increased pressure on local services due to influx of people	Negative	4	3	3	3	3	60 (ML)
Increased informal settlements due to influx of people	Negative	4	3	3	3	3	60 (ML)
Conflict between newcomers and local community	Negative	4	3	3	3	4	70 (ML)
Operational Phase							
Direct employment creation	Positive	4	4	4	4	5	108 (H)
Indirect employment creation	Positive	4	4	5	4	5	117 (H)
Paying rates and taxes	Positive	4	4	4	4	5	108 (H)
GDP injection	Positive	4	4	4	4	5	108 (H)
Royalty payments	Positive	4	4	4	4	5	108 (H)
Community development and social upliftment	Positive	4	4	4	4	5	108 (H)
Dust from a social and health perspective	Negative	4	4	4	3	4	84 (MH)
Blasting and vibration from a social aspect	Negative	3	4	4	4	3	77 (MH)
Water quality and Quantity	Negative	3	4	4	3	4	77 (MH)
Conflict between newcomers and local community	Negative	4	4	3	3	3	66 (ML)

8.1.6 Palaeontological and Heritage

The biggest potential risk to the project is the occurrence of currently unknown graves. The impact can be mitigated to an acceptable level with the implementation of a chance find procedure.

The impact on heritage sites by the proposed development is considered to be low with the correct mitigation measures in place. Impacts that may occur would be during the construction phase only and would be of low significance unless unknown graves are impacted on, in which case the impact would be of high social significance.

Cumulative impacts occur from the combination of effects of various impacts on heritage resources. The importance of identifying and assessing cumulative impacts is that the whole is greater than the sum of its parts. The area is not rich in heritage resources and the proposed development is in line with other similar developments in the area. This and other projects in the area could, however, have an indirect impact on the larger heritage landscape.

8.1.6.1 Construction Phase

8.1.6.1.1 Impact description

It is assumed that the pre-construction phase involves the removal of topsoil and vegetation as well as the establishment of infrastructure needed for the construction phase. These activities can have a negative and irreversible impact on heritage sites. Impacts include destruction or partial destruction of non-renewable heritage resources.

During this phase, the impacts and effects are similar in nature but more extensive than the pre-construction phase. These activities can have a negative and irreversible impact on heritage sites. Impacts include destruction or partial destruction of non-renewable heritage resources.

8.1.6.1.2 Mitigation measures

Unless unknown graves are impacted on (the impact would be of high social significance) the impacts are considered to be Low-Medium. Accordingly no specific mitigation measures are proposed. In such cases, implementation of a chance finds procedure is suggested.

8.1.6.2 Operational Phase

No impact is envisaged for the recorded heritage resources during this phase.

Table 8-23: Consolidated Table of Aspects and Impacts Scoring of Impact on Heritage Resources.

Spatial Scale	Rating	Duration	Rating	Severity	Rating
Activity specific	1	One day to one month	1	Insignificant/non-harmful	1
Area specific	2	One month to one year	2	Small/potentially harmful	2
Whole site/plant/mine	3	One year to ten years	3	Significant/slightly harmful	3
Regional/neighbouring areas	4	Life of operation	4	Great/harmful	4
National	5	Post closure	5	Disastrous/extremely harmful	5
Frequency of Activity		**Rating**	**Probability of Impact**		**Rating**
Annually or less		1	Almost never/almost impossible		1
6 monthly		2	Very seldom/highly unlikely		2
Monthly		3	Infrequent/unlikely/seldom		3
Weekly		4	Often/regularly/likely/possible		4
Daily		5	Daily/highly likely/definitely		5
Significance Rating of Impacts			**Timing**		
Very Low (1-25) Low (26-50) **Low – Medium (51-75)** Medium – High (76-100) High (101-125) Very High (126-150)			**Pre-construction** **Construction** Operation Decommissioning		
Adjusted Significance Rating					

8.1.7 Visual

8.1.7.1 Construction and Operational Phase

Visibility is determined by a line of sight where nothing obscures the view of an object. Exposure is defined by the degree of visibility, in other words “how much” of it can be seen. This is influenced by topography and the incidence of objects such as trees and buildings that obscure the view partially or in total.

Potential construction phase visual impact on the Viewpoints is expected to have a LOW impact before mitigation and LOW significance after mitigation, as indicated in the table below. Although the construction will be LOW visible from the Viewpoints, the time of exposure is minimal and thus the impact on the users will remain LOW.

The impact on the surrounding farmers and land users will be more significant but can still be seen as MODERATE because of the short time the proposed activity will be undertaken. Although the construction activities will be highly visible, the time of exposure is short and thus the impact on the users will be low after mitigation measures have been implemented

Table 8-24: Summarizing the significance of visual impacts on the viewpoint with an Exposure rating for the Construction phase.

Nature of impact: Potential visual impact on the viewpoints that had a visual exposure rating for the construction phase.			
		Unmitigated	**Mitigated**
Assessment Criteria	**Severity** [Insignificant / non-harmful (1); Small / potentially harmful (2); Significant / slightly harmful (3); Great / harmful (4); Disastrous / extremely harmful / within a regulated sensitive area (5)]	**2**	**2**
	Spatial Scale [Area specific (at impact site) (1); Whole site (entire surface right) (2); Local (within 5km) (3); Regional / neighbouring areas (5km to 50km) (4); National (5)]	**1**	**1**
	Duration [One day to one month (immediate) (1); One month to one year (Short term) (2); One year to 10 years (medium term) (3); Life of the activity (long term) (4); Beyond life of the activity (permanent) (5)]	**2**	**2**
	Frequency of Activity [Annually or less (1); 6 monthly (2); Monthly (3); Weekly (4); Daily (5)]	**4**	**4**
	Frequency of Incident/Impact [Almost never / almost impossible / >20% (1); Very seldom / highly unlikely / >40% (2); Infrequent / unlikely / seldom / >60% (3); Often / regularly / likely / possible / >80% (4); Daily / highly likely / definitely / >100% (5)	**4**	**3**
Consequence	Severity + Spatial Scale + Duration	**5**	**5**
Likelihood	Frequency of Activity + Frequency of impact	**8**	**7**
Risk	Consequence * Likelihood	**LOW (40)**	**LOW (35)**
Mitigation:	The visual impact can be minimized creating a visual barrier. The construction area will be cleared as soon as construction of the infrastructure is finished.		
Cumulative Impact:	The construction of the proposed Dunbar Coal project with its associated infrastructure will increase the cumulative visual impact of mining type infrastructure within the region. In context of the existing agriculture character, the construction phase of the Dunbar Coal structures will contribute to a regional increase in heavy vehicles on the roads in the region, with construction activity noticeable.		

Visibility is determined by a line of sight where nothing obscures the view of an object. Exposure is defined by the degree of visibility, in other words “how much” of it can be seen. This is influenced by topography and the incidence of objects such as trees and buildings that obscure the view partially or in total.

Potential permanent visual impact on the Viewpoints is expected to have a MEDIUM-HIGH impact before mitigation and LOW-MEDIUM significance after mitigation, as indicated in the table below. The structures will be LOW-MEDIUM visible from the Viewpoints, the time of exposure is permanent and thus the impact on the users will still remain LOW-MEDIUM.

Table 8-25: Impact table summarising the significance of the structures on users of roads and land-users.

Nature of impact: Potential visual impact on the viewpoints that had a visual exposure rating.			
		Unmitigated	**Mitigated**
Assessment Criteria	**Severity** [Insignificant / non-harmful (1); Small / potentially harmful (2); Significant / slightly harmful (3); Great / harmful (4); Disastrous / extremely harmful / within a regulated sensitive area (5)]	**2**	**2**
	Spatial Scale [Area specific (at impact site) (1); Whole site (entire surface right) (2); Local (within 5km) (3); Regional / neighbouring areas (5km to 50km) (4); National (5)]	**4**	**2**
	Duration [One day to one month (immediate) (1); One month to one year (Short term) (2); One year to 10 years (medium term) (3); Life of the activity (long term) (4); Beyond life of the activity (permanent) (5)]	**4**	**4**
	Frequency of Activity [Annually or less (1); 6 monthly (2); Monthly (3); Weekly (4); Daily (5)]	**5**	**5**
	Frequency of Incident/Impact [Almost never / almost impossible / >20% (1); Very seldom / highly unlikely / >40% (2); Infrequent / unlikely / seldom / >60% (3); Often / regularly / likely / possible / >80% (4); Daily / highly likely / definitely / >100% (5)	**4**	**3**
Consequence	Severity + Spatial Scale + Duration	**10**	**8**
Likelihood	Frequency of Activity + Frequency of impact	**9**	**8**
Risk	Consequence * Likelihood	**MEDIUM-HIGH (90)**	**LOW-MEDIUM (64)**
Mitigation:	The visual impact can be minimized by the creation of a visual barrier.		
Cumulative Impact:	The construction of the proposed Dunbar Coal structures with its associated infrastructure will increase the cumulative visual impact of agriculture type infrastructure within the region. In context of the existing Agricultural and mining character, the added structures will contribute to a regional increase in small and heavy vehicles on the roads.		

The permanent impact on the surrounding farmers and land users will be increased due to the extra mining structures added to the area.

The modelling of visibility is merely conceptual. Being based on DEM and Land cover data, it does not take into account the real world effect of buildings, trees etc. that could shield the structures from being visible or could have changed over time.

The viewshed analysis therefore signifies a worst-case scenario. The immediate landscape surrounding the observer has a determining influence on long distance views. It is expected that different land cover may offer some degree of visual screening, especially where tall trees occur around farmsteads. This influence was quantified using the land cover data, it must however be noted that this can change on a micro scale or land cover may have changed over time.

The viewshed analysis was generated and refined to reflect the visual exposure of the development according to its actual position in the landscape, as per the general assumed mining related infrastructure.

8.1.8 Air Quality

8.1.8.1 Construction Phase

8.1.8.1.1 Impacts description

The following activities during the Construction Phase are identified as possible fugitive emission sources and may impact on the ambient air quality at the relevant environmental sensitive receivers:

- **Activity 1** - Site clearing, removal of topsoil and vegetation.
- **Activity 2** - Construction of surface infrastructure (e.g. access roads, pipes, storm water diversion berms, change houses, admin blocks, drilling blasting etc.).
- **Activity 3** - General transportation, hauling and vehicle movement on site.

Activity 1

During this activity, a number of operations take place such as land clearing, topsoil removal, loading of material, hauling, grading, stockpiling, bulldozing and compaction. Initially, topsoil and subsoil will be removed with large scrapers. The topsoil will be stockpiled for rehabilitation in the infrastructure area. It is anticipated that each of the above mentioned operations will have its own duration and potential for dust generation. Fugitive dust (containing TSP (total suspended particulate, will give rise to nuisance impacts as fallout dust), as well as PM10 and PM2.5 (dust with a size less than 10 microns, and dust with a size less than 2.5 microns giving rise to health impacts)) It is anticipated that the extent of dust emissions would vary substantially from day to day depending on the level of activity, the specific operations, and the prevailing meteorological conditions. This activity will be short-term and localised, seizing after construction activities. Material will be removed by using a bulldozer and then storing this material separately for use during rehabilitation at end of life of mine when the operation cease. These construction sites are ideal for dust suppression measures as land disturbance from clearing and excavation generates a large amount of soil disturbance and open space for wind to pick up dust particles and deposit it elsewhere (wind erosion). Issues with dust can also arise during the transportation of the extracted material, usually by truck and shovel methods, to the stock piles. The dust can further be created by the entrainment from the vehicle itself or due to dust blown from the back of the bin of the trucks during transportation of material to and from stockpiles.

Mitigation measures

Various measures can be implemented to mitigate the impacts of construction activities on atmospheric environment.

- Topsoil should not be removed during windy months (August to January) due to associated wind erosion heightening dust levels in the atmosphere.
- Area of disturbance to be kept to a minimum and no unnecessary clearing of vegetation to occur.

- Topsoil should be re-vegetated to reduce exposure areas.
- During the loading of topsoil onto trucks or stockpiles, the dropping heights should be minimised.
- Water or binding agents such as (petroleum emulsions, polymers and adhesives) can be used for dust suppression on earth roads.
- When using bulldozers and graders, minimise travel speed and distance and volume of traffic on the roads.
- Stockpiles should not be left for prolonged periods as wind energy generates erosion and causes more dust to form.
- Emissions generated by wind are dependent on the frequency of disturbance of erodible surfaces and by covering the stockpiles with vegetation would reduce the negative erosion effect.
- Any crusting of the surface binds the erodible material.
- All stockpiles to be damped down, especially during dry weather or re-vegetated (hydro seeding is a good option for slope revegetation).
- Successful trialling of broad acre temporary rehabilitation of unshaped overburden emplacement areas by aerial sowing of a cover crop, providing an established vegetative stabilisation to minimise the potential for windblown dust generation.
- Constricting the areas and time of exposure of pre-strip clearing in advance of mining development.

Table 8-26: Activity 1: Site Clearing, removal of topsoil and vegetation.

		Unmitigated	Mitigated
Assessment Criteria	**Severity** [Insignificant / non-harmful (1); Small / potentially harmful (2); Significant / slightly harmful (3); Great / harmful (4); Disastrous / extremely harmful / within a regulated sensitive area (5)]	2	2
	Spatial Scale [Area specific (at impact site) (1); Whole site (entire surface right) (2); Local (within 5km) (3); Regional / neighbouring areas (5km to 50km) (4); National (5)]	1	1
	Duration [One day to one month (immediate) (1); One month to one year (Short term) (2); One year to 10 years (medium term) (3); Life of the activity (long term) (4); Beyond life of the activity (permanent) (5)]	2	2
	Frequency of Activity [Annually or less (1); 6 monthly (2); Monthly (3); Weekly (4); Daily (5)]	4	4
	Frequency of Incident/Impact [Almost never / almost impossible / >20% (1); Very seldom / highly unlikely / >40% (2); Infrequent / unlikely / seldom / >60% (3); Often / regularly / likely / possible / >80% (4); Daily / highly likely / definitely / >100% (5)	4	3
	Legal Issues [No legislation(1); Fully covered by legislation (5)]	5	5
	Detection [Immediately(1); Without much effort (2); Need some effort (3); Remote and difficult to observe (4); Covered (5)]	2	2
Consequence	Severity + Spatial Scale + Duration	5	5
Likelihood	Frequency of Activity + Frequency of impact + Legal issues + Detection	15	14
Risk	Consequence * Likelihood	**MODERATE (75)**	**MODERATE (70)**

Activity 2

During this phase, it is anticipated there will be construction of infrastructure. This will include, access roads, pipes, storm water diversion berms, change houses, admin blocks, drilling, blasting and development of box cut for mining, etc. Activities of vehicles on access roads, levelling and compacting of surfaces, as well localised drilling and blasting will have implications on ambient air quality. The above mentioned activities will result in fugitive dust emissions containing TSP (total suspended particulate, giving rise to nuisance impacts as fallout dust). Opencast mining will commence with the stripping of the vegetation for the initial box cut. Topsoil and overburden need to be removed and stockpiled separately by means of truck and shovel methods (front end loaders, excavators and haul trucks). Once the rock has been reached will blasting be required to further remove material to the point where the mineral can be extracted. Bulldozing, excavation, drilling and blasting operations will result in the emission of dust to atmosphere. The construction of roads take place through removing the topsoil and then grading the exposed surface in order to achieve a smooth finish for vehicles to move on. Temporary stockpiles will be created close to the edge of the road in order to be backfilled easily once the road has expired or need to be rehabilitated.

Mitigation measures

- Dust emitted during bulldozing activity can be reduced by increasing soil dampness by watering the material being removed thus increasing the moisture content.
- Another option would be to time the blasting with wind to ensure the dust will not be blown to the sensitive receptors or especially the community.
- Blasting should also not take place when poor atmospheric dispersion is expected i.e. early morning and late evening.
- Material need to be removed to dedicated stockpiles to be used during rehabilitation.
- This hauling of materials should take place on roads which is being watered and/or sprayed with dust suppressant.
- To reduce the amount of dust being blown from the load bin in the haul roads, the material being transported can be watered or the back of the vehicles can be covered with plastic tarpaulin covers.
- Constricting the areas and time of exposure of pre-strip clearing in advance of construction to limit exposed soil surfaces.

Table 8-27: Activity 2: Construction of surface infrastructure (e.g. access roads, pipes, storm water diversion berms, change houses, admin blocks, drilling, drilling blasting and development of box cut for mining, etc.).

		Unmitigated	Mitigated
Assessment Criteria	**Severity** [Insignificant / non-harmful (1); Small / potentially harmful (2); Significant / slightly harmful (3); Great / harmful (4); Disastrous / extremely harmful / within a regulated sensitive area (5)]	2	2
	Spatial Scale [Area specific (at impact site) (1); Whole site (entire surface right) (2); Local (within 5km) (3); Regional / neighbouring areas (5km to 50km) (4); National (5)]	1	1
	Duration [One day to one month (immediate) (1); One month to one year (Short term) (2); One year to 10 years (medium term) (3); Life of the activity (long term) (4); Beyond life of the activity (permanent) (5)]	2	2
	Frequency of Activity [Annually or less (1); 6 monthly (2); Monthly (3); Weekly (4); Daily (5)]	4	4

	Frequency of Incident/Impact [Almost never / almost impossible / >20% (1); Very seldom / highly unlikely / >40% (2); Infrequent / unlikely / seldom / >60% (3); Often / regularly / likely / possible / >80% (4); Daily / highly likely / definitely / >100% (5)	4	3
	Legal Issues [No legislation(1); Fully covered by legislation (5)]	5	5
	Detection [Immediately(1); Without much effort (2); Need some effort (3); Remote and difficult to observe (4); Covered (5)]	2	2
Consequence	Severity + Spatial Scale + Duration	5	5
Likelihood	Frequency of Activity + Frequency of impact + Legal issues + Detection	15	14
Risk	Consequence * Likelihood	MODERATE (75)	MODERATE (70)

Activity 3

Transportation of the workers and materials in and out of mine site will be a constant feature during the construction phase. This will however result in the production of fugitive dust (containing TSP, as well as PM10 and PM2.5) due to suspension of friable materials from earth roads. It is anticipated this activity will be short-term and localised and will seize once the construction activities are finalised. Haul trucks generate the majority of dust emissions from surface operations. Observations of dust emissions from haul trucks show that if the dust emissions are uncontrolled, they can be a safety hazard by impairing the operator's visibility. Substantial secondary emissions may be emitted from material moved out from the site during grading and deposited adjacent to roads. Passing traffic can thus loosen and re-suspend the deposited material again into the air. In order to minimize these impacts the stockpiles should be vegetated for the duration that it is exposed.

Mitigation measures

- Hauling of materials and transportation of people should take place on roads which is being watered and/or sprayed with dust suppressant.
- To reduce the amount of dust being blown from the load bin in the haul roads, the material being transported can be watered or the back of the vehicles can be covered with plastic tarpaulin covers.
- In order to mitigate the impacts of the activity, the speed limit should be kept to the low as more dust will be generated at higher wind speeds.
- Speed limits need to be observed and adhered to.
- Management should fit roads with speed humps to ensure adherence.
- Application of wetting agents or application of dust suppressant to bind soil surfaces to avoid soil erosion.
- The drop heights should be minimised when depositing materials to the ground.
- Encourage car-pool and bulk delivery of materials in order to reduce the number of trips generated daily.

Table 8-28: Activity 3: General transportation, hauling and vehicle movement on site.

		Unmitigated	Mitigated
Assessment Criteria	**Severity** [Insignificant / non-harmful (1); Small / potentially harmful (2); Significant / slightly harmful (3); Great / harmful (4); Disastrous / extremely harmful / within a regulated sensitive area (5)]	2	2
	Spatial Scale [Area specific (at impact site) (1); Whole site (entire surface right) (2); Local (within 5km) (3); Regional / neighbouring areas (5km to 50km) (4); National (5)]	1	1
	Duration [One day to one month (immediate) (1); One month to one year (Short term) (2); One year to 10 years (medium term) (3); Life of the activity (long term) (4); Beyond life of the activity (permanent) (5)]	2	2
	Frequency of Activity [Annually or less (1); 6 monthly (2); Monthly (3); Weekly (4); Daily (5)]	4	4
	Frequency of Incident/Impact [Almost never / almost impossible / >20% (1); Very seldom / highly unlikely / >40% (2); Infrequent / unlikely / seldom / >60% (3); Often / regularly / likely / possible / >80% (4); Daily / highly likely / definitely / >100% (5)	4	3
	Legal Issues [No legislation(1); Fully covered by legislation (5)]	5	5
	Detection [Immediately(1); Without much effort (2); Need some effort (3); Remote and difficult to observe (4); Covered (5)]	2	2
Consequence	Severity + Spatial Scale + Duration	5	5
Likelihood	Frequency of Activity + Frequency of impact + Legal issues + Detection	15	14
Risk	Consequence * Likelihood	MODERATE (75)	MODERATE (70)

8.1.8.2 Operational Phase

1. Un-mitigated - material being handled dry;

2. Mitigated 75% – Sources as Specified with Haul roads at 90% Mitigation;

Year 5 of the proposed operation throughput where used as this is the highest throughput rates, thus maximum impact on air quality is expected during this period

PM10

For the unmitigated Daily PM10 concentrations it was predicted to be higher than the 75 µg/m³ limit for 11 of the 12 sensitive receptors with major exceedances at most of the receptors.

When comparing the Daily Mitigated PM10 modelled concentrations for the Haul Roads at 75% mitigation, the sensitive receptors exceeding the 75 µg/m³ limit drop to 6 out of the 12 identified sensitive receptors. With the Haul Roads at 90% mitigation only 1 identified sensitive receptor are predicted to exceed the 75µg/m³ limit. It should be noted that this is the 2nd highest levels predicted for a 24 hour period within the period. Due to site specific atmospheric conditions these exceedances may still occur within the limit of 4 per year.

The annual average PM10 limit of 40 µg/m³ is not predicted to exceed at any of the identified sensitive receptors for any of the modelled scenarios.

Total Dust Fallout

In the mitigated and unmitigated scenarios none of the sensitive receptors are predicted to exceed the monthly dust fallout for the highest month residential limit of 600 mg/m²/day.

The predicted annual dust fall out for the mitigated and unmitigated scenarios are not predicted to exceed the annual limit of 300 mg/m²/day at any of the sensitive receptors.

8.1.8.3 Rehabilitation and Closure Phase

Decommissioning and Closure Phase

It is assumed that the decommissioning activities will only take place during daylight hours. The following activities during the Decommissioning and Closure phase are identified as possible air impacting sources and may impact on the ambient air quality at the relevant sensitive receivers:

1. **Activity 4 -** Demolition & Removal of all infrastructure (incl. transportation off site).

2. **Activity 5 -** Rehabilitation (spreading of soil, revegetation & profiling/contouring).

The decommissioning phase is associated with activities related to the demolition of infrastructure and the rehabilitation of disturbed areas. The following activities are associated with the decommissioning phase (US-EPA, 1996):

- Existing buildings and structures demolished, rubble removed and the area levelled;
- Remaining exposed excavated areas filled and levelled using overburden recovered from stockpiles;
- Stockpiles to be smoothed and contoured;
- Topsoil replaced using topsoil recovered from stockpiles; and
- Disturbed land prepared for revegetation.

Possible sources of fugitive dust emission during the closure and post-closure phase include:

- Smoothing of stockpiles by bulldozer;
- Grading of sites;
- Transport and dumping of overburden for filling;
- Infrastructure demolition;
- Infrastructure rubble piles;
- Transport and dumping of building rubble;
- Transport and dumping of topsoil; and
- Preparation of soil for revegetation – ploughing and addition of fertiliser, compost etc.

Exposed soil is often prone to erosion by water. The erodibility of soil depends on the amount of rainfall and its intensity, soil type and structure, slope of the terrain and the amount of vegetation cover (Brady, 1974). Revegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing wind and water erosion. Plants used for revegetation should be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings.

Activity 4

During this activity, there is demolition of buildings and foundation and subsequent removal of rubbles generated. There is cleaning-up of workshops, fuels and reagents, removal of power and water supply, removal of haul and access roads. Potential for impacts during this phase will depend on the extent of demolition and rehabilitation efforts during closure as well as features which will remain.

The impacts on the atmospheric environment during the decommissioning phase will be similar to the impacts during the construction phase. The process includes dismantling and demolition of existing infrastructure, transporting and handling of topsoil on unpaved roads in order to bring the site to its initial/rehabilitated state. Demolition and removal of all infrastructures will cause fugitive dust emissions. The impacts will be short-term and localised. Any implication or implications this phase will have on ambient air quality will seize once the activities are finalised.

Mitigation measures

- Demolition should not be performed during windy periods (August, September and October), as dust levels and the area affected by dust fallout will increase.
- The area of disturbance must be kept to a minimum, as demolition should be done judiciously avoid the exposure of larger areas to wind erosion.
- Speed restrictions should be imposed and enforced.
- Cabs of machines should be swept or vacuumed regularly to remove accumulated dust.
- Exhaust pipes of vehicles should be directed so that they do not raise dust.
- Engine cooling fans of vehicles should be shrouded so that they do not raise dust.
- Hard surfaced haul roads or standing areas should be washed down and swept to remove accumulated dust.
- Dust suppression of roads being used during rehabilitation should be enforced

Activity 5

During this activity, there is the reshaping and restructuring of the landscape. Since this is an opencast operation mainly, the area to be reconstructed will be limited to the opencast areas. Topsoil can be imported to reconstruct the soil structure. There is less transfer of soil from one area to other therefore negligible chances of dust through wind erosion. Profiling of dumps and waste rock dump to enhance vegetation cover and reduce wind erosion from such surfaces post mining.

Mitigation measures

- Revegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option.
- Plants with roots that bind the soil, and vegetation cover should be used that breaks the impact of falling raindrops, thus preventing wind and water erosion.
- Plants used for revegetation should be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings.
- The area of disturbance must be kept to a minimum, as demolition should be done judiciously avoid the exposure of larger areas to wind erosion.
- Spreading of soil must be performed on less windy days.
- The bare soil will be prone to erosion and therefore there is need to reduce the velocity near the surface of the soil by re-vegetation.
- Leaving the surface of soil in a coarse condition reduces wind erosion and ultimately reduces dust levels.
- Additional mitigation measures include keeping soil moist using sprays or water tanks, using wind breaks.
- The best time to re-vegetate the area must be linked to the distribution and reliability of rainfall.
- Speed restrictions should be imposed and enforced.
- Cabs of machines should be swept or vacuumed regularly to remove accumulated dust.
- Exhaust pipes of vehicles should be directed so that they do not raise dust.
- Engine cooling fans of vehicles should be shrouded so that they do not raise dust.
- Hard surfaced haul roads or standing areas to be washed down and swept to remove accumulated dust.
- Dust suppression of roads being used during rehabilitation should be enforced.
- It is recommended that the rehabilitation by vegetating should begin during the operational phase already as the objective is to minimise the erosion.
- These measures should be aimed to reduce the potential for fugitive dust generation and render the impacts on ambient air quality negligible.

8.1.9 Noise

8.1.9.1 Overview: The common characteristics

The word "noise" is generally used to convey a negative response or attitude to the sound received by a listener. There are four common characteristics of sound, any or all of which determine listener response and the subsequent definition of the sound as "noise". These characteristics are:

- Intensity;
- Loudness;
- Annoyance; and
- Offensiveness.

Of the four common characteristics of sound, the intensity is the only one which is not subjective and can be quantified. Loudness is a subjective measure of the effect sound has on the human ear. As a quantity, it is therefore complicated but has been defined by experimentation on subjects known to have normal hearing.

The annoyance and offensive characteristics of noise are also subjective. Whether or not a noise causes annoyance mostly depends upon its reception by an individual, the environment in which it is heard, the type of activity and mood of the person and how acclimatised or familiar that person is to the sound.

8.1.9.2 Noise criteria of concern

The criteria used in this report were drawn from the criteria for the description and assessment of environmental impacts considering the latest EIA Regulations, SANS 10103:2008 as well as guidelines from the World Health Organization.

There are a number of criteria that are of concern for the assessment of noise impacts. These can be summarised in the following manner:

- *Increase in noise levels:* People or communities often react to an increase in the ambient noise level they are used to, which is caused by a new source of the noise. With regards to the Noise Control Regulations (promulgated in terms of the ECA), an increase of more than 5 dBA is considered a disturbing noise. See also Figure 8-23.

Zone Sound Levels: Previously referred to as the acceptable rating levels, it sets acceptable noise levels for various areas. See also This section investigates the conceptual construction activities as discussed above. Two conceptual noise models were developed considering the activities as depicted in Figure 8-24.

It is assumed that all equipment would be operating under full load (generate the most noise) at a number of locations and that atmospheric conditions would be ideal for sound propagation. Scenario 1 assumes that mining equipment is operating at surface level without the benefit of the berms, stockpiles or an overburden dump, with scenario 2 implementing a 3 m berm between the construction activities and the closest NSD. This is likely the worst case scenario that can occur during the construction phase of the project.

Noise rating level contours are illustrated in Figure 8-25 (daytime) and Figure 8-26 (night time) for Scenario 1 and Figure 8-27 (night-time) for scenario 2 (with a 3 m berm).

Table 8-30: Projected noise levels due to construction activities.

NSD	Rating level considering character of area and existing noise sources (dBA)		Projected (maximum) construction noise rating level (dBA)		Projected (maximum) construction noise rating level (dBA) – with 3 m berm	
	Day	Night	Day	Night	Day	Night
1	45	35	48.1	48.0	44.0	43.8
2	45	35	47.1	46.7	46.5	46.1
3	45	35	29.9	28.2	29.9	29.4

- .

- *Absolute or total noise levels:* Depending on their activities, people generally are tolerant to noise up to a certain absolute level, e.g. 65 dBA. Anything above this level will be considered unacceptable.

In South Africa, the document that addresses the issues concerning environmental noise is SANS 10103:2008 (See also This section investigates the conceptual construction activities as discussed above. Two conceptual noise models were developed considering the activities as depicted in Figure 8-24.

It is assumed that all equipment would be operating under full load (generate the most noise) at a number of locations and that atmospheric conditions would be ideal for sound propagation. Scenario 1 assumes that mining equipment is operating at surface level without the benefit of the berms, stockpiles or an overburden dump, with scenario 2 implementing a 3 m berm between the construction activities and the closest NSD. This is likely the worst case scenario that can occur during the construction phase of the project.

Noise rating level contours are illustrated in Figure 8-25 (daytime) and Figure 8-26 (night time) for Scenario 1 and Figure 8-27 (night-time) for scenario 2 (with a 3 m berm).

Table 8-30: Projected noise levels due to construction activities.

NSD	Rating level considering character of area and existing noise sources (dBA)		Projected (maximum) construction noise rating level (dBA)		Projected (maximum) construction noise rating level (dBA) – with 3 m berm	
	Day	Night	Day	Night	Day	Night
1	45	35	48.1	48.0	44.0	43.8
2	45	35	47.1	46.7	46.5	46.1
3	45	35	29.9	28.2	29.9	29.4

). It provides the equivalent ambient noise levels (referred to as Rating Levels), $L_{Req,d}$ and $L_{Req,n}$, during the day and night respectively to which different types of developments may be exposed.

Acoustical measurements indicated an area where the ambient sound levels are complex and different rating levels (noise limits) should be considered, such as:

- “Rural Noise District” (45 and 35 dBA day/night-time Rating i.t.o. SANS 10103:2008).
- “Sub-urban Noise District” (50 and 40 dBA day/night-time Rating i.t.o. SANS 10103:2008).
- “Urban Noise District” (55 and 45 dBA day/night-time Rating i.t.o. SANS 10103:2008)

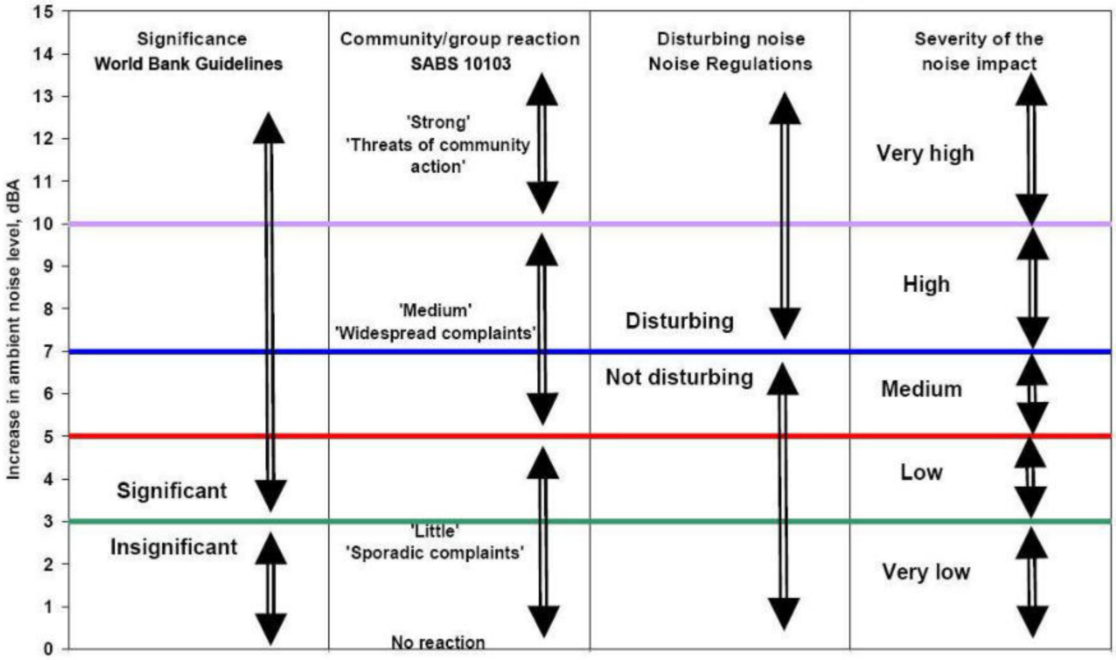


Figure 8-23: Criteria to assess the significance of impacts stemming from noise.

Table 8-29: Acceptable Zone Sound Levels for noise in districts (SANS 10103:2008)

1	2	3	4	5	6	7
Type of district	**Equivalent continuous rating level ($L_{Req,T}$) for noise** dBA					
	Outdoors			**Indoors, with open windows**		
	Day/night $L_{R,dn}$ [a]	**Daytime** $L_{Req,d}$ [b]	**Night-time** $L_{Req,n}$ [b]	**Day/night** $L_{R,dn}$ [a]	**Daytime** $L_{Req,d}$ [b]	**Night-time** $L_{Req,n}$ [b]
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with one or more of the following: workshops; business premises; and main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

SANS 10103:2008 also provides a guideline for estimating community response to an increase in the general ambient noise level caused by an intruding noise. If Δ is the increase in sound level, the following criteria are of relevance:

- **Δ ≤ 3 dBA:** An increase of 3 dBA or less will not cause any response from a community. It should be noted that for a person with average hearing acuity an increase of less than 3 dBA in the general ambient noise level would not be noticeable.
- **3 < Δ ≤ 5 dBA:** An increase of between 3 dBA and 5 dBA will elicit 'little' community response with 'sporadic complaints'. People will just be able to notice a change in the sound character in the area.
- **5 < Δ ≤ 15 dBA:** An increase of between 5 dBA and 15 dBA will elicit a 'medium' community response with 'widespread complaints'. In addition, an increase of 10 dBA is subjectively perceived as a doubling in the loudness of a noise. For an increase of more than 15 dBA, the community reaction will be 'strong' with 'threats of community action'.

Note that an increase of more than 7 dBA is defined as a disturbing noise and prohibited (National Noise Control Regulations).

8.1.9.3 Construction Phase

This section investigates the conceptual construction activities as discussed above. Two conceptual noise models were developed considering the activities as depicted in Figure 8-24.

It is assumed that all equipment would be operating under full load (generate the most noise) at a number of locations and that atmospheric conditions would be ideal for sound propagation. Scenario 1 assumes that mining equipment is operating at surface level without the benefit of the berms, stockpiles or an overburden dump, with scenario 2 implementing a 3 m berm between the construction activities and the closest NSD. This is likely the worst case scenario that can occur during the construction phase of the project.

Noise rating level contours are illustrated in Figure 8-25 (daytime) and Figure 8-26 (night time) for Scenario 1 and Figure 8-27 (night-time) for scenario 2 (with a 3 m berm).

Table 8-30: Projected noise levels due to construction activities.

NSD	Rating level considering character of area and existing noise sources (dBA)		Projected (maximum) construction noise rating level (dBA)		Projected (maximum) construction noise rating level (dBA) – with 3 m berm	
	Day	Night	Day	Night	Day	Night
1	45	35	48.1	48.0	44.0	43.8
2	45	35	47.1	46.7	46.5	46.1
3	45	35	29.9	28.2	29.9	29.4

Figure 8-24: Conceptual construction noise sources.

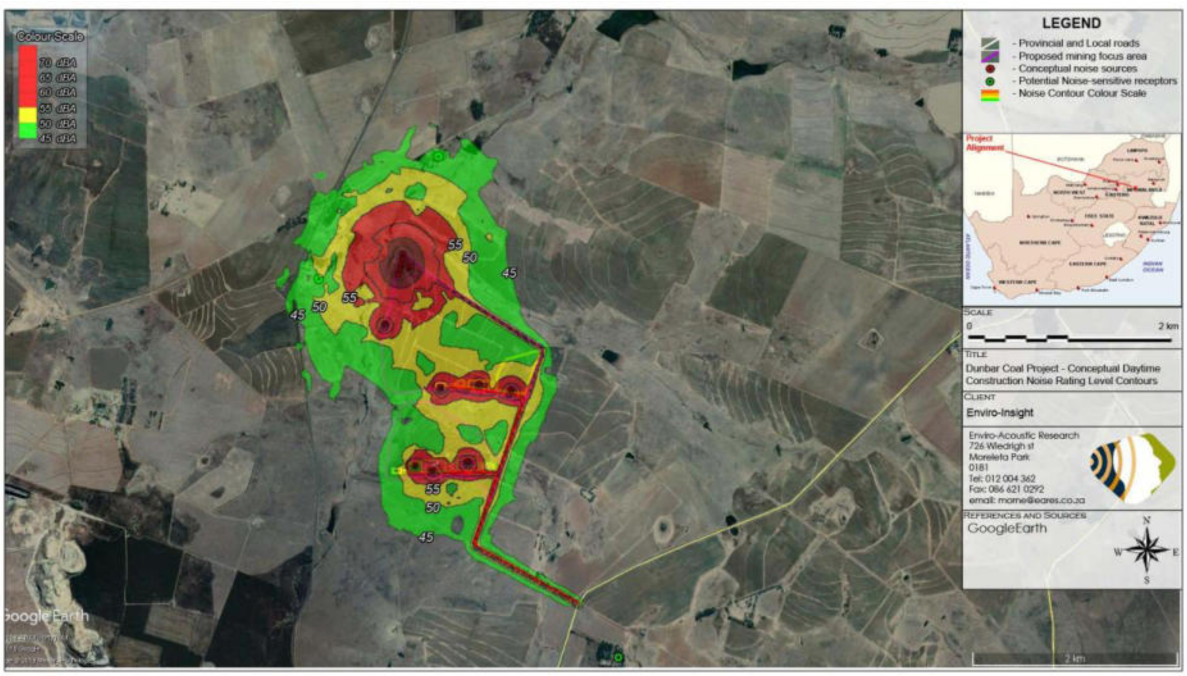


Figure 8-25: Projected conceptual daytime construction noise levels.

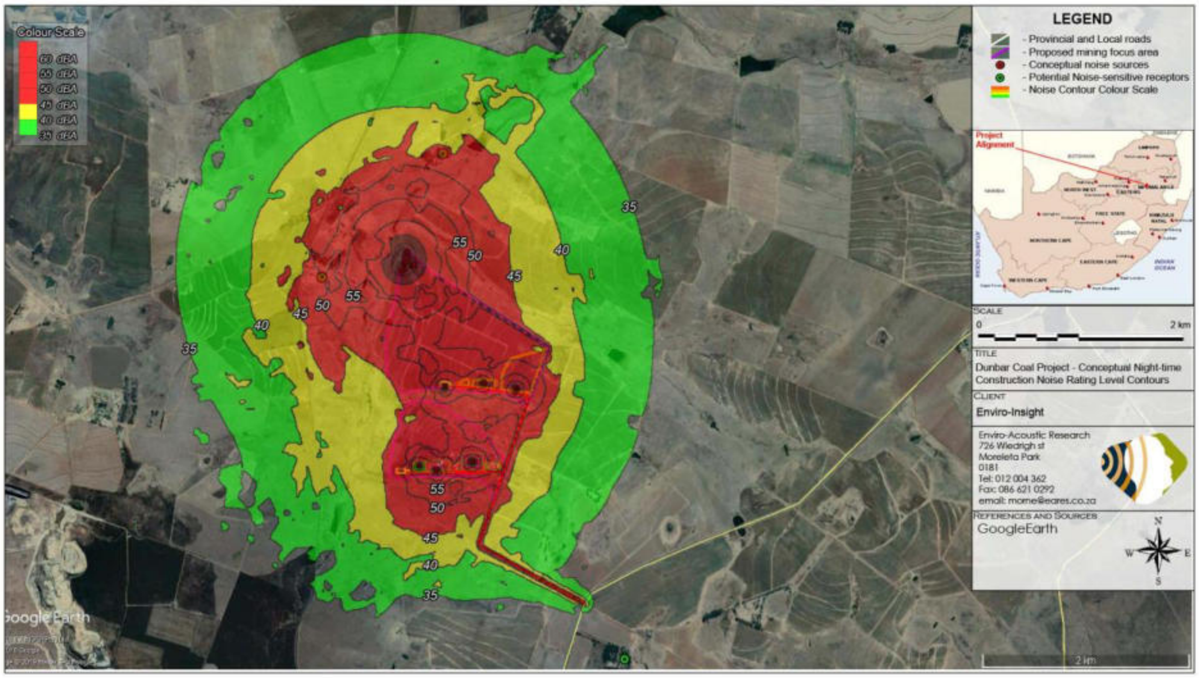


Figure 8-26: Projected conceptual night-time construction noise levels.

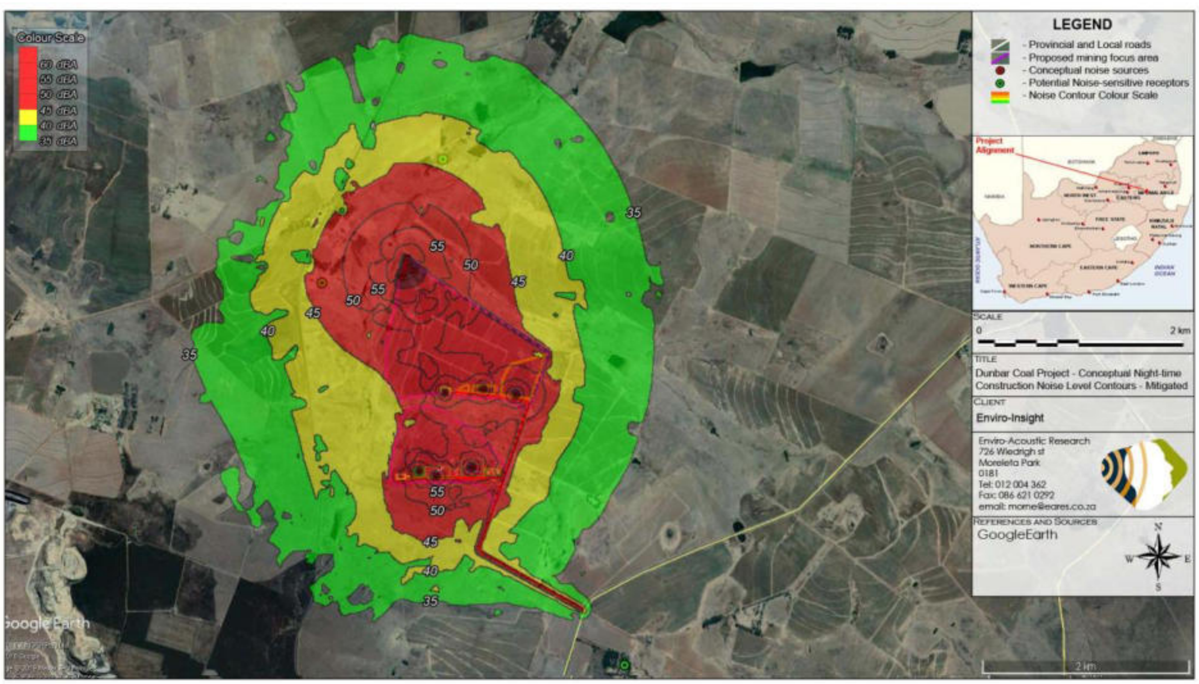


Figure 8-27: Projected conceptual night-time construction noise levels – Mitigated.

The potential significance of the noise impacts is summarized in the Tables below for the day and night-time scenarios respectively.

Table 8-31: Impact Assessment: Construction Activities during the day

Nature:	***Numerous simultaneous construction activities***	
Acceptable Rating Level	Precautious approach, with ambient sound level measurements indicating potential noise rating levels typical of a rural noise district. Tthe acceptable daytime rating levels (ideal 45 dBA during the day), with the noise limit as recommended by the WHO/IFC guidelines (55 dBA during the day) used as the upper limit.	
Status	Negative	
	Without Mitigation	***With Mitigation***
Extent	Low (Proximal - 2)	Low (Proximal - 2)
Duration	Low (Short – 2)	Low (Short – 2)
Severity	Low (2)	Low (2)
Frequency	Very high (Daily – 5)	Very high (Daily – 5)
Probability	Improbable (2)	Improbable (2)
Significance of Impact	**Low (42)**	**Low (42)**
Reversibility	High	High
Irreplaceable loss of resources?	Potential loss of quiet soundscape.	Potential loss of quiet soundscape.
Comments	Worst case scenario with numerous simultaneous construction activities	
Degree of Confidence	**High**	
Mitigation:	Mitigation not required for daytime construction activities.	
Residual Impacts:	This impact will only disappear after mine decommissioning and closure is completed.	

Table 8-32: Impact Assessment: Construction Activities at night

Nature:	***Numerous simultaneous construction activities***	
Acceptable Rating Level	Precautious approach, with ambient sound level measurements indicating potential noise rating levels typical of a rural noise district. The acceptable night-time rating levels (ideal 35 dBA at night), with the noise limit as recommended by the WHO/IFC guidelines (45 dBA during the day) used as the upper limit.	
Status	Negative	
	Without Mitigation	***With Mitigation***
Extent	Low (Proximal - 2)	Low (Proximal - 2)
Duration	Low (Short – 2)	Low (Short – 2)
Severity	Very-high (5)	High (4)
Frequency	Very high (Daily – 5)	Very high (Daily – 5)

Probability	Probable (4)	Possible (3)
Significance of Impact	**Medium-high (81)**	**Low-medium (64)**
Reversibility	High	High
Irreplaceable loss of resources?	Potential loss of quiet soundscape.	Potential loss of quiet soundscape.
Comments	Worst case scenario with numerous simultaneous construction activities	
Degree of Confidence	**High**	
Mitigation:	• General mitigation measures, see below. • The mine can develop a berm between the proposed opencast area and the closest NSD (closer than 1,000m from the active mining activities). This berm should be as high as possible, with a berm of 5 m recommended. This berm should be developed during the daytime period. • The mine can minimise night-time activities when operating within 1,000m from NSD (only allow drilling and the loading of material at one location within 1,000m with other construction activities further than 1,500m from NSD).	
Residual Impacts:	This impact will only disappear after mine decommissioning and closure is completed.	

8.1.9.3.1 Mitigation measures

Mitigation options included both management measures as well as technical changes. Options to reduce the noise impact during the construction phase include:

- All employees and contractors should receive induction that includes an environmental awareness component (noise). This is to allow employees and contractors to realize the potential noise risks that activities (especially night-time activities) pose to the surrounding environment.
- Use the topsoil and soft material to develop a noise berm between the mining opencast area (including haul roads) and the closest NSD (especially near NSD02 and 01). This berm should only be constructed during the daytime period.
- It is recommended that a noise monitoring programme is developed after the mine selected the final location of the plant. The noise monitoring program should be able to define existing long-term sound levels before the construction phase starts. This will allow the identification of a potential noise impact if a noise complaint is registered;
- Ensure a good working relationship between mine management and all potentially noise-sensitive receptors. Communication channels should be established to ensure prior notice to the sensitive receptor if work is to take place close to them. Information that should be provided to potentially sensitive receptor(s) includes:
    - Proposed working dates, the duration that work will take place in an area and working times;
    - The reason why the activity is taking place;
    - The construction methods that will be used; and

    - Contact details of a responsible person where any complaints can be lodged should there be an issue of concern.
- Ensure that equipment is well maintained and fitted with the correct and appropriate noise abatement measures. Engine bay covers over heavy equipment could be pre-fitted with sound absorbing material. Heavy equipment that fully encloses the engine bay should be considered, ensuring that the seam gap between the hood and vehicle body is minimised.
- The operation should investigate the use of white-noise alarms instead of tonal reverse alarms on heavy vehicles operating on roads, within the mining area and at stockpile areas[29, 30]. The advantages of white noise alarms above tonal alarms are:
    - It is as safe as a tonal alarm[31].
    - Highly audible close to the alarm (or reversing truck)[32].
    - It generates a more uniform sound field behind a reversing vehicle[33].
    - Greater directional information, workers can locate the source faster.
    - Significantly less environmental noise and it creates significantly less annoyance far away.
    - When properly installed, white noise alarms of a similar sound power emission level are more likely to comply with the ISO 9533 standard.

The mine must know that community involvement needs to continue throughout the project. Annoyance is a complicated psychological phenomenon; as with many industrial operations, expressed annoyance with sound can reflect an overall annoyance with the project, rather than a rational reaction to the sound itself. At all stages surrounding receptors should be informed about the project, providing them with factual information without setting unrealistic expectations. It is counterproductive to suggest that the activities (or facility) will be inaudible due to existing high ambient sound levels. The magnitude of the sound levels will depend on a multitude of variables and will vary from day to day and from place to place with environmental and operational conditions. Audibility is distinct from the sound level because it depends on the relationship between the sound level from the activities, the spectral characteristics and that of the surrounding soundscape (both level and spectral character).

---

[29] White Noise Reverse Alarms: http://www.brigade-electronics.com/products.

[30] https://www.constructionnews.co.uk/home/white-noise-sounds-the-reversing-alarm/885410.article - White noise sounds the reversing alarm

[31] https://www.acoustics.asn.au/conference_proceedings/AAS2012/papers/p126.pdf - Which is Safer – Tonal or Broadband Reversing Alarms

[32] http://www.irsst.qc.ca/media/documents/PubIRSST/R-833.pdf - Safety of workers behind heavy vehicles

[33] https://www.vaultintel.com/blog/reversing-beeps-could-be-a-thing-of-the-past

https://brigade-electronics.com/white-sound-reversing-alarms-improving-safety-environment/

8.1.9.4 Operational Phase

The potential significance of the noise impacts is summarized in the Tables below for the day and night-time scenarios respectively. This scenario is based on the assumption that a berm (minimum height of 3 m) was constructed between the mining activities and the closest NSD (including the haul roads).

Table 8-33: Impact Assessment: Operational Activities during the day

Nature:	***Numerous simultaneous operational activities***	
Acceptable Rating Level	Precautious approach, with ambient sound level measurements indicating potential noise rating levels typical of a rural noise district. The acceptable daytime rating levels (ideal 45 dBA during the day), with the noise limit as recommended by the WHO/IFC guidelines (55 dBA during the day) used as the upper limit.	
Status	Negative	
	Without Mitigation	***With Mitigation***
Extent	Low (Proximal - 2)	Low (Proximal - 2)
Duration	High (Long term – 4)	High (Long term – 4)
Severity	Very-low (1)	Very-low (1)
Frequency	Very high (Daily – 5)	Very high (Daily – 5)
Probability	Improbable (2)	Improbable (2)
Significance of Impact	**Low (49)**	**Low (49)**
Reversibility	High	High
Irreplaceable loss of resources?	Potential loss of quiet soundscape.	Potential loss of quiet soundscape.
Comments	Worst case scenario with numerous simultaneous construction activities	
Degree of Confidence	**High**	
Mitigation:	Mitigation not required for daytime operational activities.	
Residual Impacts:	This impact will only disappear after mine decommissioning and closure is completed.	

Table 8-34: Impact Assessment: Operational Activities at night.

Nature:	***Numerous simultaneous operational activities***
Acceptable Rating Level	Precautious approach, with ambient sound level measurements indicating potential noise rating levels typical of a rural noise district. The acceptable night-time rating levels (ideal 35 dBA at night), with the noise limit as recommended by the WHO/IFC guidelines (45 dBA during the day) used as the upper limit.
Status	Negative

	Without Mitigation	*With Mitigation*
Extent	Low (Proximal - 2)	Low (Proximal - 2)
Duration	High (Long – 4)	Low (Short – 2)
Severity	Very-high (5) Noise levels higher than 45 dBA at NSD02	High (4)
Frequency	Very high (Daily – 5)	Very high (Daily – 5)
Probability	Probable (4)	Possible (3)
Significance of Impact	**Medium-high (99)**	**Low-medium (64)**
Reversibility	High	High
Irreplaceable loss of resources?	Potential loss of quiet soundscape.	Potential loss of quiet soundscape.
Comments	Worst case scenario with numerous simultaneous construction activities	
Degree of Confidence	**High**	
Mitigation:	• General mitigation measures, see below. • The mine can develop a berm between the proposed opencast area and the closest NSD (closer than 1,000m from the active mining activities). This berm should be as high as possible, with a berm of 5 m recommended. This berm should be developed during the daytime period. • The mine can minimise night-time activities when operating within 1,000m from NSD.	
Residual Impacts:	The noise level will decrease as mining moves away from closest NSD. This impact will only disappear after mine decommissioning and closure is completed.	

8.1.9.4.1 Mitigation measures

Mitigation measures should include:

- Ensure that equipment is well maintained and fitted with the correct and appropriate noise abatement measures;
- Continuation of noise measurement programme;
- All employees and contractors should receive induction that includes an environmental awareness component (noise). This is to allow employees and contractors to realize the potential noise risks that activities (especially night-time activities) pose to the surrounding environment.
- The mine should investigate the use of white-noise alarms instead of tonal reverse alarms on heavy vehicles operating on roads and at stockpile areas;
- Compliance with the Noise conditions of the Environmental Management Plan that covers:
  - Potential mitigation measures as defined in this report;
  - Formal register where receptors can lodge any noise complaints;
  - Noise measurement protocol to investigate any noise complaints; and

- The commitment from the mine to consider reasonable mitigation if the noise complaint investigation indicates the validity of a noise complaint. These measures could include steps ranging from process changes, development of barriers or enclosure of the noise source and even relocation (if no other feasible alternatives exist).

8.1.9.5 Potential Decommissioning and Closure Noise Impacts

Final decommissioning activities will have a noise impact lower than either the construction or operational phases. This is because decommissioning and closure activities normally take place during the day using minimal equipment (due to the decreased urgency of the project). While there may be various activities, there is a very small risk for any additional noise impact.

8.1.10 Blasting and Vibration

8.1.10.1 Human Perceptions with blasting impacts

Beginning in the 1930s, research was conducted with volunteers to determine sensitivities to vibrations. Although people are sensitive to sounds and vibrations, it is difficult to quantify perceptions. Inside a structure, people will feel the building shake and hear the objects around them rattle such as windows and knick-knacks on walls. When an event is perceived, some people will say that they felt very strong vibrations, even if the vibration was too low to be felt outside. The reactions of people are best understood when observed in their own homes during times of real-life events. These reactions may not be the same as those of volunteers under controlled conditions.

Human response to blasting is subjective, as two people will react differently to the same vibration event depending on where they are in a structure, their frame of mind and their personality. Unfavourable reactions to vibrations may often result in complaints. When residents feel a blast, they may become concerned about damage to their home.

The threshold peak particle velocity of ground vibration perception is about 0.51 mm/s for most people. This is 1/100 of the limit of 50 mm/s commonly used for construction blasting.

People in different living environments normally perceive blasting as negative. If a project is not perceived as beneficial to a community, blasting on the project may be unwelcome.

In addition, during a blast event, people inside a building tend to perceive\experience\feel the vibrations differently than people outside a building. People inside a structure are immersed in the vibration event and often cannot tell the source of the vibration. The windows may rattle and there may be other structure responses that enhance their perception of the event. They can also perceive structure vibrations that are well below levels that could possibly cause threshold damage, yet, due to the fear of potential damage, this perception could be result in an increased response (stress, complaints, etc.). On the other hand, a person outside a structure will not notice any of the structure responses. Therefore, their perception of the event will generally be much less, mainly relating to the audible noise or the pressure changes relating to the air blast.

8.1.10.2 Why blasting concerns communities

For hard rock mining, blasting is considered as the most efficient and economical method used for fragmenting rocks masses. Nonetheless, only 20-30% of the available energy is used for rocks fragmentation and displacement, while the rest is wasted in the form of ground vibration, air blast, noise and fly-rocks.

Ground vibration and air blast are a matter of great concern as they could result in damage to existing surface structures and generate nuisances to the receptors in the vicinity of mines.

Currently there are no specific legislation pertaining to blasting vibration levels, air blast levels and fly rock control in South Africa. However, most developed countries have ground vibration standards, although most of these standards are based on the following three standards/guidelines, namely:

- Vibration criteria as published by the US Bureau of Mines (USMB) and the US Office of Surface Mining (OSM) – USBM RI 8507 only focus on potential blasting impacts.
- The Swiss standards (SN 640 312a) that are effectively three different standards; one used for blasting, one for pile driving and one used for machines and traffic.
- Vibration limits as developed by the Federal Transit Administration (FTA Noise and Vibration Manual) – used for road construction and traffic.

8.1.10.3 Ground Vibration

Humans begin to perceive ground vibration at around 0.12 mm/s PPV, a level significantly lower than the vibration level where damage may start to occur. The longer a vibration of a given peak velocity lasts; the more disturbing people will find it. In addition, the longer a vibration lasts, the greater the probability of it causing damage, all other things being equal. It should be noted that there is no correlation between vibration complaints and the ground vibration level, as people may start to complain about vibration even at very low levels.

Chiappetta (2000) and Griffin (1990) defined ground vibration levels for different frequencies as defined below and illustrated in Figure 8-28.

Table 8-35: Human response to ground vibration.

Effects on Humans	Ground vibration Level (mm/s)
Imperceptible	0.025 – 0.076
Barely perceptible	0.076 – 0.254
Distinctly perceptible	0.254 – 0.762
Strongly perceptible	0.762 – 2.540
Disturbing	2.540 – 7.620
Very disturbing	7.620 – 25.400

Vibration damage probability, as with many other quantities in science, roughly follows an S-shaped "sigmoid curve", as a function of vibration intensity. Over a range of low vibration intensities, no houses are damaged. At these low intensities, people may be able to feel the vibration, even though no visible damage is done. At the highest vibration velocities (intensities), virtually all structures experiencing the vibration can visibly be damaged. Essentially all the people feeling such a high intensity vibration will be made distinctly uncomfortable by it.

The USBM RI 8507 standard is generally accepted in South Africa. This standard was developed through research and available data over a number of years and focus on the protection of structures from potential damage. It uses an analysis graph that considers vibration amplitudes and frequency to define the risk of potential structural damage due to ground vibration (See also Figure 8-23). To minimise complaints from receptors, vibration levels should ideally be kept beneath the "unpleasant" curve (this is measured from actual blasts).

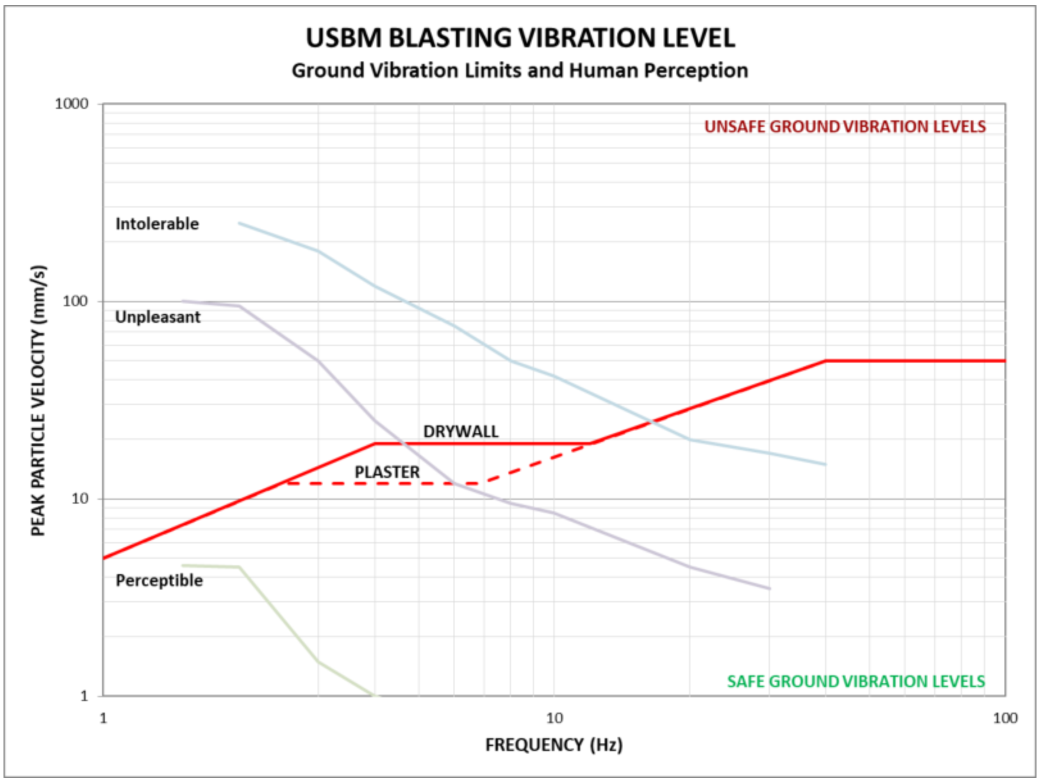


Figure 8-28: Human vibration sensitivities and potential structural damage compared to the RI 8507 limits

To avoid damage to buildings, ground vibration levels should be within the "safe" area as highlighted in Figure 8-23. Information from USBM RI 8507 indicates that 50% of homes will experience "threshold damage" at a velocity of about 51 mm/s. For "minor" damage, that 50% point is at about 76 mm/s, while for "major" damage, it is at about 100 mm/s. At the 5% probability level, the PPV for threshold damage from blasting vibrations is about 18 mm/s, based on the same data (drywall construction). The OSM and RI 8507 19 mm/s mid-frequency limits are, thus, set at a level which has approximately a 5% probability of causing damage to a drywall from direct ground vibration. These limits are developed for different types of structures and materials and highlighted below. This report will use the 25 mm/s limit for houses and other sensitive structures (including boreholes). Due to the roads, rail way line, pipeline and the electrical line various other limits will also be considered.

Table 8-36: Ground vibration limits for various structures

Material / Structure	**Ground vibration limit (mm/s)**
National Roads / Tar Roads / Railways	150
Electrical Lines	75
Steel pipelines, cement dams	50
Sensitive Plant equipment, mortar and brick house, boreholes	25
Engineered concrete and masonry (no plaster)	7.62
Sensitive structures, adobe and informal houses	6
Buildings extremely susceptible to vibration damage	3

8.1.10.4 Air blast concerns

Air blasts can cause discomfort to persons and, at high levels, damage to structures. At very high levels, it may even cause injury to people. Air blasts could also interact with structures and create secondary noises which people detect, raising their concern about the blasting activity. While rare, window breakage may be the result of an air blast. Air blast levels that may result in damage were estimated by Persson (1994) and Oriard (2002) and is defined below.

Table 8-37: Air blast levels that may result in damage or complaints

Descriptor	**Acoustic Level (dB)**
Air pressure from an 11 m/s wind gust.	110
Annoyance threshold in Australia. Mildly unpleasant.	115
Recommended limit in Australia for sensitive sites.	**120**
Resonant response of large surfaces (roofs, ceilings). Complaints start.	130
Limit for human irritability. USBM and OSMRE limit.	134
Some windows break.	150
Most windows break.	170
Structural Damage.	180

8.1.10.5 Fly-rock concerns

Fly rock is a significant danger to people, equipment and structures with damage due to this being undeniable. Mines therefore go through significant effort to ensure that the risks from fly rock are minimized due to the potential penalties to the mine if fly-rock complaints are registered. These penalties may be institutional consequences (regulatory directives, fines, legal action) and monetary compensation. As such there should be no risk of fly rock at structures or where people or animals may congregate. This is the main reason for the 500m exclusion zone around blasting activities

8.1.10.6 Significance of Ground Vibration Impacts

The magnitude of the ground vibration levels were calculated above in section 7.16, defined in the Table below with the significance summarised for human response and dangers to structures respectively.

Table 8-38: Impact Assessment: Ground vibration impacts (Human Responses)

Acceptable Level	Use the level of 2.54 mm/s as the limit for people in the area	
Status	Negative	
	Without Mitigation (detonating 5 blastholes simultaneously for a 437 kg charge per delay)	***With Mitigation (detonating only 1 blasthole at a time for a 87.4 kg charge per delay)***
Extent	Low (Proximal - 2)	Low (Proximal - 2)
Duration	High (Long term – 4)	High (Long term – 4)
Severity	High (4 – for a 437 kg charge per delay)	Medium (3 – for a 84.7 kg charge per delay)
Frequency	High (Weekly – 4)	High (Weekly – 4)
Probability	Probable (4)	Possible (3)
Significance of Impact	**Medium-High (80)**	**Low (42)**
Reversibility	High	High
Degree of Confidence	**Medium-high**	
Mitigation:	Mitigation required, including: - If no complaints are registered the blast monitoring can be ceased. This report must be updated if the blast design is changed where more than 500 kg explosives are detonated per delay. - The Mine must consider the location of closest residents to the planned blast and reduce the charge per delay to less than 437 kg when blasting within 850 m from a dwelling used for residential purposes.	

Table 8-39: Impact Assessment: Ground vibration impacts (Damage to residential structures in area).

Acceptable Level	Use the level of 6 mm/s as the limit for informal houses in local community	
Status	Negative	
	Without Mitigation (detonating 5 blastholes simultaneously for a 437 kg charge per delay)	***With Mitigation (detonating only 1 blasthole at a time for a 87.4 kg charge per delay)***
Extent	Low (Proximal - 2)	Low (Proximal - 2)

Duration	High (Long term – 4)	High (Long term – 4)
Severity	High (4 – for a 437 kg charge per delay)	Medium (3 – for a 84.7 kg charge per delay)
Frequency	High (Weekly – 4)	High (Weekly – 4)
Probability	Improbable (2)	Highly Improbable (1)
Significance of Impact	**Low-medium (60)**	**Low (54)**
Reversibility	High	High
Degree of Confidence	**Medium-high**	
Mitigation:	Mitigation not required but highlighted due to the sensitivity of people to blasting vibrations. The Mine must consider the location of closest residents to the planned blast and could reduce the charge per delay. Local community members to be notified of times when blasts will be undertaken. Community to know that the potential impact of vibration was assessed.	

Table 8-40: Impact Assessment: Ground vibration impacts (Damage to Structures in area)

Acceptable Level	Use the level of 25 mm/s as the limit for buildings and structures in area. Use the level of 50 mm/s as the limit for pipelines, cement dams and reservoirs in area. Use the level of 75 mm/s as the limit for electrical power lines in area. Use the level of 150 mm/s as the limit for roads and railway line in area.	
Status	Negative	
	Without Mitigation (detonating 5 blastholes simultaneously for a 437 kg charge per delay)	***With Mitigation (detonating only 1 blasthole at a time for a 87.4 kg charge per delay)***
Extent	Low (Proximal - 2)	Low (Proximal - 2)
Duration	High (Long term – 4)	High (Long term – 4)
Severity	Medium (3 – for a 437 kg charge per delay)	Medium (3 – for a 437 kg charge per delay)
Frequency	High (Weekly – 4)	High (Weekly – 4)
Probability	Highly Improbable (1)	Highly Improbable (1)
Significance of Impact	**Low (45)**	**Low (45)**
Reversibility	High	High
Degree of Confidence	**Medium-high**	
Mitigation:	Mitigation not required but highlighted due to the sensitivity of people to blasting vibrations.	

8.1.10.7 Significance of Air blast Impacts

The magnitude of the air blast levels were calculated in section 17.6, defined below with the significance summarised.

Table 8-41: Impact Assessment: Air blast Impacts for a 2,484 kg blast (worst-case)

Acceptable Level	Use the level of 120 dB as the limit for people in the area.	
Status	Negative	
	Without Mitigation (detonating 5 blastholes simultaneously for a 437 kg charge per delay)	***With Mitigation (detonating only 1 blasthole at a time for a 87.4 kg charge per delay)***
Extent	Low (Proximal - 2)	Low (Proximal - 2)
Duration	High (Long term – 4)	High (Long term – 4)
Severity	Low (2 – for a 437 kg charge per delay)	Very Low (1 – for a 87.4 kg charge per delay)
Frequency	High (Weekly – 4)	High (Weekly – 4)
Probability	Possible (3)	Improbable (2)
Significance of Impact	**Low-Medium (56)**	**Low (48)**
Reversibility	High	High
Degree of Confidence	**Medium-high**	
Mitigation:	Mitigation not required, although it should be noted that: - Mine should initiate a forum to inform the close residents about the likely vibration and air blast levels, the proposed blasting schedule and warning methodology the mine will employ before a blast. When the residents are inside the house during a blast, vibration of windows and ceilings may appear excessive. - Mine to erect blasting notice boards in the area with blasting dates and times highlighted. - Mine to prevent blasting in adverse meteorological conditions where possible (overcast conditions, strong wind blowing in direction of local community, early in the mornings or late in the afternoon).	

8.1.10.8 Significance of Fly rock Impacts

The magnitude of potential fly rock risk levels were calculated in section 17.6 and the significance is summarised below.

Table 8-42: Impact Assessment: Fly rock Risks

Acceptable Level	There should be no risk of fly rock that can pose a risk to people, structures or equipment.	
Status	Negative	
	Without Mitigation (stemming from 2.0 m	***With Mitigation (stemming from 2.2 m***

	associated with optimised blast design)	***associated with assumed blast design)***
Extent	Low (Proximal - 2)	Low (Proximal - 2)
Duration	High (Long term – 4)	High (Long term – 4)
Severity	Very High (5)	Very High (5)
Frequency	High (Weekly – 4)	High (Weekly – 4)
Probability	Improbable (2)	Highly Improbable (1)
Significance of Impact	**Low-Medium (66)**	**Low-Medium (55)**
Reversibility	High	High
Degree of Confidence	**Medium-high**	
Mitigation:	Mitigation not required, but the mine should: - Recommended that buildings and structures closer than 260 m from potential blasting area be relocated; - People and livestock to be moved further than 500 m from active blast before a blast is detonated; - Any evidence of fly rock is noted and the blast be analysed for possible improvements; - Consider the blast design to increase the stemming length to more than 2.2m; - Blaster to keep full records of blast (blast design, timing, explosive mass per blast hole, stemming, subdrill, spacing, burden, etc.).	

8.1.10.9 Closure and Decommissioning Phase Impacts

No drilling and blasting is expected during the closure and decommissioning phase.

Table 8-43: Potential responses to the blasting activities – optimized blast parameters.

Description of Structure	Reference	Distance from potential blast site (m)	PPV, 87.4 kg Blast Charge (mm/s)	PPV, 437 kg Blast Charge (mm/s)	Air blast level, 437 kg Blast Charge (dBA)	Potential structural damage		Potential Human Response		
						87.4 kg Blast Charge	437 kg Blast Charge	Vibration, 87.4 kg Blast Charge	Vibration, 437 kg Blast Charge	Air blast level, 437 kg Blast Charge
House	HS01	761	**0.8**	**3.0**	117	Very Low Risk	Very Low Risk	Detectable	Unpleasant	No Response
House	HS02	744	**0.8**	**3.2**	117	Very Low Risk	Very Low Risk	Detectable	Unpleasant	No Response
House	HS03	709	**0.9**	**3.4**	118	Very Low Risk	Very Low Risk	Detectable	Unpleasant	No Response
House	HS04	672	**1.0**	**3.7**	118	Very Low Risk	Very Low Risk	Detectable	Unpleasant	No Response
House	HS05	730	**0.9**	**3.3**	117	Very Low Risk	Very Low Risk	Detectable	Unpleasant	No Response
House	HS06	884	**0.6**	**2.4**	115	Very Low Risk	Very Low Risk	Detectable	Detectable	No Response
House	HS07	886	**0.6**	**2.4**	115	Very Low Risk	Very Low Risk	Detectable	Detectable	No Response
House	HS08	930	**0.6**	**2.2**	115	Very Low Risk	Very Low Risk	Detectable	Detectable	No Response
House	HS09	971	**0.5**	**2.0**	114	Very Low Risk	Very Low Risk	Detectable	Detectable	No Response
House	HS10	1960	**0.2**	**0.6**	107	Very Low Risk	Very Low Risk	Detectable	Detectable	No Response
House	HS11	1928	**0.2**	**0.7**	107	Very Low Risk	Very Low Risk	Detectable	Detectable	No Response
House	HS12	750	**0.8**	**3.1**	117	Very Low Risk	Very Low Risk	Detectable	Unpleasant	No Response
Boreholes	DBR02	836	**0.7**	**2.6**	116	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Boreholes	DBR01	473	**1.8**	**6.7**	122	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Bridge	BC01	1921	**0.2**	**0.7**	107	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Bridge	BC02	863	**0.7**	**2.5**	116	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Bridge	BC03	875	**0.6**	**2.4**	116	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Cement dam	DC01	820	**0.7**	**2.7**	116	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Cement dam	DC02	856	**0.7**	**2.5**	116	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Cement dam	DC03	714	**0.9**	**3.4**	118	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Cement dam	DC04	1465	**0.3**	**1.0**	110	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant

Description of Structure	Reference	Distance from potential blast site (m)	PPV, 87.4 kg Blast Charge (mm/s)	PPV, 437 kg Blast Charge (mm/s)	Air blast level, 437 kg Blast Charge (dBA)	Potential structural damage		Potential Human Response		
						87.4 kg Blast Charge	437 kg Blast Charge	Vibration, 87.4 kg Blast Charge	Vibration, 437 kg Blast Charge	Air blast level, 437 kg Blast Charge
Cement dam	DC05	1639	**0.2**	**0.9**	109	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Structure	SS01	886	**0.6**	**2.4**	115	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Structure	SS02	845	**0.7**	**2.6**	116	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Structure	SS03	572	**1.3**	**4.9**	120	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Structure	SS04	1608	**0.2**	**0.9**	109	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE01	876	**0.6**	**2.4**	116	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE02	279	**4.2**	**15.9**	127	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE03	522	**1.5**	**5.7**	121	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE04	839	**0.7**	**2.6**	116	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE05	287	**4.0**	**15.2**	127	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE06	316	**3.4**	**12.9**	126	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE07	355	**2.8**	**10.7**	125	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE08	391	**2.4**	**9.1**	124	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE09	368	**2.7**	**10.1**	125	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE10	607	**1.2**	**4.4**	119	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE11	857	**0.7**	**2.5**	116	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE12	1178	**0.4**	**1.5**	112	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE13	1165	**0.4**	**1.5**	113	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE14	1040	**0.5**	**1.8**	114	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE15	957	**0.6**	**2.1**	115	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE16	935	**0.6**	**2.2**	115	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE17	960	**0.5**	**2.1**	115	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant

Description of Structure	Reference	Distance from potential blast site (m)	PPV, 87.4 kg Blast Charge (mm/s)	PPV, 437 kg Blast Charge (mm/s)	Air blast level, 437 kg Blast Charge (dBA)	Potential structural damage		Potential Human Response		
						87.4 kg Blast Charge	437 kg Blast Charge	Vibration, 87.4 kg Blast Charge	Vibration, 437 kg Blast Charge	Air blast level, 437 kg Blast Charge
Pylon	PE18	1015	**0.5**	**1.9**	114	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE19	969	**0.5**	**2.0**	114	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE20	1500	**0.3**	**1.0**	110	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE21	1502	**0.3**	**1.0**	110	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE22	1714	**0.2**	**0.8**	109	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE23	1409	**0.3**	**1.1**	111	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE24	1452	**0.3**	**1.0**	110	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE25	1619	**0.2**	**0.9**	109	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE26	1877	**0.2**	**0.7**	108	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE27	1409	**0.3**	**1.1**	111	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE28	1653	**0.2**	**0.8**	109	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE29	1890	**0.2**	**0.7**	107	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE30	1828	**0.2**	**0.7**	108	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Pylon	PE31	1498	**0.3**	**1.0**	110	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant
Railway	Railway	774	**0.8**	**3.0**	117	Very Low Risk	Very Low Risk	Not relevant	Not relevant	Not relevant

8.2 ITEM 3(G)(VI): METHODOLOGY USED IN DETERMINING AND RANKING THE NATURE, SIGNIFICANCE, CONSEQUENCE, EXTENT, DURATION AND PROBABILITY OF POTENTIAL ENVIRONMENTAL IMPACTS AND RISKS

Once a potential impact has been determined it is necessary to identify which project activity will cause the impact, the probability of occurrence of the impact, and its magnitude and extent (spatial and temporal). This information is important for evaluating the significance of the impact, and for defining mitigation and monitoring strategies. Direct and indirect impacts of the impacts identified during the specialist investigations were assessed in terms of five standard rating scales to determine their significance.

The rating system used for assessing impacts (or when specific impacts cannot be identified, the broader term issue should apply) is based on six criteria, namely:

- **Status** of impacts (Table 8-44) – determines whether the potential impact is positive (positive gain to the environment), negative (negative impact on the environment), or neutral (i.e. no perceived cost or benefit to the environment). Take note that a positive impact will have a low score value as the impact is considered favourable to the environment;
- **Spatial extent** of impacts (
- Table 8-45) – determines the spatial scale of the impact on a scale of localised to global effect. Many impacts are significant only within the immediate vicinity of the site or within the surrounding community, whilst others may be significant at a local or regional level. Potential impact is expressed numerically on a scale of 1 (site-specific) to 5 (global);
- **Duration** of impacts (Table 8-46) – refers to the length of time that the aspect may cause a change either positively or negatively on the environment. Potential impact is expressed numerically on a scale of 1 (project duration) to 5 (permanent);
- **Frequency of the activity** (Table 8-47) – The frequency of the activity refers to how regularly the activity takes place. The more frequent an activity, the more potential there is for a related impact to occur.
- **Severity** of impacts (Table 8-48) – quantifies the impact in terms of the magnitude of the effect on the baseline environment, and includes consideration of the following factors:
    - The reversibility of the impact;
    - The sensitivity of the receptor to the stressor;
    - The impact duration, its permanency and whether it increases or decreases with time;
    - Whether the aspect is controversial or would set a precedent;
    - The threat to environmental and health standards and objectives;
- **Probability** of impacts (Table 8-49) –quantifies the impact in terms of the likelihood of the impact occurring on a percentage scale of <5% (improbable) to >95% (definite).

Table 8-44: Status of Impacts

Rating	Description	Quantitative Rating
Positive	A benefit to the receiving environment (positive impact)	+
Neutral	No determined cost or benefit to the receiving environment	N

Negative	At cost to the receiving environment (negative impact)	-

Table 8-45: Extent of Impacts

Rating	Description	Quantitative Rating
Very Low	**Site Specific** – impacts confined within the project site boundary	1
Low	**Proximal** – impacts extend to within 1 km of the project site boundary	2
Medium	**Local** – impacts extend beyond to within 5 km of the project site boundary	3
High	**Regional** – impacts extend beyond the site boundary and have a widespread effect - i.e. > 5 km from project site boundary	4
Very High	**Global** – impacts extend beyond the site boundary and have a national or global effect	5

Table 8-46: Duration of Impacts

Rating	Description	Quantitative Rating
Very Low	**Project duration** – impacts expected only for the duration of the project or not greater than 1 year	1
Low	**Short term** – impacts expected on a duration timescale of 1 to 2 years	2
Medium	**Medium term** – impacts expected on a duration timescale of 2-5 years	3
High	**Long term** – impacts expected on a duration timescale of 5-15 years	4
Very High	**Permanent** – impacts expected on a duration timescale exceeding 15 years	5

Table 8-47: Frequency of impacts

Rating	Frequency	Quantitative Rating
Very Low	Annually or less	1
Low	6 monthly	2
Medium	Monthly	3
High	Weekly	4
Very High	Daily	5

Table 8-48: Severity of Impacts

Rating	Description	Quantitative Rating
Very Low	Negligible – zero or very low impact	1
Low	Site specific and short term impacts	2
Medium	Local scale and / or short term impacts	3
High	Regional and / or long term impacts	4

Very High	Global scale and / or permanent environmental change	5

Table 8-49: Probability of Impacts

Rating	Description	Quantitative Rating
Highly Improbable	Likelihood of the impact arising is estimated to be negligible; <5%.	1
Improbable	Likelihood of the impact arising is estimated to be 5-35%.	2
Possible	Likelihood of the impact arising is estimated to be 35-65%	3
Probable	Likelihood of the impact arising is estimated to be 65-95%.	4
Highly Probable	Likelihood of the impact arising is estimated to be > 95%.	5

Determination of Impact Significance

The information presented above in terms of identifying and describing the aspects and impacts is summarised in below in Table 8-50 and significance is assigned with supporting rational.

Table 8-50: Consolidated Table of Aspects and Impacts Scoring

Spatial Scale	Rating	Duration	Rating	Severity	Rating
Activity specific	1	One day to one month	1	Insignificant/non-harmful	1
Area specific	2	One month to one year	2	Small/potentially harmful	2
Whole site/plant/mine	3	One year to ten years	3	Significant/slightly harmful	3
Regional/neighbouring areas	4	Life of operation	4	Great/harmful	4
National	5	Post closure	5	Disastrous/extremely harmful	5

Frequency of Activity	Rating	Probability of Impact	Rating
Annually / Once-off	1	Almost never/almost impossible	1
6 monthly	2	Very seldom/highly unlikely	2
Monthly	3	Infrequent/unlikely/seldom	3
Weekly	4	Often/regularly/likely/possible	4
Daily / Regularly	5	Daily/highly likely/definitely	5

Significance Rating of Impacts	Timing
Very Low (1-25)	Pre-construction
Low (26-50)	Construction
Low – Medium (51-75)	Operation
Medium – High (76-100)	Decommissioning

High (101-125) Very High (126-150)
Adjusted Significance Rating

Significance will be classified according to the following:

- **Very Low to Low**: it will not have an influence on the decision;
- **Medium to Medium-High**: it should have an influence on the decision unless it is appropriately mitigated;
- **High to Very High**: it would influence the decision regardless of any possible mitigation. Alternative options including rehabilitation and/or offset should be investigated.

The environmental significance rating is an attempt to evaluate the importance of a particular impact, the consequence and likelihood of which is assessed by the relevant specialist. The description and assessment of the aspects and impacts is presented in a consolidated table with the significance of the impact assigned using the process and matrix detailed below.

The sum of the first three criteria (spatial scope, duration and severity) provides a collective score for the consequence of each impact. The sum of the last two criteria (frequency of activity and frequency of impact) determines the likelihood of the impact occurring. The product of consequence and likelihood leads to the assessment of the significance of the impact, shown in the significance matrix below in Table 8-52.

Table 8-51: Significance Assessment Matrix.

	Consequence (Severity + Spatial Scope + Duration)														
Likelihood (Frequency of Activity + Probability of Impact)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	08	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

Table 8-52: Positive and Negative Impact Mitigation Ratings.

Colour Code	Significance Rating	Value	Negative Impact Management Recommendation	Positive Impact Management Recommendation
	Very High	126-150	Improve Current Management	Maintain Current Management
	High	101-125	Improve Current Management	Maintain Current Management
	Medium-High	76-100	Improve Current Management	Maintain Current Management
	Low-Medium	51-75	Maintain Current Management	Improve Current Management
	Low	26-50	Maintain Current Management	Improve Current Management
	Very Low	1-25	Maintain Current Management	Improve Current Management

The model outcome is then assessed in terms of impact certainty and consideration of available information. Where a particular variable rationally requires weighting or an additional variable requires consideration the model outcome is adjusted accordingly.

8.3 ITEM 3(G)(VII): THE POSITIVE AND NEGATIVE IMPACTS THAT THE PROPOSED ACTIVITY (IN TERMS OF THE INITIAL SITE LAYOUT) AND ALTERNATIVES WILL HAVE ON THE ENVIRONMENT AND THE COMMUNITY THAT MAY BE AFFECTED

A summary of the overall positive and negative impacts associated with the proposed activities and the alternatives considered for the proposed project will have from an environmental and socio-economic perspective are indicated in Table 8-53.

Table 8-53: Impacts (Positive or Negative) associated with the proposed activities considered for the proposed project.

Proposed activities	Alternative	Positive Impact	Negative Impact
Location: Determined by prospecting phase and exploration drilling. The location of the coal dictates the location of the pit.	The mining blocks are fixed, and are formed based on location of coal reserve, sensitive features and best practice guidelines.	Thermal coal reserve that is economically mineable.	Surrounding area environmental sensitivity, including wetlands and streams, and high agricultural potential (food security) and land capability.

Proposed activities	Alternative	Positive Impact	Negative Impact
Design and Layout	Preferred infrastructure	Closer to access road thus less traffic. Limits impacts on sensitive receptors.	Located close to Leeufonteinspruit. Located in high agricultural potential land and patches of primary grassland.
Transportation of Coal	By rail	No additional impact to the road network.	Maintenance of railway trucks and lines.
	By road	Transportation of the product more direct without loading and off-loading (less logistical and time-constraints)	Increased traffic impacts on road as well as degradation of road surface. Dust pollution from transportation.
The No-Go Option		The environmental features on site including surface and groundwater will not be impacted on. No loss of high potential agricultural land and land capability.	The economic benefits of the proposed project will not be realised, and the reserve will be left untouched, or open for other mining companies to apply for a mining right.

8.4 ITEM 3(G)(VIII): THE POSSIBLE MITIGATION MEASURES THAT COULD BE APPLIED AND THE LEVEL OF RISK

The impacts that are generated by the development can be minimised if measures are implemented in order to reduce the impacts. The mitigation measures ensure that the development considers the environment and the predicted impacts in order to minimise impacts and achieve sustainable development. The Impact Mitigation Hierarchy (DEA 2013) was followed to achieve no overall or limited negative impact on the receiving environment. The Impact Mitigation Hierarchy is a tool which is used reiteratively throughout the project lifecycle to limit negative impacts on the environment. There are four steps/tiers within the hierarchy, and include: Avoid/Prevent, Minimise, Rehabilitate and Offset (Figure 8-29).

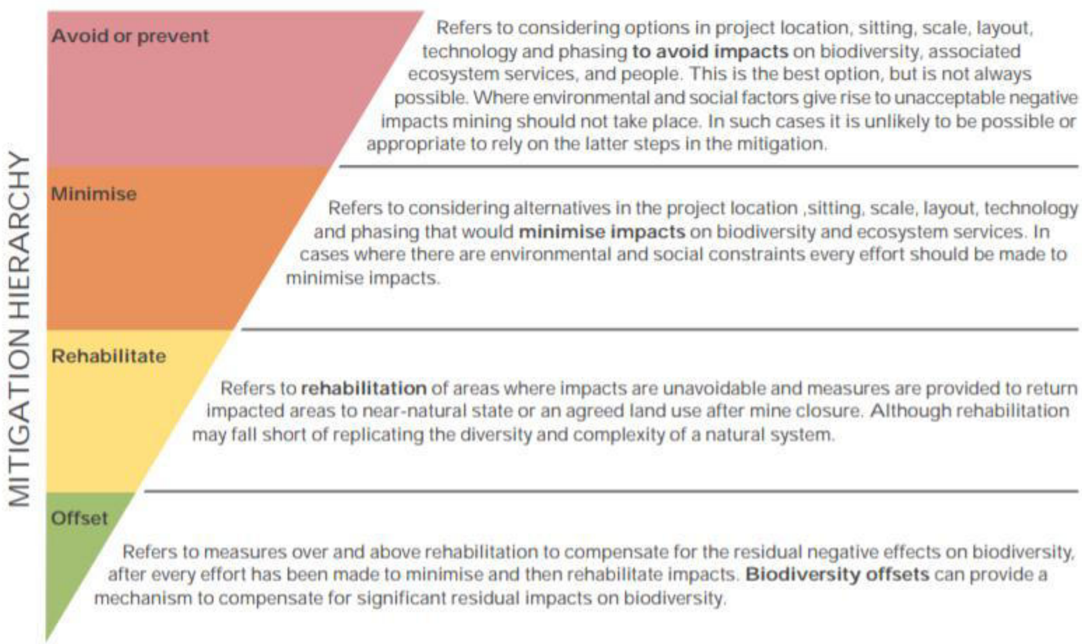


Figure 8-29: The Impact Mitigation Hierarchy (DEA et al., 2013)

Where avoidance is not possible, the impacts that are generated by the development can be minimised if measures are implemented in order to reduce the impacts. The proposed mitigation measures should ensure that the development considers the environment and the predicted impacts in order to minimise impacts and achieve sustainable development. All of the impacts identified could be either avoided or mitigated, accordingly rehabilitation and offset was not necessary. It should be noted that rehabilitation of the entire mining operation is required post-mining and the only way to avoid this is for the No-Go alternative to occur (i.e. where the proposed mine does not occur).

Mitigation measures for each identified impact have been proposed and are presented in Section 8.1 Potential Impacts.

8.5 ITEM 3(G)(IX): MOTIVATION WHERE NO ALTERNATIVES SITES WERE CONSIDERED

The alternatives considered for the Project include the location, infrastructure layout and design, the method of mining, the transportation of coal off site and the “No-Go” alternative. In terms of the mining blocks, alternative sites were not considered as the location of the mineral resource (i.e. coal) determines the location of the mining operation.

8.6 ITEM 3(G)(X): STATEMENT MOTIVATING THE ALTERNATIVE DEVELOPMENT LOCATION WITHIN THE OVERALL SITE

As a result of the scoping phase preliminary impact assessment and the sensitivity mapping exercise, a preferred layout design has been identified. The overall location of the mining right area and identified mining blocks are based on the identified coal seam during the prospecting phase; however, the sensitivity analyses undertaken for each specialist study were used to inform the preferred infrastructure and the location of the mining blocks from watercourses and the appropriate buffer have been applied. Identified wetlands were excluded from the mining blocks and infrastructure as far as possible. The layout has also considered the proximity of surrounding communities and existing infrastructure between the mining footprint and the residential areas.

9 ITEM 3(H): FULL DESCRIPTION OF THE PROCESS UNDERTAKEN TO IDENTIFY, ASSESS AND RANK THE IMPACTS AND RISKS THE ACTIVITY WILL IMPOSE ON THE PREFERRED SITE (IN RESPECT OF THE FINAL SITE LAYOUT PLAN) THROUGH THE LIFE OF THE ACTIVITY

The preferred mine layout was informed by various environmental and technical specialist studies and professional opinions, as well as existing GIS spatial data for Mpumalanga and at a National level. The initial site layout that was presented during the scoping phase has changed during the EIA phase after numerous iterations in order to accommodate sensitive features and to comply with regulations and best practice guidelines. The impacts identified and discussed in Section 8.1 Potential Impacts are applicable to the final site layout plan. Refer to section 25 below for the Composite Map.

9.1 ITEM 3(I): ASSESSMENT OF EACH IDENTIFIED POTENTIALLY SIGNIFICANT IMPACT AND RISK

The potential impacts per activity and per phase are detailed in Table 9-1 below.

Table 9-1: Assessment of each Identified Impact as per each activity.

Activity	Potential Impact	Aspects Affected	Phase	Significance Prior to Mitigation	Mitigation type	Significance Post Mitigation
Site establishment	Loss of topsoil as a resource and soil compaction from heavy machinery and vehicles during site clearance	Soil, Land Capability, Agricultural Potential and Hydropedology	Construction	High (negative)	• Follow adequate stripping guidelines; • Only remove topsoil when and where necessary; • If possible topsoil should be stripped during dry months, as to reduce compaction; • Ensure each topsoil class is stored in one dedicated stockpile, proposed 10 m high and away from surface water bodies; • If any erosion occurs, corrective actions must be taken to minimise any further erosion from taking place. If erosion has already occurred, topsoil should be sourced and replaced, and shaped to reduce the recurrence of erosion; • Only the designated access routes and internal roads are to be used to reduce any unnecessary compaction; • Prevent unauthorised borrowing of stockpiled soil; • Ensure proper storm water management designs are in place (refer to Storm Water Management Plan)	Low-Medium (negative)
	Loss of land capability such as high agricultural potential land	Soil, Land Capability, Agricultural Potential and Hydropedology	Construction	Very High (negative)	Cannot mitigate. Rehabilitation post-mining is required in order to return the land back to its original state / baseline conditions.	Very High (negative)

	Loss of natural habitat	Terrestrial Ecology	Construction	Medium-High (negative)	• Clearings associated with construction to occur in as small a footprint as possible; • Vegetation clearing close to the watercourse should be minimised and where necessary, appropriate storm water management should be put in place to limit erosion potential of exposed soil. Sedimentation trapping should be in place to prevent exposed soils from spilling into the watercourse; • The watercourse and its buffer areas should be demarcated and fenced off prior to construction to exclude the watercourse from development activities; • Minimise the development footprint, where possible; • Consider layout and site alternatives for the proposed development infrastructure, which needs to be assessed and compared in order to select the option with the lowest impact	Low – Medium (negative)
	Increased habitat fragmentation and edge effects resulting in alien plant invasion	Terrestrial Ecology	Construction	Medium-High (negative)	Buffer zones are allocated to sensitive or important habitat features to alleviate the effect of habitat loss, habitat fragmentation, disturbances, increased isolation and edge effects. It is suggested that at least a 100 m buffer zone from the watercourse must be implemented as a wildlife support area. Alien vegetation control should take place pre- and post-construction, as well as during the closure and rehabilitation phase.	Low (negative)

	Sedimentation of surface water resources resulting in the deterioration of water quality	Surface Water	Construction	Medium-High (negative)	• Development of the storm water management structures to ensure that sediment generated during the construction phase is conveyed to the silt trap, and clean water is diverted away from the boxcut and dirty water areas • Soils compacted by heavy machinery in areas that are not utilised post construction can be ripped to allow infiltration; • Roads should be maintained regularly to ensure that surface water drains freely off the road preventing erosion. Where required, temporary measures should be placed during the construction phase to minimise erosion; • Ensure that storm water management structures are within good working condition through regular inspection, especially after large storm events	Low (negative)
	Movement of heavy machine and vehicles for site clearing resulting in reduced surface water infiltration as well as an alteration in surface water drainage patterns.	Surface and Ground Water	Construction	Low-Medium (negative)	• Soils compacted by heavy machinery in areas that are not utilised post construction can be ripped to allow infiltration; • Roads should be maintained regularly to ensure that surface water drains freely off the road preventing erosion. Where required, temporary measures should be placed during the construction phase to minimise erosion; • The Storm Water Management Plan should maximize clean runoff volumes which should be diverted straight to natural surface waters; • Backfilling and rehabilitation of old boxcuts as mining progresses	Low (negative)

	Placement of impenetrable surfaces resulting in reduced surface water infiltration and alteration of base flow	Surface Water, Aquatic Ecology	Construction	Low-Medium (negative)	• Minimise the removal of vegetation in the infrastructure footprint area; • Re-vegetation of the disturbed areas within the construction footprint areas once construction is completed; • Soils compacted by heavy machinery in areas that are not utilised post construction can be ripped to allow infiltration; • Ensure that storm water management structures are within good working condition through regular inspection, especially after large storm events; • Where storm water enters river systems, sediment/silt and debris trapping, as well as energy dissipation control measures must be put in place; • Inspection of paved and unpaved roads to monitor for erosion	Low (negative)

	Water catchment and functional watercourses	Wetlands, Aquatic Ecology, Surface water, Terrestrial Ecology	Construction	High (negative)	• The edge of the non-directly impacted wetlands and streams, and at least a 60 m buffer, must be clearly demarcated in the field with wooden stakes painted red as no-go zones that will last for the duration of the construction phase; • Wetland monitoring must be carried out during the construction phase by a qualified wetland/aquatic specialist to ensure no unnecessary impact to wetlands is realised, and if so that a remedy is put in place as soon as possible. • The Storm Water Management Plan must be adhered to during the construction phase where surface water bodies within 100m of the construction sites must be highlighted as sensitive receptors and clearly marked; • Refer to Terrestrial Ecology report for managing vegetation and habitats of watercourses; • An alien and invasive plant species management programme must be in place pre-construction phase.	Low-Medium (negative)
	Increased runoff and erosion resulting in habitat change downstream	Aquatic and Terrestrial ecology	Construction	Medium-High (negative)	• Apply effective storm water management principles to ensure that clean runoff is maximised and diverted to the receiving water resource, while contaminated runoff is minimised and contained for reuse within the operation • Development of the storm water management structures to ensure that sediment generated during the construction phase is conveyed to the silt trap, and clean water is diverted away from the boxcut and dirty water areas • Run-off generated from cleared and disturbed areas such as access roads and slopes that drain into watercourses must be controlled using erosion control and sediment trapping measures. These control measures must be established at regular intervals perpendicular to the slope to break surface flow energy and reduce erosion as well as trap sediment	Low (negative)

	Increased runoff resulting in reduced baseflow and an alteration of aquatic habitats	Aquatic ecology	Construction	Medium-High (negative)	• Minimise the removal of vegetation in the infrastructure footprint area; • Re-vegetation of the disturbed areas within the construction footprint area once construction • is completed; • Soils compacted by heavy machinery in areas that are not utilised post construction can be • ripped to allow infiltration; • Ensure that storm water management structures are within good working condition through • regular inspection, especially after large storm events; • Where storm water enters river systems, sediment/silt and debris trapping, as well as energy • dissipation control measures must be put in place; • Storm water must be diverted from construction activities and managed in such a manner to • disperse runoff and prevent the concentration of storm water flow	Low (negative)
	Infrastructure noticeable to nearby receptors	Visual	Construction	Medium-High (negative)	• Vegetation should only be removed when and where necessary; • Topsoil should only be removed when and where necessary; • Topsoil stockpiles should be vegetated with indigenous grasses such as local species of the genera: *Andropogon, Aristida, Eragrostis, Hyparrhenia* and *Sporobolus* and *Cynodon dactylon, Themeda triandra* and *Melinis repens*) in order to blend into the surrounding landscape and reduce dust generation; • Limit the footprint area of topsoil stockpiles where possible; • Limit the height of topsoil stockpiles to 15m.	Low-Medium (negative)

	Increased activity noticeable	Visual	Construction	Low-Medium (negative)	• Where possible use fencing that will screen the project area from nearby receptors; • Limit the height and footprint area of temporary laydown areas and facilities for construction workers. • Ensure screening vegetation is left intact around the Project area and near receptors; • Ensure the surface infrastructure does not exceed the proposed heights; • Surface infrastructure should be painted natural hues so as to blend into the surrounding landscape where possible; • Pylons and metal structures should be galvanised so as to weather to a matt grey finish rather than be painted silver. If the pylons and metal structures are painted, it is recommended that a neutral matt finish be used.	Low (negative)
	Construction area lighting at night will have a negative visual impact on the receiving environment.	Visual and Terrestrial Ecology	Construction	Low-Medium (negative)	• Minimal bright lights should be left on at night time and they should not face outwards of the site; • Reduce exterior lighting to that necessary for safe operation, and implement operational strategies to reduce spill light; • Use down-lighting from non-UV lights where possible, as light emitted at one wavelength has a low level of attraction to insects. This will reduce the likelihood of attracting insects and their predators	Low (negative)
	Burial grounds, graves and historical buildings	Heritage	Construction	Low (negative)	In the event of *in situ* conservation, complete a BGGC process in accordance with Section 36 of the NHRA. Where this is not possible, the relevant legislation needs to be followed and permit applications submitted to SAHRA.	Low (negative)

	Noise emanating from the machinery and vehicles	Noise	Construction	Low-Medium (negative)	• Restricting construction activities to daylight hours (06:00 – 18:00) and not during weekends and public holidays; • Locating of diesel generator away from noise sensitive receptors, as well as placing generators on isolation mounts and installation of secondary silencers; • Machines and vehicles to be serviced to the designed requirements of the machinery/vehicles to ensure noise suppression mechanisms are effective; • Reversing alarms on vehicles should be broadband reversing alarms which emit directional, lower, less intrusive sound; • Environmental noise monitoring to establish compliance with the regulations and to verify the predicted noise levels; • Switching off equipment when not in use.	Low (negative)

	Employment creation during construction	Social	Construction	Positive	• Assign preferred employment status to those experiencing the bulk of the negative project impacts (communities located within and surrounding the mining area footprint); • Promotion of local, female and youth employment to achieve and where feasible exceed the targets set out by the Mining Charter; • Where possible labour-intensive construction methods should be promoted; • Verification of local residential status through consultation with appropriate authorities (e.g. municipal structures, community leaders, and landowners) • Consult neighbouring businesses/mines to determine if they would be willing to make their skills registers available; • Identify required core skills, expand skills audits to community and align and implement training and skills development initiatives to findings of audit; • Expand skills development programmes, especially ABET programmes, to include surrounding communities; • Recruitment via a registry of job seekers and potentially coordinated through the DoL; • Provide local employees with reference letters certificates of completion for in-house (on-the-job) training; and • Monitor subcontractors in terms of local employment targets.	Positive

	Local economy	Social	Construction	Positive	• Give preference first to capable local service providers; • Develop local service provision capacity; • Monitoring of sub-contractors procurement; • Development of a register of local SMMEs; • Linkages with skills development/ SMME development institutions and other mining operations; • SMME skills development as part of mine SLP commitments	Positive
	Community development and social upliftment	Social	Construction	Positive	• Expanding skills development and capacity building programmes to non-employees, especially previously disadvantage individuals; • Establish external monitoring system to regulate HDSA procurement; • Where feasible, training should be NQF accredited; • A record of training courses completed per individual should be kept; • Liaison with beneficiaries to ensure needs are met; • Collaboration with other developmental role players during implementation	Positive

	Displacement of locals	Social	Construction	Medium-High (negative)	Vandabyte (Pty) Ltd should where possible endeavour to minimise the extent of displacement through project design, where displacement cannot be minimised the following measures are recommended to alleviate the adverse impacts: • The sales agreement of land purchased should reflect the holistic value of the land (determined by a professional valuer) and should also be inclusive of the potential relocation cost of commercial farms and/or business operations; • The displacement of non-vulnerable households and individuals should be considered on a case-by-case basis; • Prior to finalising the sales agreement of land, it should be clear who will assume responsibility for the resettlement of vulnerable households, including farm workers; • If considered necessary, it is recommended that the relocation process be aligned to IFC PS and that a Resettlement Action Plan be developed.	Low-Medium (negative)
	Nuisance impacts on surrounding land users (mainly noise, blasting, dust, traffic etc.)	Social	Construction	Medium-High (negative)	• Refer to each specialist study for specific mitigation measures recommended; • Optimise mine plan/infrastructure placement to avoid/minimise negative impacts, especially in terms of visual intrusion, displacement, air quality and disruptions of traffic; • Undertake continuous information sharing and consultation with adjacent/affected farm owners and the local community; • Implement communication mechanisms to report changes in water quality/quantity, air quality, traffic impacts or vibrations.	Low (negative)

	Disruption of movement patterns	Social	Construction	Low-Medium (negative)	• Regulation of traffic at intersections, especially during peak hours; • Suggest alternative routes to motorist during the construction period (cannot block motorist from using main roads); • Inform communities of planned construction activities that would affect vehicle/ pedestrian traffic at least ten days in advance; • Measures to prevent deterioration of roads suggested in Traffic Impact Assessment; • Road upgrading measures should be investigated and implemented in conjunction with the relevant government department (Mpumalanga Department of Public Works, Roads and Transport, SANRAL, Steve Tshwete Local Municipality); • Ensure that access to key services in areas is uninterrupted.	Low (negative)

	Influx of job seekers	Social	Construction	Medium-High (negative)	• Discourage influx of job-seekers by prioritising employment of unemployed members of local communities; • Liaise with local municipalities to ensure that expected population influx is taken into account in infrastructure development and spatial development planning; • Create synergies with local government IDP and other companies' SLP projects to promote infrastructure development; • Identify if recorded criminal activities involved members of the mine's workforce by working with the local police force and the mines private security; • Clear identification of workers, prevention of loitering; • Promote projects providing housing, especially low cost housing; • Consult with local community in terms of providing housing for mining work force by means of hostel lodging; • Community education; • Measures to address potential conflict between locals and non-locals.	Low-Medium (negative)
	Increased GDP and production	Economic	Construction	Positive	• Measures to maximise the stimulation of the economy may include procurement of goods and services from local business where feasible; • Recruit local labour; • Sub-contract to local construction companies; and • Use local suppliers where viable and arrange with the local SMME to provide transport, catering and other services for the construction crew.	Positive

	Employment from construction	Economic	Construction	Positive	• Use labour intensive construction methods, where feasible; • Sub-contract to local construction companies; • Use local suppliers; and • Set-up a skills desk at the local municipal office and in the nearby communities to identify skills available in the community and assist in recruiting local labour during both construction and operation.	Positive
	Skills Development	Economic	Construction	Positive	• Skills development as per the SLP; • Ensure that the main contractor shares knowledge with the sub-contracting companies during the construction period; • Offer internships and learnerships, especially to those coming from the local communities and HDSA.	Positive
	Household Income	Economic	Construction	Positive	• Employ labour intensive methods in construction; • Sub-contract to local construction companies; and • Use local suppliers where viable and arrange with the local SMME to provide transport, catering, and other services for the construction crew.	Positive
	Government Revenue	Economic	Construction	Positive	None	Positive

	Sterilisation of Productive Agricultural Land	Economic	Construction	Very High (negative)	• Engage with directly affected farmers and landowners on alternative farming locations and investigate ways to minimise loss of agricultural production in the surrounding area; • Off-set impact by training local small-scale farmers and workers as stated in SLP in order to have no net loss; • Ensure that land preparation and rehabilitation activities implemented during various staged of the mine's lifecycle allow for restoration of land to grazing capacity post-mining operations; • Agricultural crop farming cannot be returned, but grazing is suggested.	Low-Medium (negative)
	Loss of agricultural work force	Economic	Construction	Medium-High (negative)	• Off-set impact by training local small-scale farmers and workers as stated in SLP in order to have no net loss; • Resettlement of farm workers that reside on study area	Low (negative)
	Potential Negative Impact on surrounding Property Value	Economic	Construction	Medium-High (negative)	• Independent appraisals of properties and land values in the area adjacent to the site to determine the baseline before the project's implementation is advisable; • Mitigation measures proposed by visual and noise specialists should be strictly adhered to, to minimise the probability and intensity of the visual exposure in the area; • Adequate rehabilitation post-mining is vital to restore the sense of place of the area.	Low-Medium (negative)

	Temporary storage of hazardous products, including fuel and explosives	Social, safety, Surface Water bodies and groundwater	Construction	High (negative)	• Bunded areas should be constructed for chemical stores to storage of dangerous goods • This should not be located in sensitive areas or buffer areas, especially not within 100m of watercourses; • Spill kits should readily be available on site to be used in a case of spillage emergency; • Site personnel should be trained in cleaning and removing spillages; • First aid kit should be available at the site office as well as personnel equipped to deal with medical emergencies	Low-Medium (negative)
	Chemical toilets on site	Social, Surface Water bodies and groundwater	Construction	Medium-High (negative)	• There should be a chemical toilet on site for every 12 people, easily accessible within construction camp; • Should not be located in sensitive areas or within 100 m buffer areas, including wetlands and watercourse; • Should be serviced by a contractor on a weekly basis to avoid health issues; • Should always be used by site personnel, i.e. site personnel that do not use them should be penalised	Low (negative)
	General waste facilities including refuse containers and bins	Social, Visual	Construction	Medium-High (negative)	• A waste contractor should be appointed to provide refuse containers and bins, which should be emptied on a weekly basis to prevent pollution and health issues; • Waste should be disposed of at a registered land fill site and record should be kept of this; • Toxic and chemical waste should be dealt with separately and disposed of in the right manner. Therefore, labelling of waste containers and bins are crucial to avoid contamination; • No littering on site. Any person found littering should be prosecuted;	Low (negative)

	Alteration in surface water drainage patterns and a reduction in the amount of water reaching the Leeufonteinspruit	Surface Water	Construction	High (negative)	• Implementation of the storm water management plan to prevent clean water from flowing into the boxcut. Unfortunately, there are no mitigation measures for direct rainfall falling into the boxcut; • As much as is possible, water should be reused and any treated storm flows released downstream; • Backfilling and rehabilitation of old boxcuts as mining progresses	Low-medium (negative)
	Alteration in surface water drainage patterns resulting in changes to downstream aquatic habitat	Aquatic Ecology	Construction	Medium-High (negative)	• Minimise the removal of vegetation in the infrastructure footprint area; • Re-vegetation of the disturbed areas within the construction footprint area once construction is completed; • Soils compacted by heavy machinery in areas that are not utilised post construction can be ripped to allow infiltration; • Ensure that storm water management structures are within good working condition through regular inspection, especially after large storm events; • Where storm water enters river systems, sediment/silt and debris trapping, as well as energy dissipation control measures must be put in place; • Storm water must be diverted from construction activities and managed in such a manner to disperse runoff and prevent the concentration of storm water flow; • The vegetation of unpaved roadsides; and • Inspection of paved and unpaved roads to monitor for erosion.	Low-medium (negative)

Blasting and development of initial box-cut for mining, including stockpiling from initial box-cut	Risk on community health and safety	Social, Air Quality (Dust)	Construction	High (negative)	• Notification of blasting activities; • Storage of blasting and hazardous materials should adhere to prescribed regulation; • Measures suggested minimising the impact of fly-rock on surrounding roads and structure; • Relocation of structures close to mining operations.	Low-Medium (negative)

10 ITEM 3(J): SUMMARY OF SPECIALIST REPORTS

Numerous specialist impact assessments were undertaken for the proposed project. Each specialist report was compiled and attached as appendices to this report. The specialist input included the baseline environment, potential impacts and the recommended mitigation measures.

Table 10-1: Specialist assessments undertaken for the proposed Dunbar Coal Mine project.

List of studies undertaken	Recommendations of specialist reports	Specialist Recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included
Surface Water Impact Assessment	Water quality monitoring is recommended at the sampling sites indicated in the report. These sites are located in channelled valley-bottom wetlands, upstream and downstream of the proposed mining area. Water quality parameters as listed in the report should be included in the analyses. In addition to chemical sampling, *in-situ* water quality measurements should also be taken as certain parameters (e.g. dissolved oxygen) should be measured in the field. Water quality sampling should be undertaken on a monthly basis and results should be compared to the RQOs for upper Olifants River catchment.	All recommendations have been considered and included in the EIA report.	Throughout the report – Refer to sections 7, 8 and 9 for specific details as well as the EMPr, specifically section 28 for monitoring compliance
Aquatics and Wetlands Impact Assessment	Habitat and flow in the channelled valley-bottom wetland has been largely modified to the extent that conventional SASS5 biomonitoring techniques (Dickens and Graham, 2002) are unlikely to be sensitive enough to indicate deterioration (or improvement) in water quality at sites downstream of mining activities. Diatoms are less reliant on suitable in-stream habitat quality and are excellent indicators of water quality. Diatom indices have been designed primarily for lotic systems (i.e. running water), however, given the riverine characteristics of channelled valley-bottom wetlands, the use of diatoms as a biomonitoring tool should be adopted at all water quality monitoring points within the channelled valley-bottom wetland	All recommendations have been considered and included in the EIA report.	Throughout the report – Refer to sections 7, 8 and 9 for specific details as well as the EMPr, specifically section 28 for monitoring compliance

List of studies undertaken	Recommendations of specialist reports	Specialist Recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included
Groundwater Impact Assessment	A total of nineteen (19) new monitoring boreholes (excluding the existing DBR01 and DBR03 boreholes) are recommended to be drilled comprised of 6 multi-level borehole sets drilled between mine workings and wetland features, 7 monitoring boreholes installed during the operational phase and 6 monitoring boreholes installed at rehabilitated mine workings following closure. The multi-level boreholes should be installed to intersect the deeper aquifer zone, intermediate weathered zone and upper interflow/unsaturated zone, with the deepest borehole installed closest to the mining area and the shallowest installed toward the wetland/surface water feature being considered for baseflow monitoring. It is recommended that a geochemical model assessment is completed during the life of the mine in order to calibrate and validate its results and to construct an effective closure plan. Monitoring of mine water is critical in order to validate the geochemical assessment. A geochemical model should be constructed that assess the effectiveness of potential mitigation measures and the evolution of water qualities during the operational phase so that mitigation measures could be implemented proactively. During backfilling of completed cuts at the Site it is recommended that the materials are placed in such a manner that sulphide-bearing materials are placed at the base of the pit and covered with more neutral overburden material, with the material being compacted suitably to mimic the surrounding hydrogeological environment as far as possible. The backfill material should be capped with a 200 mm clay layer to limit the ingress of water into the material during operations. It is recommended that topsoil placement is only done once the final landform has been created at the open pit area. Any groundwater ingress into the opencast pit during the operational phase should be collected in a central sump area and discharged to the PCD complex as soon as possible, thus limiting contact time with exposed material within the pit area. During mining operations, a surface water berm should always be maintained at the limits of	All recommendations have been considered and included in the EIA report.	Throughout the report – Refer to sections 7, 8 and 9 for specific details as well as the EMPr, specifically section 28 for monitoring compliance

List of studies undertaken	Recommendations of specialist reports	Specialist Recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included
	the pit area to prevent clean runoff entering the pit area. The Site water management plan should aim to keep clean and dirty water separate during all phases of LoM, with all water encountering mining activities being considered dirty and disposed of at the PCD complex as soon as possible. Based on the geochemical, groundwater level and groundwater quality data available for the Site currently and the simulated groundwater impacts for the Site during the operational, closure and post-closure LoM phases several potential AMD management/treatment solutions were evaluated for the Site. The potential solutions considered were pump-and-treat (ion exchange), neutralisation of backfill material and constructed wetlands. Each of the potential solutions were evaluated based on their efficiencies, overall environmental footprint (incl. space requirements, power requirements, by-product generation etc.). The constructed wetland treatment solution would be the preferred solution at the Site, offering benefits such as wetland reclamation and low operational costs. However, the final solution for the management of AMD (if any) at the Site will be determined, designed and implemented (where possible) during the operational phase of the LoM following further geochemical testing and numerical groundwater modelling refinement at the Site.		

List of studies undertaken	Recommendations of specialist reports	Specialist Recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included
Terrestrial Ecology	Incomplete baseline data for monitoring purposes was established, and a pre-construction survey during optimal seasonal and climatic conditions will be required as indicated above. Following such a survey, additional mitigation measures will be provided to reduce the anticipated impacts, where necessary. If additional SCC are recorded, the necessary mapping of suitable habitat and the appropriate buffer areas will be updated. As with camera trapping, it must be stated that due to logistical limitations and security concerns, as well as adequate results stemming from the utilisation of other methods (i.e. scat analysis and Mackinnon sampling), no Sherman Traps were deployed for the study. However, ongoing Sherman trap monitoring during both the construction and monitoring phases of the project is recommended when sufficient security has been established to ensure the low likelihood of trap theft. It is unlikely that any severe and lasting impacts could occur from the mine activities if proper mitigation and monitoring takes place (as outlined in this report). The biggest concern is the effect of pollution/siltation on the Leeufonteinspruit watercourse and the importance of this habitat for the regional flora and fauna. It is therefore recommended that frequent monitoring must take place within this system to prevent and mitigate potential impacts, as well as to link impacts to specific events for adaptive management.	All recommendations have been considered and included in the EIA report.	Throughout the report – Refer to sections 7, 8 and 9 for specific details as well as the EMPr, specifically section 28 for monitoring compliance

List of studies undertaken	Recommendations of specialist reports	Specialist Recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included
Soils, Land Capability, and Agricultural Potential	The hydrological functioning of the areas provided in the report yield the following: • Recharge Zones: The dryland crop production areas function as recharge zones with lateral flow of water occurring at depth in the soils. Surface runoff occurs during high intensity rainfall events that exceed the infiltration capacity. A significant intercept occurs during the growing season with crop water use. • Deep Interflow Zones: Fractured rock and deep plinthic horizons represent interflow zones. • Shallow Interflow Zones: E horizons underlain by higher clay content soil horizons represent shallow interflow zones with intercept by wetland vegetation. • Responsive Soil Zones: Soil with high clay content in low lying landscape positions represent response areas where interflow water approaches the land surface or flows out onto the land surface at times. These zones are characterised by seasonal and permanent wetland vegetation depending on the duration of later flow contributions from the landscape. The practical implications of the above impacts are the following: • Arbitrary buffers on responsive areas soils (read “wetlands” and “watercourses”) do not have any effect on the protection of the water resource. This aspect renders the concept of a buffer moot since it has no practical application or benefit in opencast coal mining areas. • The protection of flow parameters in landscapes that undergo opencast coal mining is also a moot point as the flow is drastically altered through the severing of all the flow paths and recharge and storage characteristics of the landscape. The re-establishment of flow can only happen during the rehabilitation phase – if properly planned. However, during this phase the implementation of plans to deal with AMD and altered flow regimes and water quality is critical in order to regain some of the original flow and water dynamics in the landscape.	All recommendations have been considered and included in the EIA report.	Throughout the report – Refer to sections 7, 8 and 9 for specific details as well as the EMPr, specifically section 28 for monitoring compliance

List of studies undertaken	Recommendations of specialist reports	Specialist Recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included
Socio-economic Impact Assessment	It is proposed that a monitoring programme be developed and implemented to monitor the implementation of social management actions. Furthermore, it is recommended that this is conducted by a competent Monitoring and Evaluation (M&E) officer as the implementation of monitoring tools (surveys, databases, etc.) will require specialised skills. In accordance with international good practice the proposed Dunbar Coal Mine should establish a specific mechanism for dealing with grievances. A grievance is a complaint or concern raised by an individual or organisation that judges that they have been adversely affected by the project during any stage of its development. Grievances may take the form of specific complaints for actual damages or injury, general concerns about project activities, incidents and impacts, or perceived impacts.	All recommendations have been considered and included in the EIA report.	Throughout the report – Refer to sections 7, 8 and 9 for specific details as well as the EMPr, specifically section 28 for monitoring compliance
Palaeontological Impact Assessment	Based on survey and observations during the site visit, it is clear that there are no fossils present in the soils. There is very small chance that fossils may occur in the shales and mudstones associated with the coal seams. In this area the soils are about 10-14m deep so the chance that fossils occur below this depth. Their occurrence in the Vryheid Formation (Ecca Group) is sporadic and unpredictable. A Fossil Find Protocol should be added to the EMPr: if fossils are found once mining has commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample	All recommendations have been considered and included in the EIA report.	Throughout the report – Refer to sections 7, 8 and 9 for specific details as well as the EMPr, specifically section 28 for monitoring compliance

List of studies undertaken	**Recommendations of specialist reports**	**Specialist Recommendations that have been included in the EIA report**	**Reference to applicable section of report where specialist recommendations have been included**
Heritage Impact Assessment	The impact of the proposed project on heritage resources is considered to be low with the correct mitigation measures in place and it is recommended that the proposed project can commence based on the following recommendations included as a condition of authorisation in the EMPr: • It is recommended that the Stone Cairn (Feature 1) should be avoided by the development with a 15 meter buffer. If this is not possible, it should be confirmed whether the Stone Cairn represents a grave through a social consultation process. If it is indeed a grave, Feature 1 should preferably be avoided and retained *in situ.* If the feature is not a grave no mitigation is required. If any graves are located in future they should ideally be preserved in-situ or alternatively relocated according to existing legislation. • The implementation of a chance finds procedure during the pre-construction and construction phase of the project as outlined under Section 10.1 of the report. The possibility of the occurrence of subsurface finds cannot be excluded. Therefore, if during construction any possible finds such as graves, stone tool scatters, artefacts or bone and fossil remains are made, the operations must be stopped and a qualified archaeologist must be contacted for an assessment of the find and therefore chance find procedures should be put in place as part of the EMPr.	All recommendations have been considered and included in the EIA report.	. Throughout the report – Refer to sections 7, 8 and 9 for specific details as well as the EMPr, specifically section 28 for monitoring compliance
Traffic Impact Assessment	By comparing the operating conditions for the different scenarios, it is concluded that the proposed project will have an insignificant traffic impact on the surrounding road network. Seeing as no traffic problems or congestion is expected as a result of the project activities no mitigation measures are required. The project can be authorized from a traffic engineering viewpoint.	All recommendations have been considered and included in the EIA report.	Throughout the report – Refer to sections 7, 8 and 9 for specific details as well as the EMPr, specifically section 28 for monitoring compliance

List of studies undertaken	Recommendations of specialist reports	Specialist Recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included
Visual Impact Assessment	The construction and operation phase of the proposed Dunbar Coal project related activities and its associated infrastructure will have a MODERATE visual impact on the natural scenic resources and the topography. However, with the correct mitigation measures the impact might decrease to a point where the visual impact can be seen as less significant. In light of certain factors that reduce the impact of the facility, the visual impact is assessed as LOW-MEDIUM VISUAL IMPACT after mitigation measures have been implemented. The visual impact from the mining activities can be sufficiently mitigated to a point where it can be seen as insignificant. Thus, mitigation measures are very important and one of the most significant mitigation measures are the rehabilitation of the area after mining has concluded.	All recommendations have been considered and included in the EIA report.	Throughout the report – Refer to sections 7, 8 and 9 for specific details as well as the EMPr, specifically section 28 for monitoring compliance.
Air Quality Impact Assessment	- It is recommended that ambient air quality monitoring be established to get a baseline condition prior to the onset of the operations and in order to establish the level at which the proposed operations are noted to impact on the ambient air quality. - Fallout monitoring should be continued for the life of mine to better assess the level of nuisance dust associated with both mining and process related operations. Sampling of fallout should be undertaken within the neighbouring areas as well as on-site. Dust fallout monitoring is recommended at the locations as indicated in the report. - PM10 and PM2.5 dust monitoring must also be undertaken at the same sites as mentioned under the previous bullet but also in and around potential fugitive emission sources to determine mitigation measures and focus management efforts. - Further mitigation measures that should be applied, if it is found that dust and PM10 levels are measured to be exceeding the limits are: • Reducing the speed of the Haul Trucks on the Pit and Access Haul Roads. • Fully sealed Pit and Access Haul Road to achieve 90-100% mitigation on these roads	All recommendations have been considered and included in the EIA report.	Throughout the report – Refer to sections 7, 8 and 9 for specific details as well as the EMPr, specifically section 28 for monitoring compliance

List of studies undertaken	Recommendations of specialist reports	Specialist Recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included
Blast and Vibrations Impact Assessment	The mine must know that community involvement needs to continue throughout the project. This is especially true for opencast mining projects close to residential dwellings. Blasting relates impacts are definite to upset the community and complaints will be one of the tools that the community may use to express their annoyance with the project, rather than a rational reaction to the vibration or air blast level itself. At all stages surrounding receptors should be informed about the project, providing them with factual information without setting unrealistic expectations. Even with the best measures, blasting related impacts will be perceived and the community members may complain. It is therefore in the best interest of the mine to continually monitor and manage the blast in an effort to improve and minimise potential blasting effects. It is highly recommended that the mine conduct a detailed photographic survey at brick and cement residential houses (that does not belong to the applicant) located within 2,000m from the mine (from the opencast boundary limit) before the construction phase start. This should include a survey of all water boreholes and cement dams to determine the status of these structures. It is concluded that, if the mine considers the recommendations in this report (incorporated in the Environmental Management Plan), that blasting risks do not constitute a fatal flaw. It is, therefore, the recommendation that the Dunbar Coal Project be authorized (from a blasting impact perspective) subject to compliance with the conditions of the EMP.	All recommendations have been considered and included in the EIA report.	Throughout the report – Refer to sections 7, 8 and 9 for specific details as well as the EMPr, specifically section 28 for monitoring compliance

List of studies undertaken	Recommendations of specialist reports	Specialist Recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included
Noise Impact Assessment	The potential noise rating levels were calculated using a sound propagation model. Conceptual scenarios were developed for the construction and operational phase with the output of the modelling exercise indicating a medium-high risk of a noise impact for night-time construction and mining activities. Mitigation is recommended to ensure that potential annoyance with the project is managed and reduce the potential significance of the noise impact. It is recommended that a noise monitoring programme is developed. It is concluded that, if the mine considers the recommendations in this report (incorporated in the Environmental Management Plan), that the increases in noise levels do not constitute a fatal flaw. It is, therefore, the recommendation that the Dunbar Coal Project is authorized (from a noise impact perspective).	All recommendations have been considered and included in the EIA report.	Throughout the report – Refer to sections 7, 8 and 9 for specific details as well as the EMPr, specifically section 28 for monitoring compliance

11 ITEM 3(K): ENVIRONMENTAL IMPACT STATEMENT PLAN

11.1 ITEM 3(K)(I): SUMMARY OF THE KEY FINDINGS OF THE ENVIRONMENTAL IMPACT ASSESSMENT

Activity	Potential Impact	Significance Prior to Mitigation	Mitigation type	Significance Post Mitigation
Site establishment	Loss of topsoil as a resource and soil compaction from heavy machinery and vehicles during site clearance	High (negative)	• Follow adequate stripping guidelines; • Only remove topsoil when and where necessary; • If possible topsoil should be stripped during dry months, as to reduce compaction; • Ensure each topsoil class is stored in one dedicated stockpile, proposed 10 m high and away from surface water bodies; • If any erosion occurs, corrective actions must be taken to minimise any further erosion from taking place. If erosion has already occurred, topsoil should be sourced and replaced, and shaped to reduce the recurrence of erosion; • Only the designated access routes and internal roads are to be used to reduce any unnecessary compaction; • Prevent unauthorised borrowing of stockpiled soil; • Ensure proper storm water management designs are in place (refer to Storm Water Management Plan)	Low-Medium (negative)
	Loss of land capability such as high agricultural potential land	Very High (negative)	Cannot mitigate. Rehabilitation post-mining is required in order to return the land back to its original state / baseline conditions.	Very High (negative)

	Loss of natural habitat	Medium-High (negative)	• Clearings associated with construction to occur in as small a footprint as possible; • Vegetation clearing close to the watercourse should be minimised and where necessary, appropriate storm water management should be put in place to limit erosion potential of exposed soil. Sedimentation trapping should be in place to prevent exposed soils from spilling into the watercourse; • The watercourse and its buffer areas should be demarcated and fenced off prior to construction to exclude the watercourse from development activities; • Minimise the development footprint, where possible; • Consider layout and site alternatives for the proposed development infrastructure, which needs to be assessed and compared in order to select the option with the lowest impact	Low – Medium (negative)
	Increased habitat fragmentation and edge effects resulting in alien plant invasion	Medium-High (negative)	Buffer zones are allocated to sensitive or important habitat features to alleviate the effect of habitat loss, habitat fragmentation, disturbances, increased isolation and edge effects. It is suggested that at least a 100 m buffer zone from the watercourse must be implemented as a wildlife support area. Alien vegetation control should take place pre- and post-construction, as well as during the closure and rehabilitation phase.	Low (negative)

	Sedimentation of surface water resources resulting in the deterioration of water quality	Medium-High (negative)	• Development of the storm water management structures to ensure that sediment generated during the construction phase is conveyed to the silt trap, and clean water is diverted away from the boxcut and dirty water areas • Soils compacted by heavy machinery in areas that are not utilised post construction can be ripped to allow infiltration; • Roads should be maintained regularly to ensure that surface water drains freely off the road preventing erosion. Where required, temporary measures should be placed during the construction phase to minimise erosion; • Ensure that storm water management structures are within good working condition through regular inspection, especially after large storm events	Low (negative)
	Movement of heavy machine and vehicles for site clearing resulting in reduced surface water infiltration as well as an alteration in surface water drainage patterns.	Low-Medium (negative)	• Soils compacted by heavy machinery in areas that are not utilised post construction can be ripped to allow infiltration; • Roads should be maintained regularly to ensure that surface water drains freely off the road preventing erosion. Where required, temporary measures should be placed during the construction phase to minimise erosion; • The Storm Water Management Plan should maximize clean runoff volumes which should be diverted straight to natural surface waters; • Backfilling and rehabilitation of old boxcuts as mining progresses	Low (negative)

	Placement of impenetrable surfaces resulting in reduced surface water infiltration and alteration of base flow	Low-Medium (negative)	• Minimise the removal of vegetation in the infrastructure footprint area; • Re-vegetation of the disturbed areas within the construction footprint areas once construction is completed; • Soils compacted by heavy machinery in areas that are not utilised post construction can be ripped to allow infiltration; • Ensure that storm water management structures are within good working condition through regular inspection, especially after large storm events; • Where storm water enters river systems, sediment/silt and debris trapping, as well as energy dissipation control measures must be put in place; • Inspection of paved and unpaved roads to monitor for erosion	Low (negative)
	Water catchment and functional watercourses	High (negative)	• The edge of the non-directly impacted wetlands and streams, and at least a 60 m buffer, must be clearly demarcated in the field with wooden stakes painted red as no-go zones that will last for the duration of the construction phase; • Wetland monitoring must be carried out during the construction phase by a qualified wetland/aquatic specialist to ensure no unnecessary impact to wetlands is realised, and if so that a remedy is put in place as soon as possible. • The Storm Water Management Plan must be adhered to during the construction phase where surface water bodies within 100m of the construction sites must be highlighted as sensitive receptors and clearly marked; • Refer to Terrestrial Ecology report for managing vegetation and habitats of watercourses; • An alien and invasive plant species management programme must be in place pre-construction phase.	Low-Medium (negative)

	Increased runoff and erosion resulting in habitat change downstream	Medium-High (negative)	• Apply effective storm water management principles to ensure that clean runoff is maximised and diverted to the receiving water resource, while contaminated runoff is minimised and contained for reuse within the operation • Development of the storm water management structures to ensure that sediment generated during the construction phase is conveyed to the silt trap, and clean water is diverted away from the boxcut and dirty water areas • Run-off generated from cleared and disturbed areas such as access roads and slopes that drain into watercourses must be controlled using erosion control and sediment trapping measures. These control measures must be established at regular intervals perpendicular to the slope to break surface flow energy and reduce erosion as well as trap sediment	Low (negative)
	Increased runoff resulting in reduced baseflow and an alteration of aquatic habitats	Medium-High (negative)	• Minimise the removal of vegetation in the infrastructure footprint area; • Re-vegetation of the disturbed areas within the construction footprint area once construction • is completed; • Soils compacted by heavy machinery in areas that are not utilised post construction can be • ripped to allow infiltration; • Ensure that storm water management structures are within good working condition through • regular inspection, especially after large storm events; • Where storm water enters river systems, sediment/silt and debris trapping, as well as energy • dissipation control measures must be put in place; • Storm water must be diverted from construction activities and managed in such a manner to • disperse runoff and prevent the concentration of storm water flow	Low (negative)

	Infrastructure noticeable to nearby receptors	Medium-High (negative)	• Vegetation should only be removed when and where necessary; • Topsoil should only be removed when and where necessary; • Topsoil stockpiles should be vegetated with indigenous grasses such as local species of the genera: *Andropogon, Aristida, Eragrostis, Hyparrhenia* and *Sporobolus* and *Cynodon dactylon, Themeda triandra* and *Melinis repens*) in order to blend into the surrounding landscape and reduce dust generation; • Limit the footprint area of topsoil stockpiles where possible; • Limit the height of topsoil stockpiles to 15m.	Low-Medium (negative)
	Increased activity noticeable	Low-Medium (negative)	• Where possible use fencing that will screen the project area from nearby receptors; • Limit the height and footprint area of temporary laydown areas and facilities for construction workers. • Ensure screening vegetation is left intact around the Project area and near receptors; • Ensure the surface infrastructure does not exceed the proposed heights; • Surface infrastructure should be painted natural hues so as to blend into the surrounding landscape where possible; • Pylons and metal structures should be galvanised so as to weather to a matt grey finish rather than be painted silver. If the pylons and metal structures are painted, it is recommended that a neutral matt finish be used.	Low (negative)
	Construction area lighting at night will have a negative visual impact on the receiving environment.	Low-Medium (negative)	• Minimal bright lights should be left on at night time and they should not face outwards of the site; • Reduce exterior lighting to that necessary for safe operation, and implement operational strategies to reduce spill light; • Use down-lighting from non-UV lights where possible, as light emitted at one wavelength has a low level of attraction to insects. This will reduce the likelihood of attracting insects and their predators	Low (negative)

	Burial grounds, graves and historical buildings	Low (negative)	In the event of *in situ* conservation, complete a BGGC process in accordance with Section 36 of the NHRA. Where this is not possible, the relevant legislation needs to be followed and permit applications submitted to SAHRA.	Low (negative)
	Noise emanating from the machinery and vehicles	Low-Medium (negative)	• Restricting construction activities to daylight hours (06:00 – 18:00) and not during weekends and public holidays; • Locating of diesel generator away from noise sensitive receptors, as well as placing generators on isolation mounts and installation of secondary silencers; • Machines and vehicles to be serviced to the designed requirements of the machinery/vehicles to ensure noise suppression mechanisms are effective; • Reversing alarms on vehicles should be broadband reversing alarms which emit directional, lower, less intrusive sound; • Environmental noise monitoring to establish compliance with the regulations and to verify the predicted noise levels; • Switching off equipment when not in use.	Low (negative)

	Employment creation during construction	Positive	• Assign preferred employment status to those experiencing the bulk of the negative project impacts (communities located within and surrounding the mining area footprint); • Promotion of local, female and youth employment to achieve and where feasible exceed the targets set out by the Mining Charter; • Where possible labour-intensive construction methods should be promoted; • Verification of local residential status through consultation with appropriate authorities (e.g. municipal structures, community leaders, and landowners) • Consult neighbouring businesses/mines to determine if they would be willing to make their skills registers available; • Identify required core skills, expand skills audits to community and align and implement training and skills development initiatives to findings of audit; • Expand skills development programmes, especially ABET programmes, to include surrounding communities; • Recruitment via a registry of job seekers and potentially coordinated through the DoL; • Provide local employees with reference letters certificates of completion for in-house (on-the-job) training; and • Monitor subcontractors in terms of local employment targets.	Positive
	Local economy	Positive	• Give preference first to capable local service providers; • Develop local service provision capacity; • Monitoring of sub-contractors procurement; • Development of a register of local SMMEs; • Linkages with skills development/ SMME development institutions and other mining operations; • SMME skills development as part of mine SLP commitments	Positive

	Community development and social upliftment	Positive	• Expanding skills development and capacity building programmes to non-employees, especially previously disadvantage individuals; • Establish external monitoring system to regulate HDSA procurement; • Where feasible, training should be NQF accredited; • A record of training courses completed per individual should be kept; • Liaison with beneficiaries to ensure needs are met; • Collaboration with other developmental role players during implementation	Positive
	Displacement of locals	Medium-High (negative)	Vandabyte (Pty) Ltd should where possible endeavour to minimise the extent of displacement through project design, where displacement cannot be minimised the following measures are recommended to alleviate the adverse impacts: • The sales agreement of land purchased should reflect the holistic value of the land (determined by a professional valuer) and should also be inclusive of the potential relocation cost of commercial farms and/or business operations; • The displacement of non-vulnerable households and individuals should be considered on a case-by-case basis; • Prior to finalising the sales agreement of land, it should be clear who will assume responsibility for the resettlement of vulnerable households, including farm workers; • If considered necessary, it is recommended that the relocation process be aligned to IFC PS and that a Resettlement Action Plan be developed.	Low-Medium (negative)

	Nuisance impacts on surrounding land users (mainly noise, blasting, dust, traffic etc.)	Medium-High (negative)	• Refer to each specialist study for specific mitigation measures recommended; • Optimise mine plan/infrastructure placement to avoid/minimise negative impacts, especially in terms of visual intrusion, displacement, air quality and disruptions of traffic; • Undertake continuous information sharing and consultation with adjacent/affected farm owners and the local community; • Implement communication mechanisms to report changes in water quality/quantity, air quality, traffic impacts or vibrations.	Low (negative)
	Disruption of movement patterns	Low-Medium (negative)	• Regulation of traffic at intersections, especially during peak hours; • Suggest alternative routes to motorist during the construction period (cannot block motorist from using main roads); • Inform communities of planned construction activities that would affect vehicle/ pedestrian traffic at least ten days in advance; • Measures to prevent deterioration of roads suggested in Traffic Impact Assessment; • Road upgrading measures should be investigated and implemented in conjunction with the relevant government department (Mpumalanga Department of Public Works, Roads and Transport, SANRAL, Steve Tshwete Local Municipality); • Ensure that access to key services in areas is uninterrupted.	Low (negative)

	Influx of job seekers	Medium-High (negative)	• Discourage influx of job-seekers by prioritising employment of unemployed members of local communities; • Liaise with local municipalities to ensure that expected population influx is taken into account in infrastructure development and spatial development planning; • Create synergies with local government IDP and other companies' SLP projects to promote infrastructure development; • Identify if recorded criminal activities involved members of the mine's workforce by working with the local police force and the mines private security; • Clear identification of workers, prevention of loitering; • Promote projects providing housing, especially low cost housing; • Consult with local community in terms of providing housing for mining work force by means of hostel lodging; • Community education; • Measures to address potential conflict between locals and non-locals.	Low-Medium (negative)
	Increased GDP and production	Positive	• Measures to maximise the stimulation of the economy may include procurement of goods and services from local business where feasible; • Recruit local labour; • Sub-contract to local construction companies; and • Use local suppliers where viable and arrange with the local SMME to provide transport, catering and other services for the construction crew.	Positive
	Employment from construction	Positive	• Use labour intensive construction methods, where feasible; • Sub-contract to local construction companies; • Use local suppliers; and • Set-up a skills desk at the local municipal office and in the nearby communities to identify skills available in the community and assist in recruiting local labour during both construction and operation.	Positive

	Skills Development	Positive	• Skills development as per the SLP; • Ensure that the main contractor shares knowledge with the sub-contracting companies during the construction period; • Offer internships and learnerships, especially to those coming from the local communities and HDSA.	Positive
	Household Income	Positive	• Employ labour intensive methods in construction; • Sub-contract to local construction companies; and • Use local suppliers where viable and arrange with the local SMME to provide transport, catering, and other services for the construction crew.	Positive
	Government Revenue	Positive	None	Positive
	Sterilisation of Productive Agricultural Land	Very High (negative)	• Engage with directly affected farmers and landowners on alternative farming locations and investigate ways to minimise loss of agricultural production in the surrounding area; • Off-set impact by training local small-scale farmers and workers as stated in SLP in order to have no net loss; • Ensure that land preparation and rehabilitation activities implemented during various staged of the mine's lifecycle allow for restoration of land to grazing capacity post-mining operations; • Agricultural crop farming cannot be returned, but grazing is suggested.	Low-Medium (negative)
	Loss of agricultural work force	Medium-High (negative)	• Off-set impact by training local small-scale farmers and workers as stated in SLP in order to have no net loss; • Resettlement of farm workers that reside on study area	Low (negative)
	Potential Negative Impact on surrounding Property Value	Medium-High (negative)	• Independent appraisals of properties and land values in the area adjacent to the site to determine the baseline before the project's implementation is advisable; • Mitigation measures proposed by visual and noise specialists should be strictly adhered to, to minimise the probability and intensity of the visual exposure in the area; • Adequate rehabilitation post-mining is vital to restore the sense of place of the area.	Low-Medium (negative)

	Temporary storage of hazardous products, including fuel and explosives	High (negative)	• Bunded areas should be constructed for chemical stores to storage of dangerous goods • This should not be located in sensitive areas or buffer areas, especially not within 100m of watercourses; • Spill kits should readily be available on site to be used in a case of spillage emergency; • Site personnel should be trained in cleaning and removing spillages; • First aid kit should be available at the site office as well as personnel equipped to deal with medical emergencies	Low-Medium (negative)
	Chemical toilets on site	Medium-High (negative)	• There should be a chemical toilet on site for every 12 people, easily accessible within construction camp; • Should not be located in sensitive areas or within 100 m buffer areas, including wetlands and watercourse; • Should be serviced by a contractor on a weekly basis to avoid health issues; • Should always be used by site personnel, i.e. site personnel that do not use them should be penalised	Low (negative)
	General waste facilities including refuse containers and bins	Medium-High (negative)	• A waste contractor should be appointed to provide refuse containers and bins, which should be emptied on a weekly basis to prevent pollution and health issues; • Waste should be disposed of at a registered land fill site and record should be kept of this; • Toxic and chemical waste should be dealt with separately and disposed of in the right manner. Therefore, labelling of waste containers and bins are crucial to avoid contamination; • No littering on site. Any person found littering should be prosecuted;	Low (negative)
	Alteration in surface water drainage patterns and a reduction in the amount of water reaching the Leeufonteinspruit	High (negative)	• Implementation of the storm water management plan to prevent clean water from flowing into the boxcut. Unfortunately, there are no mitigation measures for direct rainfall falling into the boxcut; • As much as is possible, water should be reused and any treated storm flows released downstream; • Backfilling and rehabilitation of old boxcuts as mining progresses	Low-medium (negative)

	Alteration in surface water drainage patterns resulting in changes to downstream aquatic habitat	Medium-High (negative)	• Minimise the removal of vegetation in the infrastructure footprint area; • Re-vegetation of the disturbed areas within the construction footprint area once construction is completed; • Soils compacted by heavy machinery in areas that are not utilised post construction can be ripped to allow infiltration; • Ensure that storm water management structures are within good working condition through regular inspection, especially after large storm events; • Where storm water enters river systems, sediment/silt and debris trapping, as well as energy dissipation control measures must be put in place; • Storm water must be diverted from construction activities and managed in such a manner to disperse runoff and prevent the concentration of storm water flow; • The vegetation of unpaved roadsides; and • Inspection of paved and unpaved roads to monitor for erosion.	Low-medium (negative)
Blasting and development of initial box-cut for mining, including stockpiling from initial box-cut	Risk on community health and safety	High (negative)	• Notification of blasting activities; • Storage of blasting and hazardous materials should adhere to prescribed regulation; • Measures suggested minimising the impact of fly-rock on surrounding roads and structure; • Relocation of structures close to mining operations.	Low-Medium (negative)

11.2 ITEM 3(K)(II): FINAL SITE MAP

The final layout plan is provided in Figure 11-1 with the proposed infrastructure indicated in Figure 11-2.

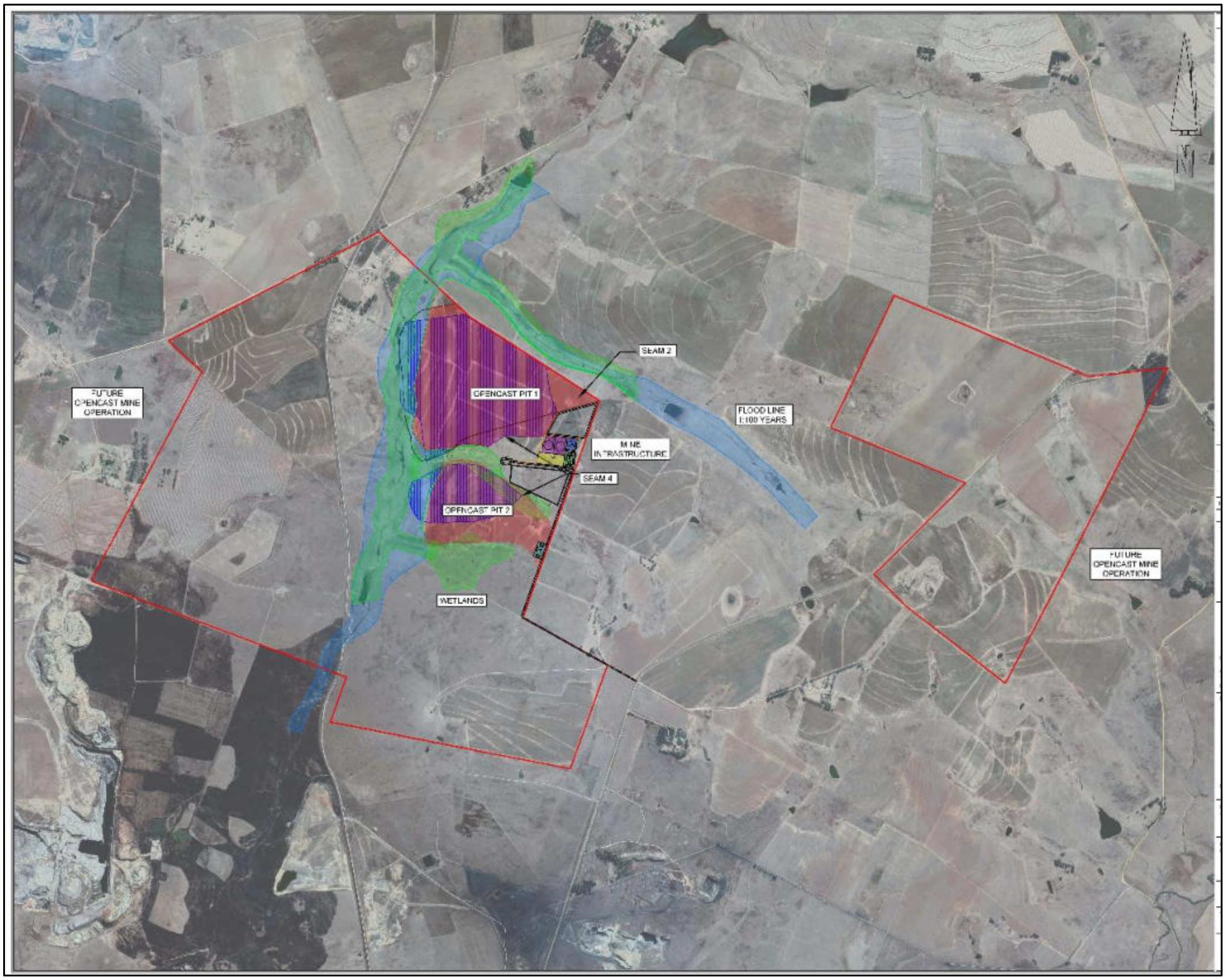


Figure 11-1: Final site map as provided in the MWP for the for the Proposed Dunbar Coal Mine.

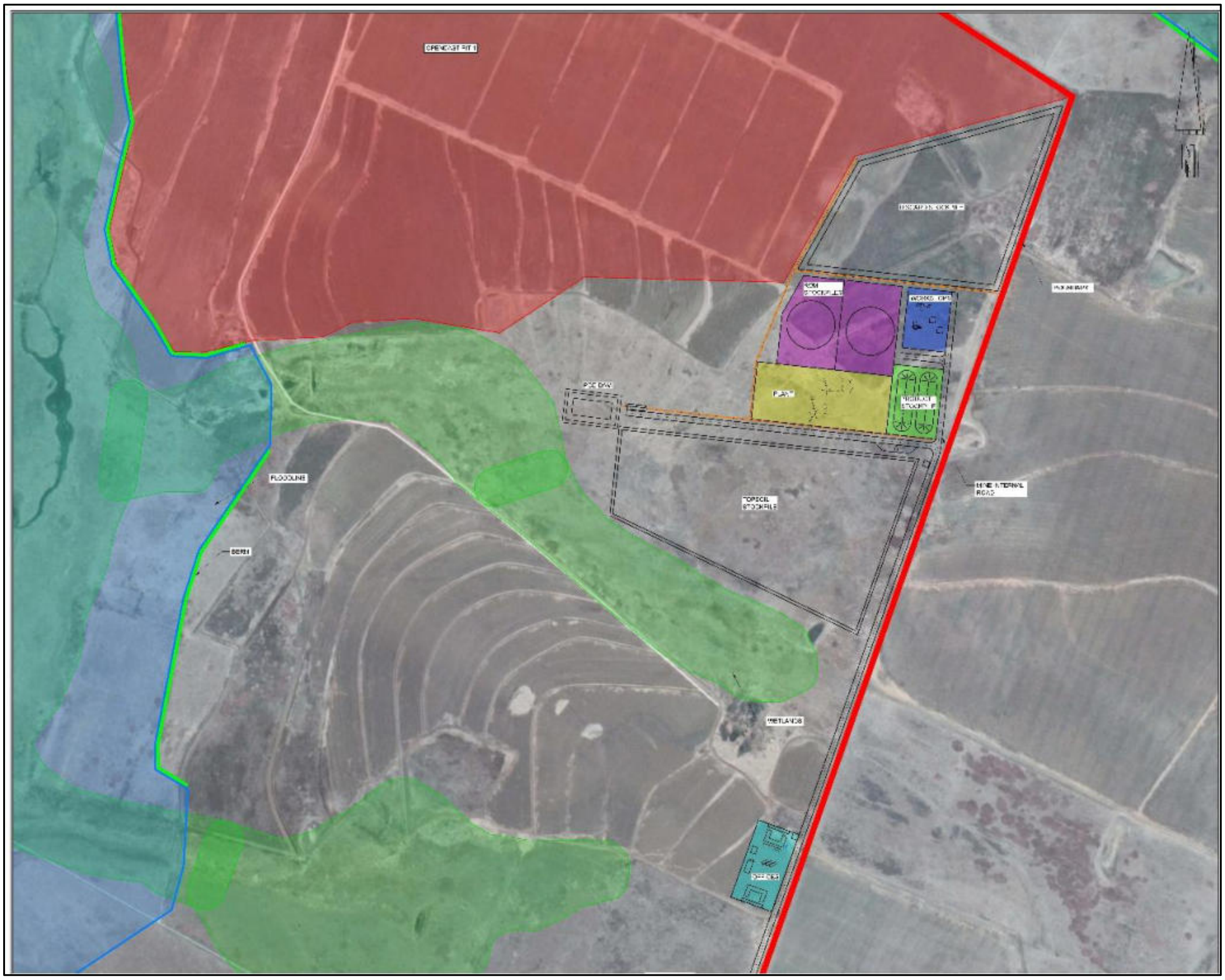


Figure 11-2: Mine Infrastructure Layout for the Proposed Dunbar Coal Mine.

11.3 ITEM 3(K)(III): SUMMARY OF THE POSITIVE AND NEGATIVE IMPLICATIONS AND RISKS OF THE PROPOSED ACTIVITY AND IDENTIFIED ALTERNATIVES

The positive and negative implications were assessed according to the construction, operational and decommissioning phases of the proposed Project. A description of the main impacts is provided in Section 11.1 above. A short summary is provided below for each phase of the project.

Construction Phase

During the construction phase of the proposed project the majority of the negative impacts are associated with physical site clearance and vegetation removal activities. Topsoil loss should be limited by storing and protecting the topsoil to be used for rehabilitation purposes post-mining. Site clearance and vegetation removal will result in a loss in land capability. The affected land will transform from agricultural use to mining use which is an irreversible negative impact. Natural vegetation removal is minimal as the majority of the land where the mining footprint is situated is agricultural land. Alteration of the sub catchment and the subsequent amount of water flowing to the Leeufonteinspruit as well as increased sedimentation of surface water resources which may also impact aquatic biota is considered a medium-high negative impact. The implementation of mitigation measures such as commencing with rehabilitation activities (where required) immediately following construction will however reduce the impact to be of low-medium negative significance. The main negative implications associated with other general construction activities that are of moderate negative significance are nuisance noise, dust and visual impacts.

From a socio-economic perspective the development of the mine will have a positive impact on employment creation, economic and social upliftment and community development. An increase in employment opportunities, household income and skills development will contribute to a positive growth in the local economy for the construction period. Major negative social impacts are expected due to the possible displacement of households in the proposed footprint area. An influx of people in the area are expected which could increase conflict between locals and the newcomers.

Operational Phase

The majority of the impacts identified for the operational phase are associated open pit mining. Initial box-cut removal will negatively impact on agricultural land as well as patches of semi-natural (although disturbed) grassland. Mining will result in the perforation of rock and groundwater reserves leading to severe hydrological and geomorphological impacts to wetlands and catchment due to draw down cone. Blasting activities associated with open pit mining may have significant implications (moderate negative impact) namely blasting close to the mine infrastructure may result in fly rock damage and the rock fragments may pose a risk to road users. The implementation of mitigation measures and proper blast designs these impacts can be reduced to be of minor negative significance.

The operation of surface infrastructure may lead to deterioration of water quality. Stormwater management measures will be in place to ensure clean and dirty water separate. Runoff emanating from surface infrastructure will be contained in the PCD as far as possible; however, this in turn will result in the reduction in catchment yield. Topsoil loss has been identified as a potential impact of moderate significance during the operational phase as a result of rainwater runoff and wind erosion from roads and soil stockpiles. In addition, alien vegetation may establish on the topsoil. This can be prevented by planting indigenous grass mixture, which will also assist in erosion reduction.

Similar to the construction phase, nuisance noise, dust and visual impacts of moderate negative significance are expected from general operation activities such as loading, hauling and stockpiling overburden and ROM. All of these impacts can be mitigated.

Employment creation during operation as well as stimulation and growth of the local and regional economies will be a continued and more positive social impact during the operational phase. Additionally, local SMME will indirectly benefit from the operational phase of the mine. The community will also benefit from community projects which should improve the well-being of the community.

Decommissioning Phase

During the decommissioning phase positive impacts will occur from rehabilitation activities including the restoration of land capability to its pre-mining state or agreed upon alternative, the restoration of vegetation and habitat types as well as the rehabilitation of infrastructure footprint areas. The expected negative impacts are associated with the movement of machinery to dismantle and remove equipment and infrastructure and rehabilitate the disturbed areas. Negligible to moderately negative impacts resulting from soil loss, erosion and dust emissions were identified. Moderate negative social impacts are expected when mining operations cease as a dependency on the mine for sustaining local economy would have been established.

Post closure monitoring is essential to determine if rehabilitation was successful and sustainable. The potential for decant is possible at the central region of Opencast 1 where the decant product (if any) would likely flow towards the perennial river west of the proposed Dunbar coal mine. Groundwater monitoring boreholes at the proposed Dunbar coal mine should be monitored quarterly during the early stages of post-closure in order to identify groundwater level trends. Should decant occur at the Site, a suitable capture and treat system should be implemented and the water treated to levels suitable for discharge to the environment. The implementation of these measures will result in the impact remaining low according to Appendix F2.

12 ITEM 3(L): PROPOSED IMPACT MANAGEMENT OBJECTIVES AND THE IMPACT MANAGEMENT OUTCOMES FOR INCLUSION IN THE EMPR

The EMPr seeks to achieve a required end state and describes how activities that have, or could have, an adverse impact on the environment and surrounding communities will be mitigated, controlled and monitored.

The EMPr will address the environmental impacts and possible unplanned events during each phase of the Project (construction, operational, decommissioning and post-closure). Due regard must be given to environmental protection during the entire Project; a number of environmental recommendations are made to achieve environmental protection.

The objectives of impact mitigation and management are to:

- Primarily pre-empt impacts, assess their significance and implement appropriate mitigation and management measures to avoid, minimise and/or remediate the associated impacts where they cannot completely be avoided.
- Implement an adequate monitoring programme to:
    - Ensure that mitigation and management measure are effective.
    - Allow quick detection of potential impacts, which in turn will allow for quick response to issue/impacts.
    - Reduce duration of any potential negative impacts.

13 ITEM 3(M): FINAL PROPOSED ALTERNATIVES

The location of the project has been decided upon based on the location of the identified coal seams. Alternatives were therefore assessed for the layout of the Project with consideration given to the environmental and technical assessments undertaken. The final proposed layout (Figure 11-1 and Figure 11-2) aimed to ensure that the placement of infrastructure in such a manner as to avoid and minimise potential environmental impacts as detailed in Section 8 above.

The mine design has been adjusted to avoid sensitive areas, including the watercourses (wetlands) and ther associated buffer areas. Following the mitigation hierarchy, most impacts can be mitigated to acceptable levels. Accordingly, impacts that could not be avoided, mitigation and management measures have been provide to lessen the significance of the adverse impacts. The loss of agricultural land is irreversible as the land cannot optimally be rehabilitated back to baseline conditions. At best, it can be returned to grazing capacity.

14 ITEM 3(N): ASPECTS FOR INCLUSION AS CONDITIONS OF AUTHORISATION

The studies and impact assessment has been based on the proposed mine layout and mining work programme. Should there be any changes to the proposed project description, the adequacy and accuracy of the work may be affected and additional work may be required to fill in the gaps.

The Terrestrial Ecology specialist assessment is dependent on seasonality which affects the outcome and sensitivity mapping of the affected mining area. A wet season site visit will be conducted in November prior to submitting the final EIA report for review by the competent authority.

Any feedback from I&APs and stakeholders such as SAHRA will be incorporated in the final EIA report.

This section will therefore be updated after the 30 day review period of the EIA report.

15 ITEM 3(O): DESCRIPTION OF ANY ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

Each specialist assessment had its own assumptions, uncertainties, limitations and knowledge gaps, and are indicated below:

Aquatic and Surface Water Assessment:

- The field assessment was undertaken during the dry season, which is not the best time to observe vegetative indicators of wetland habitat. Wetland soil indicators were therefore the primary means of delineation.
- The field assessment was restricted to those watercourses that are likely to be impacted by mining activities, which include the opencast pits and associated infrastructure;
- The accuracy of wetland delineations was based primarily on the recording of onsite wetland terrain, vegetation and soil indicators using a GPS. GPS accuracy will therefore influence the accuracy of the mapped sampling points and the water resource boundaries and an error of 1-5m can be expected. All wetland indicators were recorded using a Garmin MontanaTM Global Positioning System (GPS) and captured using Geographical Information Systems (GIS) for further processing;
- All vegetation information recorded was based on the onsite observations of the author and no formal vegetation sampling was undertaken. Furthermore, the vegetation information provided only gives an indication of the dominant and/or indicator aquatic species and only provides a general indication of the composition of the vegetation communities;
- Although every effort was made to correctly identify the plant species encountered onsite, the author is not a botanist and experience in plant identification is limited to facultative wetland and obligate wetland plants. Therefore, it is possible that some plants may have been overlooked and other may have been incorrectly identified, particularly dryland plant species;
- While fish species are likely to occur within the main reach of the Leeufonteinspruit, these would have been restricted to the isolated in-stream dams occurring along the length of the river which were not sampled as part of this assessment. No fish species of conservation concern are expected to occur within the Leeufonteinspruit and those that are expected to occur, are relatively tolerant to modifications in flow and water quality. No wetland fauna

sampling or faunal searches were conducted and the assessment of wetlands was purely habitat focussed;

- With ecology being dynamic and complex, there is the likelihood that some aspects (some of which may be important) may have been overlooked. Similarly, sampling by its nature, means that generally not all aspects of ecosystems can be assessed and identified; and
- The PES and EIS assessments undertaken are largely qualitative assessment tools and thus the results are open to professional opinion and interpretation. An effort has been made to substantiate all claims where applicable and necessary.

Blasting and Vibration

It is not the purpose of this assessment to calculate exact vibration levels, or the precise level of the air overpressure, but to use various tools to identify potential issues of concern. Due to unknowns this assessment leans towards a precautious approach, rather over-estimate the distance that fly-rock may travel, the ground vibration or the level of an air blast. However, the following assumptions and limitations must be noted:

- No blast design report was available for this project and the blast input parameters were communicated to the author from the developer, considering the blast parameters of a similar mine of the developer. Two scenarios were investigated, namely the blast parameters from a previous project and blast parameters considering the "Rules of Thumb" from Dyno, 2010;
- This impact assessment does not make a statement on the acceptability of the blast design as evaluated (viable bench height, fracturing, powder factors, etc.) and only assesses the potential impacts considering the available information;
- None of the structures were visited to confirm the status of each structure. It is highly recommended that the mine complete a survey of all structures and boreholes (location, depth, yield, static water level, ground water quality, usage, etc.) located within 1,000 m from the proposed opencast limits to determine the status and state of the structures before the construction of the mine start (first blasting taking place);
- The report assumed an average borehole depth of 10m. The borehole depths were used as the average bench height;
- A blast hole diameter of 110 mm was used, with the burden and spacing estimated from the blast hole diameter as well as the average bench height of 10 m using the "Rules of Thumb" from Dyno, 2010, for the second scenario;
- Attenuation rates for ground vibration levels, air blast levels and fly rock distances are site-specific. Empirical formula have been developed by a number of researchers, yet all these equations use constants that should be developed considering site specifics. These site constants can initially be assumed but should be refined considering the results of blasting vibration and air pressure measurements. This data must be analysed and with the information used to update this report;
- Calculations are based on an ideal situation, with the bedrock having constant characteristics, whereas in practice the geology is complex with faults, dykes, folds, stratigrapical layers etc. This means that each blast may different;
- The report assumed that blasting will take place during the afternoon when atmospheric conditions are the most unstable with no inversion layer or a potential inversion layer that is high with no overcast conditions.

Terrestrial Ecological Assessment

- It is assumed that all third party information acquired is correct (e.g. GIS data and scope of work);

- Due to the nature of most biophysical studies, it is not always possible to cover every square metre of a given PAOI. Due to factors such as thick vegetation stands and suboptimal seasonality it is conceivable that small individual plant species of conservation concern (SCC) may have been overlooked;
- Access to adjacent habitat in farm Portion 4/189 was prevented by electric fencing, and will need to be surveyed during the wet season supplementary survey; and
- The initial ecological survey was carried out during suboptimal, early and late dry season conditions. A wet season supplementary study should take place using the methods described below.

Hydrogeological Assessment

Model hydraulic parameters were based on literature values, previous investigations completed within the Site region and Site-specific aquifer testing and were assumed to be representative of Site conditions;

- Recharge to groundwater was assumed to be equally distributed across the model domain;
- Geochemistry testing results available for the Site, combined with literature geochemistry results, were assumed to be valid and representative of the Site conditions;
- Worst case scenario contaminant source concentrations were taken from Mokoena (2012) with concentrations at the backfill material and the Site stockpile areas, dumps and the PCD assigned as 670 mg/l and 300 mg/l, respectively;
- A numerical model does not provide a unique solution. Therefore, numerical modelling will always have inaccuracies due to the uncertainty in data, the capabilities/limitations of numerical modelling code to describe the natural processes and the factors selected by the modeller to resolve the non-unique solution;
- The complexities of fractured rock aquifers imply that the model can only be used as a guide to determine the order of magnitude of dewatering and contaminant transport; and
- The interpretation of modelled results should be based on the assumptions the model was built on and actual results will vary as unknown aquifer conditions and parameters vary in the natural system.

Heritage

The authors acknowledge that the brief literature review is not exhaustive on the literature of the area. Due to the subsurface nature of archaeological artefacts, the possibility exists that some features or artefacts may not have been discovered/recorded during the survey and the possible occurrence of graves and other cultural material cannot be excluded and might require further mitigation. Similarly, the depth of the deposit of heritage sites cannot be accurately determined due to its subsurface nature. This report only deals with the footprint area of the proposed development and consisted of non-intrusive surface surveys. This study did not assess the impact on medicinal plants and intangible heritage as it is assumed that these components would have been highlighted through the public consultation process if relevant. It is possible that new information could come to light in future, which might change the results of this Impact Assessment.

Noise

Measurements of Ambient Sound Levels

- Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. High measurements may not necessarily mean that noise levels in the area are high. Similarly, a low sound level measurement will not necessarily mean that the area is always quiet, as sound levels will vary over seasons, time of the day, faunal characteristics, vegetation in the area and meteorological conditions (especially wind). This is excluding the potential effect of sounds from anthropogenic origin. It is impossible to quantify and identify the numerous sources that influenced a measurement using the reading result at the end of the measurement. Therefore trying to define ambient sound levels using the result of one 10-minute measurement can be inaccurate (very low confidence level in the results) for the reasons mentioned above. The more measurements that can be collected at a location the higher the confidence levels in the ambient sound level determined. The more complex the sound environment, the longer the required measurement. When singular measurements are used, a precautious stance must be adopted (as done in this report).

- It is assumed that the measurement locations represent other residential dwellings in the area (similar environment), yet, in practice, this can be highly erroneous as there are numerous factors that can impact on ambient sound levels, including:
  - the distance to closest trees, number and type of trees as well as the height of trees;
  - available habitat and food for birds and other animals;
  - distance to residential dwelling, type of equipment used at dwelling (compressors, air-con);
  - general maintenance condition of house (especially during windy conditions); and
  - number and type of animals kept in the vicinity of the measurement locations (typical land use taking place around the dwelling).
- Exact location of a sound level meter in an area in relation to structures, infrastructure, vegetation and external noise sources will influence measurements. It may determine whether one is measuring anthropogenic sounds from a receptors dwelling, or environmental ambient soundscape contributors of significance (faunal, road traffic, railway line movement etc.). At times there are extraneous noises that cannot be heard during deployment, or not operational, that can significantly impact on readings (such as water pumps, transformers, faunal communication, etc.).
- Determination of existing road traffic and other noise sources of significance are important (traffic counts etc.). Traffic, however, is highly dependent on the time of day as well as general agricultural activities taking place during the site investigation. Traffic noise is one of the major components in urban areas and could be a significant source of noise during busy periods. Traffic[34] on the N12 is significant and traffic noises will have an impact on the ambient sound levels in an area up to about 1,000m either side of the N12, and depending on specific conditions, it may be more during other times. Traffic may be audible at distances up to 3,000 m during quiet periods (little faunal and other noises), especially if the wind blows from the road to the receptors.

[34] [34] Derived from https://nraaudit.nra.ie/CurrentTrafficCounterData/html/N17-15.htm and https://www.arrivealive.co.za/2003-TRAFFIC-OFFENCE-SURVEY-Comprehensive-Report-on-Fatal-Crash-Statistics-and-Road-Traffic-Information-11

- Measurements over wind speeds of 3 m/s could provide data influenced by wind-induced noises. While the windshields used limits the effect of fluctuating pressure across the microphone diaphragm, the effect of wind-induced noises in the trees in the vicinity of the microphone did impact on the ambient sound levels. The site visit, unfortunately, coincided with a relatively windy period.
- Ambient sound levels are dependent not only on time of day and meteorological conditions but also change due to seasonal differences. Ambient sound levels are generally higher in summer months when faunal activity is higher and lower during the winter due to reduced faunal activity. Winter months unfortunately also coincide with lower temperatures and very stable atmospheric conditions, ideal conditions for propagation of noise. Many faunal species are more active during warmer periods than colder periods. Certain cicada species can generate noise levels up to 120 dB for mating or distress purposes, sometimes singing in synchronisation magnifying noise levels they produce from their tymbals[35].
- Ambient sound levels recorded near rivers, streams, wetlands, trees and bushy areas can be high. This is due to faunal activity which can dominate the sound levels around the measurement location. This generally is still considered naturally quiet and understood and accepted as features of the natural soundscape, and in various cases sought after and pleasing.
- Considering one or more sound descriptor or equivalent can improve an acoustical assessment. Parameters such as L_{AMin}, L_{Aleq}, L_{AFeq}, L_{Ceq}, L_{AMax}, L_{A10}, L_{A90} and spectral analysis forms part of the many variables that can be considered.
- As a residential area develops the presence of people will result in increased sounds. These are generally a combination of traffic noise, voices, animals and equipment (incl. TV's and Radios). The result is that ambient sound levels will increase as an area matures.

Calculating noise emissions – Adequacy of predictive methods

The noise emissions into the environment from the various sources as defined were calculated for the operational phase in detail, using the sound propagation model described in ISO 9613-2.

The following was considered:

- The octave band sound pressure emission levels of processes and equipment;
- The distance of the receiver from the noise sources;
- The impact of atmospheric absorption;
- The operational details of the proposed project, such as projected areas where activities will be taking place;
- Topographical layout; and

[35] Clyne, D. *"Cicadas: Sound of the Australian Summer, Australian Geographic"* Oct/Dec Vol 56. 1999.

- Acoustical characteristics of the ground. 50% soft ground conditions were modelled, as the area where the mining activity would be taking place is well vegetated and sufficiently uneven to allow the consideration of relatively soft ground conditions. This is because the use of hard ground conditions could represent a too precautionary situation.

The noise emission into the environment due to additional traffic was calculated using the sound propagation model described in RLS-90 used in Germany. Corrections such as the following were considered:

- Distance of receptor from the road;
- Road construction material;
- Average speeds of travel;
- Types of vehicles used; and
- Ground acoustical conditions.

In this project, it illustrates the potential extent of the calculated noises of the complete project and not noise levels at a specific moment in time. It is used to define potential issues of concern and not to predict a noise level at a potential noise-sensitive receptor. For this, the selected model is internationally recognised and considered adequate.

Adequacy of Underlying Assumptions

Noise experienced at a certain location is the cumulative result of innumerable sounds emitted and generated both far and close, each in a different time domain, each having a different spectral character at a different sound level. Each of these sounds is also impacted differently by surrounding vegetation, structures and meteorological conditions that result in a total cumulative noise level represented by a few numbers on a sound level meter.

As previously mentioned, it is not the purpose of noise modelling to accurately determine a likely noise level at a certain receptor but to calculate a noise rating level that is used to identify potential issues of concern.

Uncertainties associated with mitigation measures

Any noise impact can be mitigated to have a low significance; however, the cost of mitigating this impact may be prohibitive, or the measure may not be socially acceptable (such as the relocation of an NSD). These mitigation measures may be engineered, technological or due to management commitment.

For the purpose of the determination of the significance of the noise impact mitigation measures were selected that is feasible, mainly focussing on management of noise impacts using rules, policy and require a management commitment. This, however, does not mean that noise levels cannot be reduced further, only that to reduce the noise levels further may require significant additional costs (whether engineered, technological or management).

It was assumed the mitigation measures proposed for the construction phase will be implemented and continued during the operational phase.

16 ITEM 3(P): REASONED OPINION AS TO WHETHER THE PROPOSED ACTIVITY SHOULD OR SHOULD NOT BE AUTHORISED

16.1 ITEM 3(P)(I): REASONS WHY THE ACTIVITY SHOULD BE AUTHORISED OR NOT

Various specialist studies were undertaken during the EIA Phase of the proposed project with the objective of identifying and weighing anticipated impacts and risks associated with the mining activities as well as in accordance to all relevant legislative requirements.

The findings of the impact assessment have shown that the proposed project will have adverse impacts on the receiving environment, including:

- The loss of high potential agricultural land to open pit mining (land use change). This is an irreversible impact to the land use and the overall land capability as the soil cannot be rehabilitated to cultivated land post-mining. At best, it can be reused for grazing purposes post-mining.

All other impacts could either be avoided by altering the layout and by implementing buffer areas, or be mitigated to acceptable levels that will not be detrimental to the environment.

Where possible, mitigation and management measures, no-go areas, as well as further recommendations have been provided by specialist which in reducing the significance of these impacts to minor or negligible significance, including:

- All watercourses should be buffered by 60 m which should be clearly demarcated as no-go areas and sensitive receptors;
- Berms must be maintained as a buffer between the coal handling area and the sensitive receiving environment;
- Commitment ot optimal rehabilitation post-mining in order to return the land back to baseline conditions, to limit and reduce the impact on surface and groundwater, and to monitor all impacts in order to act accordingly to rectify situations.
- Decant is proposed for Opencast 1, which could impact on the watercourse west of the proposed mine. Should decant occur at the Site, a suitable capture and treat system should be implemented and the water treated to levels suitable for discharge to the environment. The implementation of these measures will result in the impact remaining low

Monitoring plans, which should be implemented throughout the life of the mine, have also been provided to ensure that adverse impacts are realised and continuous improvements are developed. Options of improving the water quality or reducing the current damage on the overall system will be investigated as part of the IWULA process, with discussions with the DWS, and will look at improving the system on a larger scale.

Rehabilitation must be implemented based on best practice principles (and not just another exercise as most coal mines fail to comply with effective rehabilitation measures), and the Department of Environment, Forestry and Fisheries (DEFF) should monitor activities during the construction, operational and closure phases of the proposed mine.

Several coal mines exist in the surrounding area and additional Mining Right applications are in progress or have been approved recently in the surrounding areas of the proposed project; therefore it may be conducive to look at what positive impacts could be cumulated on a regional level between all the mining houses.

With the correct mitigation and management measures, including the incorporation of the 60m buffer around the identified watercourses, sustainable mining operations could be feasible.

16.2 ITEM 3(P)(II): CONDITIONS THAT MUST BE INCLUDED IN THE AUTHORISATION

16.2.1 Specific conditions to be included into the compilation and approval of EMPR

The following specific conditions are proposed:

- All mitigation measures proposed in this report should be implemented;
- All buffer areas indicated for features should be implemented and avoided. Where avoidance and mitigation is not possible, alternatives such as rehabilitation or offset agreements needs to be reached. In the case of historical buildings and graves, the relevant authority needs to be contacted and the required legislative processes should be followed.
- Environmental monitoring should take place as recommended by the specialists;
- All flora and fauna Species of Conservation Concern must be relocated by a qualified specialist as part of a relocation and monitoring plan prior to construction activities. No faunal species may be hurt, killed or captured during the construction or operational phase of the project;
- A grievance system or communication platform must be established to create a forum for the public to interact with the mining house;
- A Water Use License must be obtained prior to the construction phase and mining operations;
- The closure cost assessment should be updated and submitted as per the legislative requirements.

16.2.2 Rehabilitation requirements

The post-mining land use should be restored to either grazing and/or cultivated land and should represent the pre-mining land use (baseline conditions), as far as possible. Refer to Appendix G for the Rehabilitation, Decommissioning and Closure Plan.

Rehabilitation of the project will aim to:

- Ensure that the final elevation around the site is free draining (the catchment are should be restored).
- Ensure that soil replaced in the same sequence to ensure soil characteristics are retained as far as possible to alow for optimal land use conditions.
- Ensure a self-sustaining post-mining land capability similar to pre-mining of grazing and limited low-intensity arable lands. Where wetlands and grasslands have been transformed, the land should be returned to these natural features.
- Ensure that the rehabilitated areas are cleared of all contaminating substances and that runoff from the area is returned to the natural catchment.
- Ensure that vegetation growth and cover on the rehabilitated areas is sustainable and local indigenous species (for grasslands and watercourses) are establishing on the site and that succession and colonisation from surrounding

areas is taking place on rehabilitated areas. Ecological and ecosystem processes should function optimally after a prescribed period.

- Ensure that alien invasive species are eradicated until the closure certificate is granted.
- The rehabilitation model must be drafted before final rehabilitation activities commence.
- In order to ensure rehabilitation of the site can be undertaken responsibly, soils must be stripped and stockpiled separately. This will ensure preservation of soil for re-use in rehabilitation of the site.
- Some infrastructure such as the discard dump, the associated storm water management features around the dump, and the PCD might be permanent features. The main access road to site and the roads to the mine residue dump should be retained in order to undertake the necessary post-closure monitoring.

The closure and rehabilitation objectives for the Project are listed below, and should be met:

- Achieve a final land use that is sustainable and meets both legislative requirements and stakeholder needs;
- Maintain and monitor all rehabilitated areas following re-vegetation and, if this monitoring shows that the objectives have been met, make an application for closure;
- Comply with local, district and national regulatory requirements; and
- Follow a comprehensive consultation and communication process with all stakeholders.

17 ITEM 3(Q): PERIOD FOR WHICH THE ENVIRONMENTAL AUTHORISATION IS REQUIRED

The anticipated mining operations, excluding construction and decommissioning, are anticipated to be maintained for a period of 10 years. The LOM has been calculated at 10 years for Opencast 1. To allow for construction, decommissioning, closure and rehabilitation, additional 5 years are required. Therefore the EA should be granted for a period of 15 years.

18 ITEM 3(R): UNDERTAKING

Please refer to Part B: Section 32 for the complete undertaking applicable to the EIA and EMPr sections of this report.

19 ITEM 3(S): FINANCIAL PROVISION

The financial provision was calculated according to Regulation 6 of the Financial Provision Regulations (2015) which prescribe the minimum content requirements.

The financial provision for concurrent rehabilitation for the planned activities is **R13 330 768.07 (Excl. VAT)** – Refer to Table 19-1 below and Appendix G for more details.

19.1 ITEM 3(S)(I): EXPLAIN HOW THE AFORESAID AMOUNT WAS DERIVED

The NEMA Financial Provision Regulations (2015) require that the closure costs be calculated according to real rates. These rates were sourced from a third-party contractor, specialising in demolition and rehabilitation. In order to calculate the closure cost using the third-party contractor rates, each of the closure actions from the report were broken down into specific sub-sections (i.e. roads, power lines, buildings, plant equipment etc.). A BOQ was determined for each of the sub-sections and applied to the third-party contractor rates to determine a closure cost per unit. The addition of these costs represents the

Subtotal 1 of the financial liability. An additional cost for site establishment and contractor project management is included to determine a subtotal 2 and a 10% contingency is calculated on subtotal 2 to obtain a subtotal 3 (cost excluding VAT). Subtotal 3 is seen by the Department of Environmental Affairs as the Financial Closure Liability of the mine (Table 19-1).

The sudden closure cost (assuming the mine were to close tomorrow) was based on quantities from the GIS department. The major rehabilitation measures that would need to take place should the mine undergo sudden closure would include:

- The dismantling of all surface infrastructure;
- The backfilling and shaping of all voids;
- The ripping and vegetating of the remaining disturbed areas; and
- The aftercare and maintenance measure which would include monitoring.

Table 19-1: Financial Provision Summary

	Dunbar Colliery Closure	Final Closure Cost
	Mine Closure Costs 2019	
1	**Surface Infrastructure**	**R4 640 829.23**
1	Dismantling of processing plant and associated structures (including associated conveyors & power lines)	R1 601 284.48
2(A)	Demolition of steel buildings and structures (including floor slabs)	R47 158.50
2(B)	Demolition of reinforced concrete buildings and structures	R746 100.38
3	Rehabilitation of access roads	R1 206 530.81
4(A)	Demolition of electrified railway lines	R0.00
4(B)	Demolition and rehabilitation of non-electrified railway lines	R0.00
5	Demolition of housing and facilities (including floor slabs)	R940 008.79
12	Fencing	R99 746.26
2	**Mining Areas & Waste Sites**	**R1 274 580.00**
6	Opencast rehabilitation (including final voids and ramps)	R1 274 580.00
7	Sealing of shafts, adits and inclines (including concrete cap)	R0.00
3	**Mine Residue Sites**	**R1 756 386.75**
8(A)	Rehabilitation of overburden and spoils	R0.00
8(B)	Rehabilitation of processing waste deposits and evaporation ponds (basic, salt-producing waste)	R0.00
8(C)	Rehabilitation of processing waste deposits and evaporation ponds (acidic, metal-rich waste)	R931 709.10
9	Rehabilitation of subsided areas	R0.00
13	Water management (Separating clean and dirty water, managing polluted water and managing the impact on groundwater, including treatment, when required)	R824 677.65
4	**General Rehabilitation**	**R1 455 718.19**
10	General surface rehabilitation, including of all denuded areas	R1 455 718.19
5	**Aftercare & Maintenance**	**R1 692 914.46**
13	Monitoring	R870 000.00
14	Maintenance	R822 914.46
15	Water Facility	R0.00
	Sub Total 1	**R10 820 428.63**
	Site establishment and project Management	**R1 298 451.44**
	Sub Total 2	**R12 118 880.06**
	Contingency (10% of subtotal 2)	**R1 211 888.01**
	Sub Total 3	**R13 330 768.07**
	VAT (14% of subtotal 3)	**R1 866 307.53**
	Total	**R15 197 075.60**

19.2 ITEM 3(S)(II): CONFIRM THAT THIS AMOUNT CAN BE PROVIDED FOR FROM OPERATING EXPENDITURE

Provided the Mining Right is approved, Vandabyte will provide for closure as per the legal requirements. A liability assessment will also need to be undertaken annually to ensure the financial provision is in line with the closure cost.

20 ITEM 3(T): DEVIATIONS FROM THE APPROVED SCOPING REPORT AND PLAN OF STUDY

20.1 ITEM 3(T)(I): DEVIATIONS FROM THE METHODOLOGY USED IN DETERMINING THE SIGNIFICANCE OF POTENTIAL ENVIRONMENTAL IMPACTS AND RISKS

There were no deviations from the plan of study as stipulated in the Scoping Report.

20.2 ITEM 3(T)(II): MOTIVATION FOR THE DEVIATION

There were no deviations from the plan of study as stipulated in the Scoping Report.

21 ITEM 3(U): OTHER INFORMATION REQUIRED BY THE COMPETENT AUTHORITY

Compliance with the provision of section 24(4)(a) and (b) read with section 24 (3) (a) and (7) of the National Environmental Management Act (Act 107 of 1998) the EIA report must include the:-

21.1 ITEM 3(U)(I)(1): IMPACT ON THE SOCIO-ECONOMIC CONDITIONS OF ANY DIRECTLY AFFECTED PERSON

The potential socio-economic impacts expected to arise as a result of the proposed project have been investigated and assessed in the SIA (Appendix F5).

People in the vicinity of the mine will experience both positive and negative impacts of the proposed Project. The loss of agricultural land and consequently loss of agricultural jobs and food security is perhaps the most important socio-economic negative impact of the proposed Dunbar Coal mine. In contrast, the proposed Dunbar Coal Mine will provide employment opportunities, skills development, social development programmes, community upliftment and economic injection to the local area and regionally. Refer to Section 8 for more details as well as Appendix F5.

21.2 ITEM 3(U)(I)(2): IMPACT ON ANY NATIONAL ESTATE REFERRED TO IN SECTION 3(2) OF THE NATIONAL HERITAGE RESOURCES ACT.

A Heritage Impact Assessment was undertaken during the EIA phase of the project (Appendix F7). Three features were recorded namely a stone cairn (Feature 1), ruins of a farmstead younger than 60 years (Feature 2) and the remains of a rectangular brick structure (Feature 3). If Feature 1 is a grave it is oh high social significance. Based on historical maps Feature 2 dates to between 1965 and 1984 and is therefore not older than 60 years and of no heritage significance. Feature 3 is not indicated on historical maps and is not considered to be of heritage significance.

22 ITEM 3(V): OTHER MATTERS REQUIRED IN TERMS OF SECTIONS 24(4)(A) AND (B) OF THE ACT

Section 24(4) states: *Before any regulations are prescribed under this section or any other law that contemplates the assessment of the potential environmental impact of activities and notwithstanding such other law—*

(a) a Minister or MEC must submit a draft of such regulations to the Committee;

(b) the Committee must within 30 days of the receipt of such draft regulations—

(i) determine whether the draft regulations would bring about a duplication of effort by persons initiating activities contemplated in subsection (1) in the investigation and assessment of the potential impacts of activities that require authorisation or permission from more than one organ of state; and

(ii) approve the draft regulations unless they would bring about such a duplication of effort; or

(iii) specify amendments to be made to such draft regulations in order toavoid such a duplication of effort:

The NEMA EIA Regulations (2014, as amended) and the NEMA Financial Provision Regulations (2015) have been considered in this application for EA. The potential impacts of activities that require authorisation or permission from more than one organ of state has been considered, and found that under the One Environmental System both Listed activities under NEMA EIA Regulations and NEMWA have been included and require authorisation only from the Department of Mineral Resources and Energy. A separate authorsation for an Integrated Water Use Licence should be obtained from the Department of Human Settlements, Water and Sanitation.

Part B: Environmental Management Programme Report

23 ENVIRONMENTAL MANAGEMENT PROGRAMME

23.1 ITEM 1(A): DETAILS OF THE EAP

Vandabyte (Pty) Ltd has appointed Enviro-Insight CC as an independent Environmental Assessment Practitioner (EAP) to undertake a Scoping and Environmental Impact Assessment (S&EIA) process that is required to support the application for a mining right.

Enviro-Insight CC has no vested interest in the proposed project and hereby declares its independence as required by the NEMA EIA Regulations. For purposes of this S&EIA, the following person may be contacted at Enviro-Insight CC:

Table 23-1: Contact details of EAP.

Company:	Enviro-Insight CC
Contact Person:	Corné Niemandt
Purpose:	Project coordinator and EAP
Address:	Unit 8 Oppidraai Office Park, 862 Wapadrand Road, Wapadrand Security Village, Pretoria, 0081
Telephone:	012 807 0637
Email:	corne@enviro-insight.co.za

24 ITEM 1(B): DESCRIPTION OF THE ASPECTS OF THE ACTIVITY

Refer to Part A for the list of aspects associated with the proposed project.

25 ITEM 1(C): COMPOSITE MAP

The Composite Map is displayed below (Figure 25-1; Appendix C). The following buffer areas were applied:

- 60m for wetlands and watercourse in the Project Area of Interest; and
- 1:50 and 1:100 year flood lines.

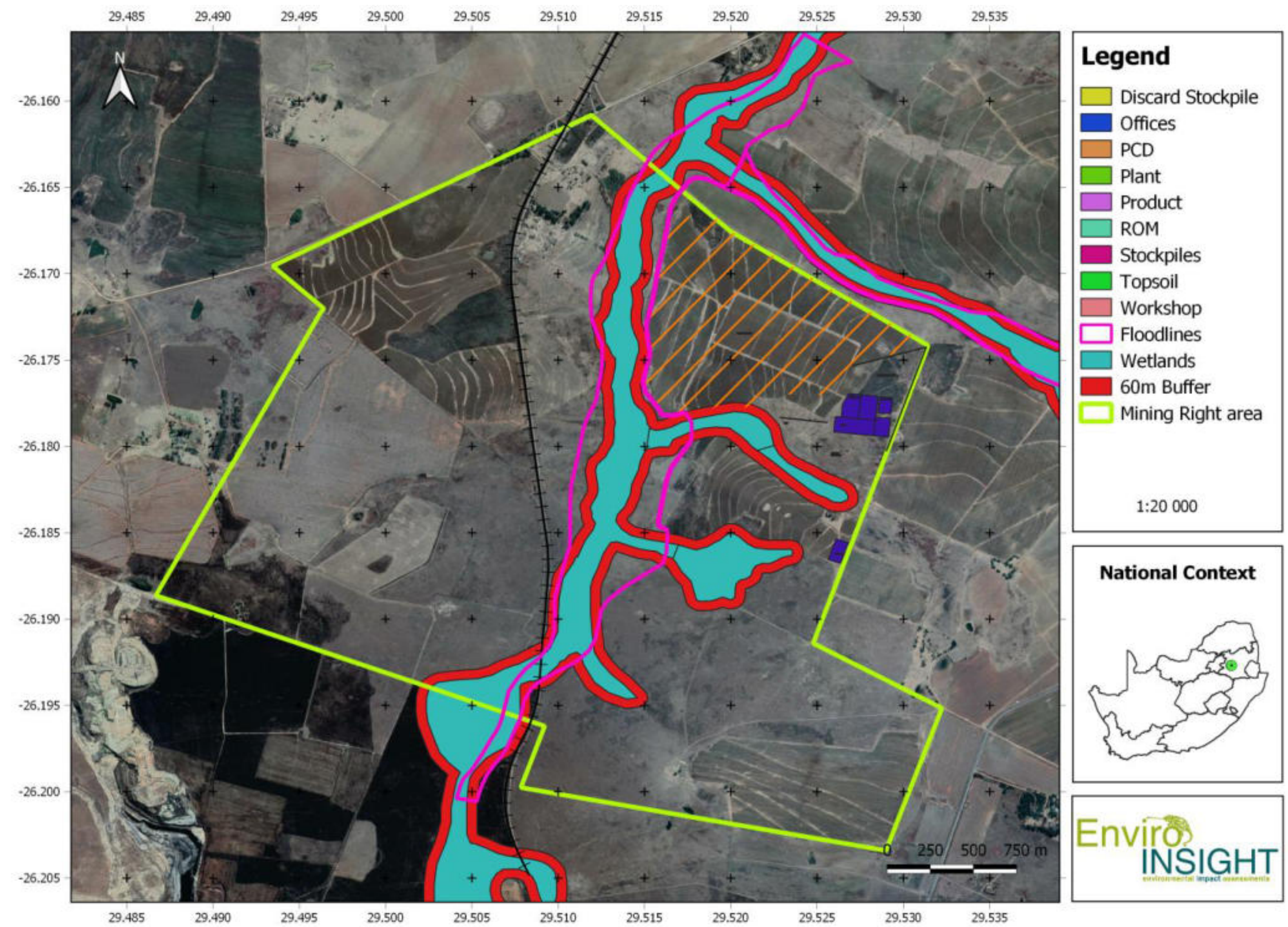


Figure 25-1: Composite map (i.e. sensitivity map of the proposed mining are).

26 ITEM 1(D): DESCRIPTION OF IMPACT MANAGEMENT OBJECTIVES INCLUDING MANAGEMENT STATEMENTS

26.1 ITEM 1(D)(I): DETERMINATION OF CLOSURE OBJECTIVES

Closure and rehabilitation is a continuous series of activities that begin with planning prior to the project's design and construction, and end with achievement of long-term site stability that creates a safe, physically stable rehabilitated landscape that limits long-term erosion potential and environmental degradation, and restores the land to pre-mining conditions as far as possible.

The following points outline the main objectives for rehabilitation and closure:

- Achieve a final land use that represents pre-mining conditions that is sustainable and meets both legislative requirements and stakeholder needs;

- Create opportunities for alternative post-mining livelihoods by aligning to the regional planning;
- Ensure interconnectivity between the rehabilitated landscapes with surrounding regionally biologically diverse areas;
- Encourage, if and where required, the re-instatement of terrestrial and aquatic wetland biodiversity over time;
- Maintain and monitor all rehabilitated areas following re-vegetation and establishment of landscape features such as wetland pans. If this monitoring shows that the objectives have been met, make an application for closure;
- Prevent / Minimise negative impacts and risks as identified in this report
- Comply with local, district, provincial and national regulatory requirements; and
- Follow a comprehensive consultation and communication process with all stakeholders.

26.2 ITEM 1(D)(II): THE PROCESS FOR MANAGING ANY ENVIRONMENTAL DAMAGE, POLLUTION, PUMPING AND TREATMENT OF EXTRANEOUS WATER OR ECOLOGICAL DEGRADATION AS A RESULT OF UNDERTAKING A LISTED ACTIVITY

An Environmental Response Plan (ERP) is a process to respond rapidly and effectively to and manage emergency situations that may arise at the mine.

The Emergency Preparedness and Response Code of Practice will be compiled in accordance with the following:

- Occupational Health and Safety OHSAS 18001; and
- The Mine Health and Safety Act, 1996 (Act No. 29 of 1996).

In the event of an emergency, the ERP and applicable Procedure will be consulted and the required actions implemented. To facilitate the effective implementation of the procedures, copies of the Emergency Response Plan will be placed in accessible and visible locations around the site, such as the site office and contractors yards.

The applicant shall ensure that employees and contractors are adequately trained with regard to the implementation of the EMPr, environmental legal requirements and obligations, and the ERP. Environmental awareness is applicable to all project involved personnel as well as part time personnel who shall be trained so that they are aware of environmental obligations by the time they visit the site. An Environmental Awareness Practitioner or Environmental Control Officer (ECO) will be appointed to conduct training during site establishment and will be responsible for how the site look like before the drilling and how it looks like after rehabilitation. This will be to ensure that the site has been restored to its original state or to an acceptable level, and ensure the ERP is adequately applied in case of an emergency. Accordingly, training programmes and frequent emergency simulations is suggested to ensure that all personnel are aware of safety and emergency procedures.

In addition, a list of emergency contact numbers will be displayed at various locations around the site. If the emergency has the potential to affect surrounding communities, the communities will be alerted via alarm signals or contacted in person.

Personnel that do not comply or ignore training and instruction regarding this should be fined based on their offensive. First time offenders may only get away with a written warning, depending on the seriousness of the offence. Second time offenders may be suspended or fined depending on the decision made by the site manager who may consult with the ECO, contractor and Safety, Health and Quality Officer of the mine.

26.3 ITEM 1(D)(III): POTENTIAL RISK OF ACID MINE DRAINAGE

At the Site, all waste generated during mining will be stored at temporary storage facilities at the Site until it is used to backfill the opencast pit area during mining (i.e. rollover rehabilitation). Coal processing will take place on the Site and all 'dirty' water will report to a pollution control dam (PCD) at the Site. Due to the temporary nature of the stockpile areas and the PCD being limited in its size, the only risk for AMD generation at the Site is the backfill material to be used during rollover rehabilitation during the mine operational phase.

26.4 ITEM 1(D)(IV): STEPS TAKEN TO INVESTIGATE, ASSESS, AND EVALUATE THE IMPACT OF ACID MINE DRAINAGE

The Hydrogeology (groundwater) assessment (Appendix F2) included a geochemical analysis and included management of potential AMD that may arise from backfill material to be used during rollover rehabilitation during the mine operational phase.

During the operational phase of mining at the Site water will be removed from the active pit to allow for safe mining conditions. Groundwater intersected during mining is expected to be of good quality and will not be significantly degraded during operations at the Site. During opencast mining the pit walls will be exposed to the atmosphere, where oxidation of sulphide-bearing materials would be initiated.

Concurrent backfilling of the opencast pit will take place during the operational phase and following cessation of mining, the opencast pit water levels will rise and eventually flood the backfilled material and reach equilibrium with regional groundwater levels. During the flooding of the backfilled pit groundwater will encounter the oxidised material and will most likely degrade in quality.

Once mining has been completed at the Site, the final mining cut will be backfilled, and a topsoil horizon placed above the 200 mm clay layer for the establishment of vegetation. During the placement of the topsoil layer it is important to avoid compaction of the soil as this will lead to destruction of the soil horizons.

During topsoil placement the following steps should be taken:

- Assuming soils were stripped according to form, the soils should be placed according to the existing plan for the Site;
- A soil reserve should be maintained at the Site to allow for the repair of localised subsidence (if any);
- The replacement of soils should be done using appropriate equipment to avoid compaction and the greatest possible thickness achieved with a single lift;
- In order to minimize compaction, it is recommended that soils are moved when they are dry;
- Should soil layering be implemented, running over lower soil layers with heavy machinery should be minimized to avoid compaction;
- It is recommended that soil smoothing is done using dozers as opposed to graders; and
- Once in place, soils should be ripped to full rooting depth and where natural vegetation is not possible tilling should be done to allow for seeding of pre-selected plant species.

Simulated groundwater rebound at the Site indicated that decant is possible, although limited, at the central region of Opencast 1, with no decant expected at Opencast 2. The predicted decant volume at Opencast 1 was in the order of 250-300 m3/day, with expected sulphate concentrations of ~400-500 mg/l.

26.5 ITEM I(D)(V): ENGINEERING OR MINE DESIGN SOLUTIONS TO BE IMPLEMENTED TO AVOID OR REMEDY ACID MINE DRAINAGE

During the operational phase of the LoM AMD generation is limited to the backfill material used in the concurrent rehabilitation of the pit.

Based on the geochemical, groundwater level and groundwater quality data available for the Site currently and the simulated groundwater impacts for the Site during the operational, closure and post-closure LoM phases several potential AMD management/treatment solutions were evaluated for the Site. These potential solutions were evaluated based on their efficiencies, overall environmental footprint (incl. space requirements, power requirements, by-product generation etc.) and are discussed in more detail in Appendix F2. The final solution for the management of AMD (if any) at the Site will be determined, designed and implemented (where possible) during the operational phase of the LoM. Proposed solutions that wll be discussed with the competent authorities include:

- Pump-and-Treat AMD Solution (Ion Exchange)
- Neutralisation of Backfill Material
- Constructed Wetland Treatment

26.6 ITEM 1(D)(VI): MEASURES THAT WILL BE PUT IN PLACE TO REMEDY ANY RESIDUAL OR CUMULATIVE IMPACT THAT MAY RESULT FROM ACID MINE DRAINAGE

The risk of AMD is localised as indicated in Appendix F2. No residual or cumulative impacts have been identified for this project.

26.7 ITEM 1(D)(VII): VOLUMES AND RATE OF WATER USE REQUIRED FOR THE MINING, TRENCHING OR BULK SAMPLING OPERATION

Water is required for use in the crushing, screening & wash facility, on various stockpiles as well as for potable use. It is therefore planned that water is abstracted from existing and/or new boreholes, and/or supplied by the local municipality (at least for potable use). These water sources and volumes are still to be confirmed by undertaking the relevant feasibility studies (i.e. water balance), and will be confirmed in the Integrated Water Use Licence Application.

There will be a PCD collecting the dirty water generated form the respective mining blocks. The dirty water will be abstracted and re-used within the mining activities, to augment the coal processing plants' water deficit and for dust suppression. By augmenting the process water with dirty water runoff, the reliance on external, ground water resources can be significantly reduced. Dust suppression will be implemented on the stockpiles, loading platform, crushing area, overburden stockpiles and on the internal roads.

26.8 ITEM 1(D)(VIII): HAS A WATER USE LICENCE BEEN APPLIED FOR

Pre-application for Integrated Water Use License Application (IWULA) and associated Integrated Water and Waste Management Plan (IWWMP) as per the requirements of the NWA was submitted to the DWS on 12 July 2019 (Appendix M). A site visit took place on 31 July 2019 and the application for Water Uses was submitted on 29 September 2019. The following water uses are anticipated to be included in the IWULA (but will be confirmed in the IWULA):

- Section 21 (a);
- Section 21 (b);
- Section 21 (c & i);
- Section 21 (g);
- Section 21 (j).

26.9 ITEM 1(D)(IX): IMPACTS TO BE MITIGATED IN THEIR RESPECTIVE PHASES;

The full impact assessment with associated mitigation and management measures are presented in Part A: Section 8 Item 3(g)(v): Impacts and risks identified including the nature, significance, consequence, extent, duration and probability as well as in Part A: Section 9.

27 FINANCIAL PROVISION

27.1 ITEM (I)(1): DETERMINATION OF THE AMOUNT OF FINANCIAL PROVISION

Regulation 6 of the Financial Provision Regulations (GN R1147 in GG 39425 of 20 November 2015) requires that an applicant for a mining right must determine the financial provision calculation based on the actual costs required for:

- Annual rehabilitation;
- Final rehabilitation, decommissioning and closure; and
- The remediation of latent or residual environmental impacts including but not limited to the pumping and treatment of polluted or extraneous water.

Refer to Appendix G for more details.

27.2 ITEM (I)(1)(A): DESCRIBE THE CLOSURE OBJECTIVES AND THE EXTENT TO WHICH THEY HAVE BEEN ALIGNED TO THE BASELINE ENVIRONMENT DESCRIBED UNDER REGULATION 22 (2) (D) AS DESCRIBED IN 2.4 HEREIN

Closure and rehabilitation is a continuous series of activities that begin with planning prior to the project's design and construction, and end with achievement of long-term site stability that creates a safe, physically stable rehabilitated landscape that limits long-term erosion potential and environmental degradation, and restores the land to pre-mining conditions as far as possible.

The following points outline the main objectives for rehabilitation and closure:

- Achieve a final land use that represents pre-mining conditions that is sustainable and meets both legislative requirements and stakeholder needs;
- Create opportunities for alternative post-mining livelihoods by aligning to the regional planning;
- Ensure interconnectivity between the rehabilitated landscapes with surrounding regionally biologically diverse areas;
- Encourage, if and where required, the re-instatement of terrestrial and aquatic wetland biodiversity over time;
- Maintain and monitor all rehabilitated areas following re-vegetation and establishment of landscape features such as wetland pans. If this monitoring shows that the objectives have been met, make an application for closure;
- Prevent / Minimise negative impacts and risks as identified in this report
- Comply with local, district, provincial and national regulatory requirements; and
- Follow a comprehensive consultation and communication process with all stakeholders.

27.3 ITEM (I)(1)(B): CONFIRM SPECIFICALLY THAT THE ENVIRONMENTAL OBJECTIVES IN RELATION TO CLOSURE HAVE BEEN CONSULTED WITH LANDOWNER AND INTERESTED AND AFFECTED PARTIES

The draft EIA Report and EMPr is made available for public review for a period of 30 days. Comments received from landowners and/or I&APS will be incorporated into the final EIA report and EMPr before submitting it to the DME for final decision-making.

27.4 ITEM (I)(1)(C): PROVIDE A REHABILITATION PLAN THAT DESCRIBES AND SHOWS THE SCALE AND AERIAL EXTENT OF THE MAIN MINING ACTIVITIES, INCLUDING THE ANTICIPATED MINING AREA AT THE TIME OF CLOSURE

Refer to Appendix G for the complete Rehabilitation and Closure Plan associated with the proposed project.

27.5 ITEM (I)(1)(D): EXPLAIN WHY IT CAN BE CONFIRMED THAT THE REHABILITATION PLAN IS COMPATIBLE WITH THE CLOSURE OBJECTIVES

The Rehabilitation Plan has been compiled in support of the primary closure objectives which are to remove the mining infrastructure and rehabilitate the land to a suitable land use which represent pre-mining conditions and provides a safe and sustainable environment for surrounding receptors. Refer to Appendix G for the complete Rehabilitation and Closure Plan associated with the proposed project.

27.6 ITEM (I)(1)(E): CALCULATE AND STATE THE QUANTUM OF THE FINANCIAL PROVISION REQUIRED TO MANAGE AND REHABILITATE THE ENVIRONMENT IN ACCORDANCE WITH THE APPLICABLE GUIDELINE

The financial provision was calculated according to Regulation 6 of the Financial Provision Regulations (2015) which prescribe the minimum content requirements.

The financial provision for concurrent rehabilitation for the planned activities is **R13 330 768.07 (Excl. VAT)** – Refer to Table 19-1 and Appendix G for more details.

27.7 ITEM (I)(1)(F): CONFIRM THAT THE FINANCIAL PROVISION WILL BE PROVIDED AS DETERMINED

Provided the Mining Right is approved, Vandabyte will provide for closure as per the legal requirements. A liability assessment will also need to be undertaken annually to ensure the financial provision is in line with the closure cost.

28 MONITORING COMPLIANCE WITH AND PERFORMANCE ASSESSMENT

Vandabyte will be responsible for the implementation of all monitoring, mitigation and management measures, as well as compliance with the EMP. The recommended monitoring for the identified impacts is detailed below. The applicant will keep a record of all environmental monitoring taken on site. A summary of the environmental monitoring to be undertaken is included below.

28.1 ITEM 1(G): MONITORING OF IMPACT MANAGEMENT ACTIONS

28.1.1 Soils, Land Use and Land Capability

- Soil monitoring plan guidelines should be put in place to ensure that rehabilitation is a success from a soils perspective. The monitoring plan for soils must contain the following:
- The location of soil types that can be stripped and stockpiled together;
- Stripping depths of different soil types; and
- The location, dimensions and volumes of planned stockpiles for different soil types.

28.1.2 Surface Water

A water quality monitoring and aquatic biomonitoring programme is essential for detecting negative impacts as they arise and ensuring that necessary mitigation measures are operating effectively. It also ensures that storm water management structures are in working order. Monitoring should be implemented prior to and throughout the life of the mine.

Water quality monitoring is recommended at the sampling sites indicated in (Figure 28-1). These sites are located in channelled valley-bottom wetlands, upstream and downstream of the proposed mining area. Water quality parameters listed in Table 7-3 should be included in the analyses. In addition to chemical sampling, *in-situ* water quality measurements should also be taken as certain parameters (e.g. dissolved oxygen) should be measured in the field. Water quality sampling should be undertaken on a monthly basis and results should be compared to the RQOs for upper Olifants River catchment.

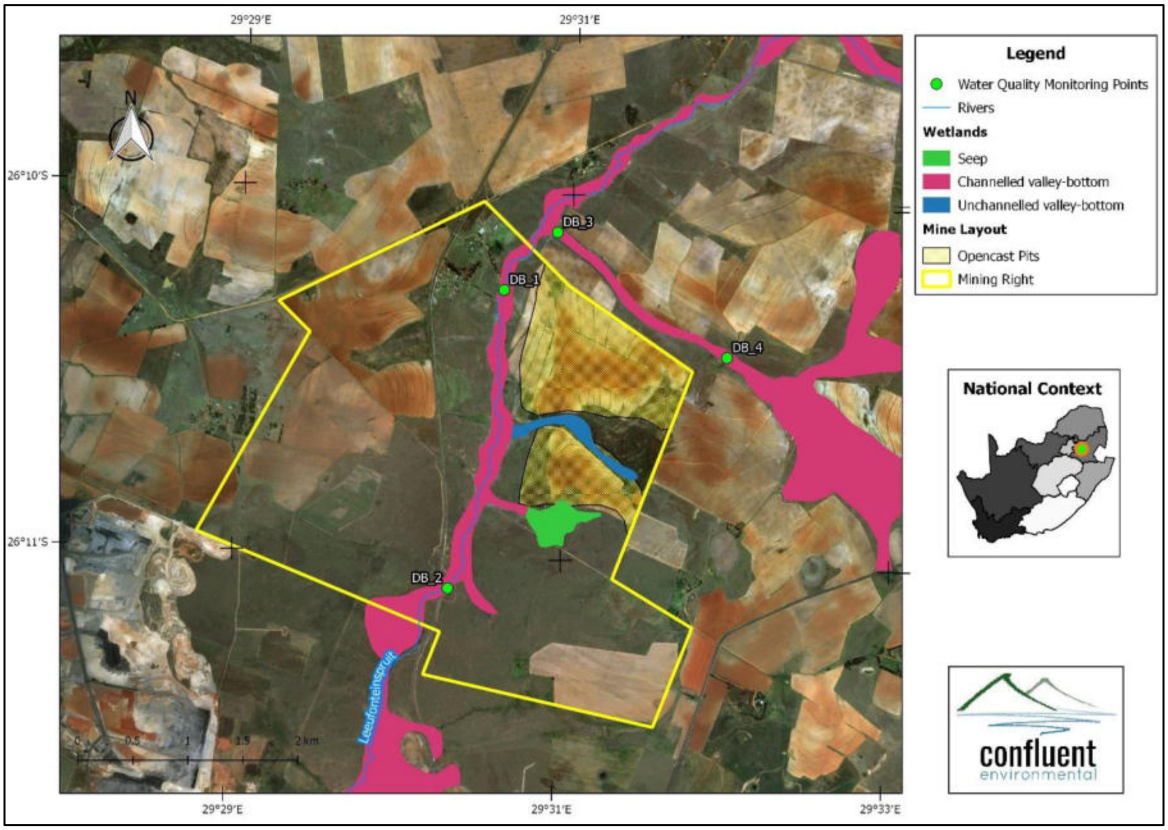


Figure 28-1: Recommended water quality monitoring points for the proposed Dunbar coal mine.

28.1.3 Aquatic Biomonitoring

Habitat and flow in the channelled valley-bottom wetland has been largely modified to the extent that conventional SASS5 biomonitoring techniques (Dickens and Graham, 2002) are unlikely to be sensitive enough to indicate deterioration (or improvement) in water quality at sites downstream of mining activities. Diatoms are less reliant on suitable in-stream habitat quality and are excellent indicators of water quality. Diatom indices have been designed primarily for lotic systems (i.e. running water), however, given the riverine characteristics of channelled valley-bottom wetlands, the use of diatoms as a biomonitoring tool should be adopted at all water quality monitoring points within the channelled valley-bottom wetland.

- Diatom sampling should be conducted bi-annually during the wet and dry season.
- The relative abundance and pollution sensitivity of each diatom species should be used to calculate the Specific Pollution Sensitivity Index (SPI) which can be used to derive one of five ecological health categories, ranging from High Quality to Bad Quality (Harding and Taylor, 2011).
- Wetland health assessments should be implemented once a year for all wetlands that fall within the mine property. The primary objective of these assessments should be to ensure that no modifications to the hydrological, geomorphological and vegetation characteristics of the wetlands have occurred during the construction and operational phase.

28.1.4 Groundwater

The groundwater monitoring network design should comply with the risk-based source-pathway -receptor principle. A groundwater-monitoring network should contain monitoring positions which can assess the groundwater status at certain areas.

Both the impact on water quality and water quantity should be catered for in the monitoring system. The boreholes in the network should cover the following: contaminant sources, receptors and potential contaminant plumes.

Furthermore, monitoring of the background water quality and levels is also required.

Groundwater monitoring should be conducted to assess the following:

- The impact of mine dewatering on the surrounding aquifers (if any). This will be achieved through monitoring of groundwater levels in the monitoring boreholes. If private boreholes are identified within the zone of impact on groundwater levels, these will be included in the monitoring programme;
- Groundwater inflow into the mine workings. This will be achieved through monitoring of groundwater levels in the monitoring boreholes as well as measuring water volumes pumped from mining areas;
- Groundwater quality trends. This will be achieved through sampling of the groundwater in the boreholes at the prescribed frequency;
- The rate of groundwater recovery and the potential for decant after mining ceases. This can be achieved through drilling of additional boreholes into the opencast workings for monitoring purposes. These boreholes should be drilled in the deepest sections of the mine. Stage curves will be drawn to assess the inflow into defunct workings; and
- Groundwater Monitoring should be undertaken to SABS and DWS requirement according to the schedule presented in Table 28-1 below.

Table 28-1: Monitoring Network Programme Summary.

Monitoring position	Sampling interval	Analysis	Water Quality Standards
Operational Phase			
Rainfall	Daily at the mine	N/a	N/a
All monitoring boreholes	Monthly: measuring the depth of groundwater levels	N/a	N/a
All monitoring boreholes	Monthly: sampling for water quality analysis	Full analysis	- South African Water Quality Guidelines: Domestic Use, livestock watering
		Groundwater level	- WUL Requirements
Decommissioning and Post Closure Phases			
Rainfall	Daily at the mine	N/a	N/a
All monitoring boreholes	Quarterly: measuring the depth of groundwater levels	N/a	N/a
All monitoring boreholes	Quarterly: sampling for water quality analysis	Full analysis	- South African Water Quality Guidelines: Domestic Use, livestock watering
		Groundwater level	- WUL Requirements

The proposed monitoring network can be seen in Figure 28-2 and is summarised in Table 28-2. A total of nineteen (19) new monitoring boreholes (excluding the existing DBR01 and DBR03 boreholes) are recommended to be drilled comprised of 6 multi-level borehole sets drilled between mine workings and wetland features, 7 monitoring boreholes installed during the operational phase and 6 monitoring boreholes installed at rehabilitated mine workings following closure.

The multi-level boreholes should be installed to intersect the deeper aquifer zone, intermediate weathered zone and upper interflow/unsaturated zone, with the deepest borehole installed closest to the mining area and the shallowest installed toward the wetland/surface water feature being considered for baseflow monitoring.

This network complies with the above-mentioned criteria. It is envisaged that the frequency of monitoring remains on a monthly basis, due to the short LoM, with post-closure monitoring occurring on a quarterly basis for a period of five years after mine closure.

Table 28-2: Proposed Monitoring Network.

X-Coordinate (LO29, WGS84)	Y-Coordinate (LO29, WGS84)	Borehole ID	Description	LoM Phase
52964.73	-2896583	BH01	Monitoring Borehole at Opencast 1 WRD	Operational Phase
52623.50	-2896602	BH02	Monitoring Borehole at Opencast 1 Stockpile Area	Operational Phase
52215.85	-2896656	BH03	Monitoring Borehole at Opencast 1 PCD	Operational Phase
52618.59	-2897290	BH04	Monitoring Borehole upstream of Opencast 2	Operational Phase
51599.09	-2897450	BH05	Monitoring Borehole at Opencast 2 PCD	Operational Phase
50971.06	-2897096	BH06	Background Monitoring Borehole for Opencast 2	Operational Phase
51121.68	-2896047	BH07	Background Monitoring Borehole for Opencast 1	Operational Phase
51479.15	-2896026	DBR01	Monitoring Borehole between Opencast 1 and perennial Leeuwfontein River	Existing
52147.31	-2897349	DBR02	Monitoring Borehole at Opencast 2 ROM Stockpile	Existing
51418.49	-2897249	MW01	Multi-Level Borehole Nest between Opencast 2 and Leeuwfonteinspruit Wetland	Operational Phase
51507.00	-2896911	MW02	Multi-Level Borehole Nest between Opencast 2 and Leeuwfonteinspruit Wetland	Operational Phase
51829.24	-2896783	MW03	Multi-Level Borehole Nest between Opencast 2 and northern wetland area	Operational Phase
51554.65	-2896694	MW04	Multi-Level Borehole Nest between Opencast 1 and southern/eastern wetland areas	Operational Phase
51643.35	-2895320	MW05	Multi-Level Borehole Nest between Opencast 1 and Leeuwfonteinspruit wetland area	Operational Phase
52434.77	-2895711	MW06	Multi-Level Borehole Nest between Opencast 1 and northern wetland area	Operational Phase
51675.68	-2896317	PCBH01	Monitoring Borehole at Rehabilitated Opencast 1	Closure Phase
51729.30	-2895712	PCBH02	Monitoring Borehole at Rehabilitated Opencast 1	Closure Phase
51961.62	-2896133	PCBH03	Monitoring Borehole at Rehabilitated Opencast 1	Closure Phase
52227.13	-2896210	PCBH04	Monitoring Borehole at Rehabilitated Opencast 1	Closure Phase
51606.75	-2897104	PCBH05	Monitoring Borehole at Rehabilitated Opencast 2	Closure Phase
52056.08	-2897065	PCBH06	Monitoring Borehole at Rehabilitated Opencast 2	Closure Phase

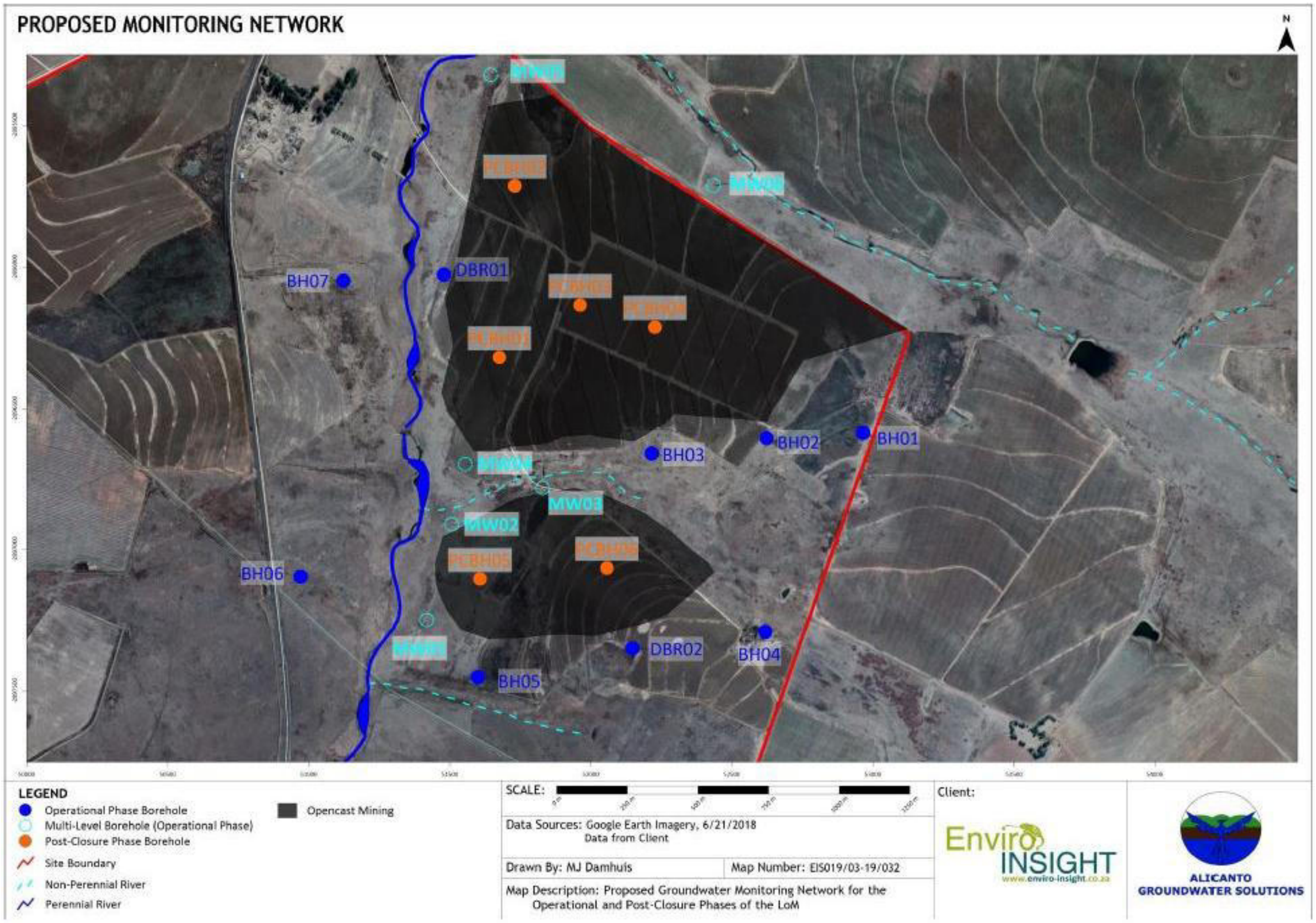


Figure 28-2: Proposed monitoring network.

28.1.5 Terrestrial Ecology

Incomplete baseline data for monitoring purposes was established, and a pre-construction survey during optimal seasonal and climatic conditions will be required as indicated in the report.

28.1.6 Noise

It is recommended that a noise monitoring programme is developed as per the Appendix F10:

Environmental Noise Monitoring can be divided into two distinct categories, namely:

- Passive monitoring – the registering of any complaints (reasonable and valid) regarding noise; and
- Active monitoring – the measurement of noise levels at identified locations.

Active environmental noise monitoring is recommended due to the medium-high significance for a noise impact to develop. In addition, should a valid complaint be registered, the mine must investigate this complaint as per the following sections. It is recommended that the noise investigation is done by an independent acoustic consultant.

While this section recommends a noise monitoring programme, it should be used as a guideline as site-specific conditions may require that the monitoring locations, frequency or procedure be adapted.

28.1.6.1 Measurement Localities and Procedures

28.1.6.1.1 Measurement Localities

Noise measurements are recommended at NSD01 and 02 during construction and operational phase.

If any of these receptors are relocated the measurement locations should be replaced with a similar location. If there are no potential noise-sensitive receptors living within 1,000m (maximum distance where noise may be problematic, SANS 10328) from any noise sources (associated with the mine) no noise measurements are required.

In addition, noise measurements must be conducted at the location of the person that registered a valid and reasonable noise complaint. The measurement location should consider the direct surroundings to ensure that other sound sources cannot influence the reading. A second instrument must be deployed at the mine infrastructure area (close to the source of noise) during the measurement.

28.1.6.1.2 Measurement Frequencies

Once-off ambient sound measurements are recommended before construction activities start at the measurement locations identified in the report (or any additional measurement locations that can be motivated) using a defined measurement procedure. This is to define the pre-mining ambient sound levels at these locations.

Once construction starts, noise measurements should be conducted on an annual basis at the measurement locations identified in the report (or any additional measurement locations that can be motivated) using a defined measurement procedure. Noise measurements should continue during the operational phase when the noise monitoring plan can be reviewed (measurements increased, continued, reduced or stopped). Compliance with the set Environmental Management Objectives as well as the number of registered noise complaints should be considered.

28.1.6.1.3 Measurement Procedures

Ambient sound measurements should be collected as defined in SANS 10103:2008. Measurements should be collected in 10-minute bins defining the 10-minute descriptors such as $L_{Aeq,I}$ (National Noise Control Regulation requirement), $L_{A90,f}$ (background noise level as used internationally) and $L_{Aeq,f}$ (Noise level used to compare with IFC noise limit).

Spectral frequencies should also be measured to define the potential origin of noise. When a noise complaint is being investigated, measurements should be collected during a period or in conditions similar to when the receptor experienced the disturbing noise event.

28.1.6.2 Relevant Standard for Noise Measurements

Noise measurements must be conducted as required by the National Noise Control Regulations (GN R154 of 1992) and SANS 10103:2008. It should be noted that the SANS standard also refers to a number of other standards.

28.1.6.3 Data Capture Protocols

28.1.6.3.1 Measurement Technique

Noise measurements must be conducted as required by the National Noise Control Regulations (GN R154 of 1992) and SANS 10103:2008.

28.1.6.3.2 Variables to be analysed

Measurements should be collected in 10-minute bins defining the 10-minute descriptors such as $L_{Aeq,I}$ (National Noise Control Regulation requirement), $L_{A90,f}$ (background noise level as used internationally) and $L_{Aeq,f}$ (Noise level used to compare with IFC noise limit). Spectral frequencies should also be measured to define the potential origin of noise.

28.1.6.3.3 Database Entry and Backup

Data must be stored unmodified in the electronic file saved from the instrument. This file can be opened to extract the data to a spreadsheet system to allow the processing of the data and to illustrate the data graphically. Data and information should be safeguarded from accidental deletion or corruption.

28.1.6.3.4 Feedback to Receptor

A monitoring report must be compiled considering the requirements of the National Noise Control Regulations (GN R154 of 1992) and SANS 10103:2008. The mine must provide feedback to the potential noise-sensitive receptors using the channels and forums established in the area to allow interaction with stakeholders, alternatively in a written report.

28.1.6.4 Standard Operating Procedures for Registering a Complaint

When a noise complaint is registered, the following information must be obtained:

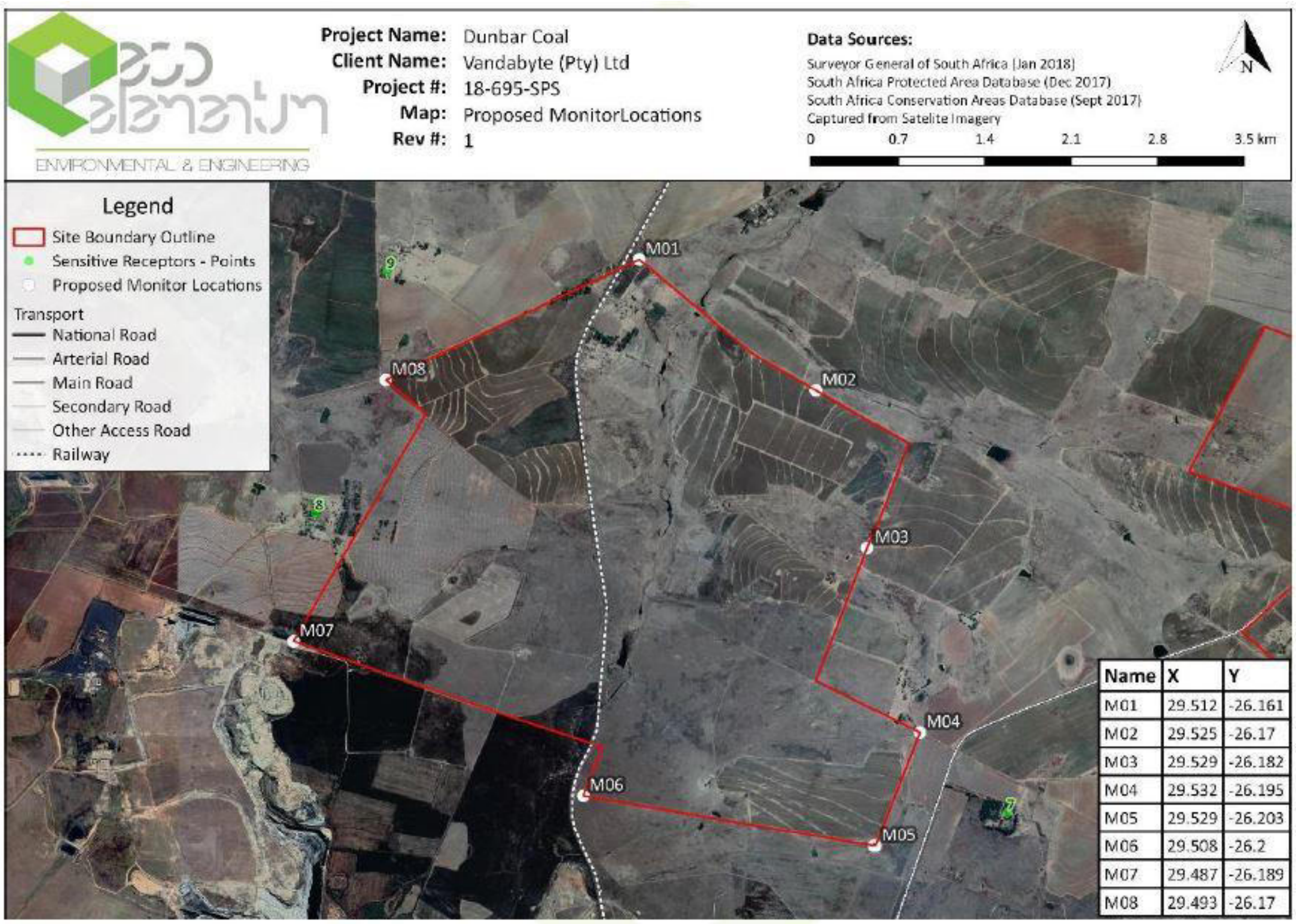
- Full details (names, contact numbers, location) of the complainant;
- Date and approximate time when this non-compliance occurred;
- Description of the noise or event; and
- Description of the conditions prevalent during the event (if possible).

28.1.7 Air Quality

It is highly recommended that a dust monitoring campaign be conducted prior to the proposed mining operations commence and then continue for the life of mine in order to establish historical repository of data needed to fully understand/address fugitive and airborne dust emissions from the construction, operation and closure activities. Managing dust fallout effectively will result in the reduction of respiratory diseases that are as a result of air pollution, reduced risk of damage to property, improved visibility, and fewer disturbances to existing flora and fauna habitats.

Fallout monitoring should be continued for the life of mine to better assess the level of nuisance dust associated with both mining and process related operations. Sampling of fallout should be undertaken within the neighbouring areas as well as on-site. Dust fallout monitoring is recommended at the locations as shown in Figure 28-3.

- PM10 and PM2.5 dust monitoring must also be undertaken at the same sites as mentioned under the previous bullet but also in and around potential fugitive emission sources to determine mitigation measures and focus management efforts.
- Further mitigation measures that should be applied, if it is found that dust and PM10 levels are measured to be exceeding the limits are:
    - Reducing the speed of the Haul Trucks on the Pit and Access Haul Roads.
    - Fully sealed Pit and Access Haul Road to achieve 90-100% mitigation on these roads



Name	X	Y
M01	29.512	-26.161
M02	29.525	-26.17
M03	29.529	-26.182
M04	29.532	-26.195
M05	29.529	-26.203
M06	29.508	-26.2
M07	29.487	-26.189
M08	29.493	-26.17

Figure 28-3: Recommended monitoring locations.

Site layout for sampling points must be carried out according to the eight main compass directions; the site layout and equipment placement must be done in accordance with the ASTM standard, D 1739 – 2010, thereafter relevant sampling reference numbers will be allocated to the receptors accordingly. At each gravimetric dust fallout gauge/receptor point there is a stand built according to specification containing the dust sample collection bucket. Samples will be collected after a 1 month running period (+-30 day's exposure). After sample collection, the samples are taken to a SANAS accredited laboratory as required. A visual site investigation is done where after correlations are drawn and findings are identified and reported on.

Dust buckets of a standard size and shape are prepared and set up at locations related to the eight main compass points on the borders of the property so that dust can settle in them for periods of 30+/-2 days. The dust buckets are then sealed and replaced with new empty ones and send away to the SANAS accredited laboratory for analysis. The masses of the water-soluble and –insoluble components of the material collected are then determined and results are reported as mg/m²/day. This methodology is described according to South African National Standards 1929:2004 and the American Society for Testing and Materials (ASTM) Designation: D 1739-98 (2010). The results for this method of testing are obtained by gravimetrical weighing. The apparatus required include open top buckets/containers not less than 150 mm in diameter with a height not less than twice its diameter. The buckets must be placed on a stand at a height of 2 +/-0.2 m above the ground.

It is recommended that the client should establish a fine particulate monitoring programme, which should include one particulate instrument to monitor PM10 and preferably PM2.5 specifically at the problem areas shown by the passive sampling campaign at the residential areas. Handheld sampling instruments not only allows for sampling in the 8 main wind directions, but also on-site sampling down-wind of potential dust sources to quantify and determine impacts that need to be managed. It is advised to conduct this sampling on a monthly basis but also when the need arise during periods of elevated dust concentrations being emanated from the site.

New technology to perform cost effective real-time dust and particulate matter is currently becoming a cost effective option. This type of technology can record real-time wind speed and direction together with particulate concentrations. It can thus be used more effectively for management purposes. Actionable intelligence is generated on dust and particulate matter emissions, which in turn can then be used to determine the origin of the particulate emissions. In a scenario where mining operations are situated in such close proximity to each other and residential areas, this type of technology can become instrumental in decision making on the management of dust for a mining operation.

28.1.8 Visual

Primary measures that will be implemented will mainly be measures that will minimise the visual impact by softening the visibility of the structures by "blending" with the surrounding areas. Such measures will include rehabilitation of the mining area by re-vegetation of the mining site and surrounding area.

Secondary measures will include final rehabilitation, after care and maintenance of the vegetation and to ensure that the final landform is maintained.

In addition the following measures are recommended:

- Plant some indigenous trees to create a barrier between the neighbours and roads;
- Dust from Stockpile areas, roads and other activities must be managed by means of dust suppression to prevent excessive dust;
- A wind barrier system that encloses the stockpiles;
- Rehabilitation of the area must be done once mining is completed.

Grievances from visual receptors must be recorded, monitored and addressed through a Grievance Mechanism throughout the project, including the construction, operation and rehabilitation phase. Continuous consultation with stakeholders is vital.

It is also suggested that photographic records should be maintained together with findings (and GPS location of photographs), follow up actions and close out records as part of the Environmental Management System.

28.1.9 Blasting and Vibration

Mitigation is available that can and will reduce the potential magnitude of vibration and air blast levels and the significance of this impact. While the risks from blasting impacts are manageable, people are always concerned about the potential effects and dangers of blasting and measures are recommended for the applicant to note. The mitigation include technical as well as management measures:

- The Blasting Impact Assessment report must be updated if the blast design is changed where more than 500 kg explosives are detonated per delay.
- Mine to reduce the charge per delay (less than 437 kg) to ensure that maximum ground vibration levels are less than 2.54 mm/s when blasting has to take place within 850m from residential houses.
- Mine should initiate a forum to inform the close residents about the likely vibration and air blast levels, the proposed blasting schedule and warning methodology the mine will employ before a blast. When the residents are inside the house during a blast, vibration of windows and ceilings may appear excessive.
- Mine to erect blasting notice boards in the area with blasting dates and times highlighted.
- Mine to prevent blasting in adverse meteorological conditions where possible (overcast conditions, strong wind blowing in direction of local community, early in the mornings or late in the afternoon).
- People and livestock to be moved further than 500 m from active blast before a blast is detonated;
- Any evidence of fly rock further than 250 m from a blast is noted and the blast be analysed for possible improvements;
- Blaster to keep full records of blast (blast design, timing, explosive mass per blast hole, stemming, subdrill, spacing, burden, etc.).

28.1.10 Heritage and Palaeontology

28.1.11 Social

It is proposed that a monitoring programme be developed and implemented to monitor the implementation of social management actions. Furthermore, it is recommended that this is conducted by a competent Monitoring and Evaluation (M&E) officer as the implementation of monitoring tools (surveys, databases, etc.) will require specialised skills.

28.2 ITEM 1(H): MONITORING AND REPORTING FREQUENCY

Table 28-3 discusses the monitoring and reporting frequency.

28.3 ITEM 1(I): RESPONSIBLE PERSONS

The roles and responsibilities associated with the monitoring programme are set out in Table 28-3.

28.4 ITEM 1(J): TIME PERIOD FOR IMPLEMENTING IMPACT MANAGEMENT ACTIONS

Table 28-3 captures the time period for implementing impact management actions.

28.5 ITEM 1(K): MECHANISM FOR MONITORING COMPLIANCE

Table 28-3 sets out the mechanism for monitoring compliance with the identified impact management actions.

Table 28-3: Monitoring and Management of Environmental Impacts.

Activities	**Impacts requiring monitoring programmes**	**Functional requirements for monitoring**	**Roles and responsibilities (For the execution of the monitoring programmes)**	**Monitoring and reporting frequency and time periods for implementing impact management actions**
Surface Water	Water quality	Ensure that monitoring is implemented to cover all mining activity areas. Water quality parameters that need to be analyzed are shown in the Surface Water Report (Appendix F1).	Specialist Environmental Quality	- Monthly during construction. - Reduce to quarterly on rehabilitated areas. - Monitoring needs to carry on after the project has ceased (until closure certificate is obtained) and the results depict a steady state, as is standard practice to detect residual impacts.
	Water quantity	Flow monitoring should be carried out in channels and pipelines and at facilities on site. Monitoring water levels in dams and channels. Records of Pit dewatering (Appendices F1 and F2).	Specialist Environmental Quality	-Instantaneous where automatic flow meters are in place for real time measurements -where there are no automatic flow meters weekly monitoring needs to be done -in operational areas, daily records need to be kept
	Physical structures and SWMP performance	Dams are inspected for silting and blockages of inflows, pipelines for hydraulic integrity; monitor the overall SWMP performance. Personnel should have a walk around facilities to determine the facilities conditions and pick out any anomalies such as leaks or overflows and system malfunctions on a monthly basis.	Specialist Environmental Quality	Continuous process and yearly formal report

	Meteorological data	Measure rainfall	Appointed Mine Environmental Officer ECO to do spot checks	Real time system if in place – Should be monitored daily. Alternatively install a rain gauge and measure storm depths after rainfall events
Soil	Fertility	Monitoring should always be carried out at the same time of the year. Soils should be sampled and analysed for the following parameters: pH (KCl); Phosphorus (Bray 1); Cations: Calcium, Magnesium, Potassium, Sodium, Zin (mg/kg); Cation exchange capacity (CEC); Soil organic carbon (%); and Soil texture (Clay, Silt and Sand)	Soil scientist	Annually, at the same time each year
	Erosion	Erosion occurrences	Soil scientist	Annually, at the same time each year
	Stripped and stockpiled soil	The location of soil types that can be stripped and stockpiled together; Stripping depths of different soil types; and The location, dimensions and volumes of planned stockpiles for different soil types	Soil scientist	Annually, at the same time each year
Aquatic Ecology	Overall PES	Standard River Ecosystem Monitoring Programme (Ecostatus) methods	Aquatic specialist	Bi-annual (dry and wet season)
	Determine if water quality deterioration is occurring	SASS5 scores should not decrease due to mining activities. It should be mentioned that the baseline assessment (Appendix F1) was carried out during dry season where no flowing water was present.	Aquatic specialist	Bi-annual (dry and wet season)

	Determine if water quality deterioration is occurring	Standard water quality monitoring, as per the surface water specialist report (Appendix F1).	Aquatic specialist	Quarterly. If conditions are declining, monitoring should be done monthly until conditions have stabilised after intervention.
	Determine if water/habitat quality deterioration is occurring	Monitor for presence of fish and vegetation	Aquatic specialist	Bi-annual (dry and wet season)
Fauna and Flora Monitoring	Impacts on vegetation structure and health; Impacts on faunal populations and numbers; Fauna and flora species of conservation concern	Ensuring sustainable populations of both fauna and flora persist till closure. No animals may be killed or harmed.	Terrestrial Ecologist / Flora specialist / Fauna specialist	Biannually (dry and winter seasons)
Vegetation Rehabilitation	Success of rehabilitation	Rehabilitation success	Rehabilitation Specialist including input from botanist	Quarterly 1 year after rehabilitation, then biannually for 2 years afterwards
Soil disturbance	Establishment of alien plant species	Alien plant monitoring	Qualified botanist	Yearly monitoring for life of mine, including 3 year post-mining
Construction and operational phase Noise	Noise disturbance	Monitoring should be undertaken in accordance with the National Noise Control Regulations in conjunction with the SANS 10103:2008 guidelines; The locations to be monitored as per the baseline assessment (Appendix F10)	Independent qualified specialist	The client's Environmental Coordinator to implement and manage the recommended monitoring programme; and Independent specialist to carry out the monitoring programme on a yearly basis. Should there be any concerns raised about noise levels, inspection should be carried out to confirm the concerns.

Groundwater	Groundwater levels	Monitoring of groundwater levels in the monitoring boreholes as well as measuring water volumes pumped from mining areas	Geohydrologist	Operational: Monthly
	Groundwater quality	Achieved through sampling of the groundwater in the boreholes. Analyses as prescribed by the specialist report (Appendix F2).	Geohydrologist	Operational: Monthly
	Rate of groundwater recovery and the potential for decant after mining ceases	Achieved through drilling of additional boreholes into the opencast workings for monitoring purposes. These boreholes should be drilled in the deepest sections of the mine. Stage curves will be drawn to assess the inflow into defunct workings	Geohydrologist	Post-mining: Quarterly
Wetlands	General - All impacts and threats to wetlands predicted or not	Monitoring of the activities through all phases is important to ensure all impacts are remediated as soon as possible; thus preventing and long term residual impacts to the system that compromises the ability of the wetland to function. The valley bottom wetlands of high sensitivity should be monitored on a regular basis to detect if the mining activities are having any residual or unforeseen impact on the functioning of these important systems. The functional aspects of the wetland should be assessed such as floral diversity, water quality, use of wetland by faunal species, erosion and more.	The environmental officer of the mine. Independent wetland specialist	Internal monitoring should be done as often as possible according to the management practices of the mine. External independent wetland specialist monitoring should be done regularly and when needed, i.e. after an incident

Site clearance within watercourse and their buffer areas	Removal of wetland soils and vegetation; loss of wetland habitat.	Monitor for all risks including uncontrolled erosion, hydrocarbon spills etc. and remediate; ensure proper handling and storage of wetland soils; Must ensure that all activities are done according to the detailed design and are implemented with the least possible impacts to the wetlands.	Wetland specialist	Construction activities should be monitored weekly – the buffer areas are not be enetered
Decommissioning activities within and around watercourse	The decommissioning and rehabilitation activities occurring within ecologically sensitive catchment pose significant potential negative impacts to functioning watercourse. The rehabilitated area could cause major negative impacts due to spread of alien invasive vegetation, increased soil compaction, erosion and subsequent sedimentation into the watercourse	Monitor for all risks including uncontrolled erosion, hydrocarbon spills etc. and remediate; ensure proper handling and storage of wetland soils; Must ensure that all activities are done according to the detailed design and are implemented with the least possible impacts to the wetlands. Monitor and control alien invasive species.	• Wetland specialist • Rehabilitation specialist • Botanist	Rehabilitation activities should be monitored monthly once the rehabilitation process commence. After completion, should be monitored quarterly

Employment creation	Employment created during construction and operation	Local Employment Policy is developed that assigns preferential status to local, female and youth employment, as well as associated targets.	HR Department	Once-off for construction and operational phase, respectively
		Applicable requirements of the existing Recruitment and Selection Policy are applied when employing locally	HR Department	Every six months
		Local employment requirements are included in contractor management plans.	Procurement and Supply Chain Management Department	Monthly or as required
		Engagement with relevant groups to ensure that all understand the Project's employment requirements in terms of skills, type of employment.	HR Department, and Social Manager	Prior to construction, thereafter every six months
		Compilation and implementation of Structured Stakeholder Engagement Plan and Grievance mechanism.	Social Consultant, Social Manager	Prior to construction, and should continue to implement the Grievance mechanism and report back to stakeholders on a quarterly basis. Grievances should be address within 14 days
		Targets in terms of local recruitment are met by Project and contractors	HR Department	Monthly
		All locally recruited employees are recruited by means of the database	HR Department	Annually
		Percentage of locally-recruited employees increases on an annual basis	HR Department	Annually

		Labour pool database is developed and kept up-to-date.	Procurement and Supply Chain Management Department	Every six months
Economic development	Multiplier effects on the local economy and diversification and growth of the economy	Project design parameter has avoided/minimised displacement	Senior management	Pre-construction
		A transparent negotiation process has been implemented	Land Acquisition/access Manager Public relations manager	Pre-construction
		Compensation and resettlement is implemented.	Land Acquisition/access Manager	As required
Influx related impacts	Influx of people may have an impact on the socio-economic environment	Develop Influx management Plan.	SHEQ Manager Social Manager Senior Management	Pre-construction as well as pre-operation phase
		Investigate partnerships with local authorities.	Social Manager Public Relations Manager Legal Department	Once-off during construction, thereafter annually
		Sign agreements with local authorities on assistance with IDPs and SDFs.	Senior Management	Continuous interaction with local authorities at least on a yearly basis

Impacts on community health and safety (Socio-economic)	Community health and safety may be impacted by the construction and operation of the mine	Technical Consultant is appointed to develop a Community Health Safety and Security Plan (CHSSP), which should include an awareness campaign.	Procurement and Supply Chain Management Department; Social Manager	Once-off at start of construction, and with a detailed revision when operation commences
		CHSSP is adopted and implemented	Senior Management SHEQ Manager Social Manager	Adopted once-off at start of construction, and with a detailed revision when operation commences. Implemented every four months
		Policing Forum is established.	Social Manager	Once-off at start of operation
		HIV/AIDS policy is expanded to include HIV awareness campaigns in communities and provision of Voluntary Counselling and Testing (VCT) for communities.	SHEQ Department; senior management	Once off
		Service providers appointed to implement HIV awareness campaigns in communities and provide VCT for communities.	Procurement and Supply Chain Management Department; Social Manager	Once off
		HIV awareness in communities is improved, and VCT services are accessed.	Service provider; Social Manager	Annually
		HIV awareness campaigns in communities and provision of VCT for communities are implemented.	Service provider; Social Manager	Annually

Community development and social upliftment (Socio-economic)	Community development and social upliftment	Detailed skills inventory is prepared for the Project.	SLP Manager; HR Department; Senior Management inputs	Once-off, reviewed annually
		Appoint qualified Technical Consultant for Skills Survey.	Procurement and Supply Chain Management Department; Social Manager	Once-off prior to construction and appointment of operational work force
		Qualified Training Consultant is appointed to develop training programmes.	HR Department; Procurement and Supply Chain Management Department	Once-off prior to construction
		Training programme is developed based on the skills gaps identified for the Project.	Consultant; HR Department; Social Manager	Once-off prior to construction, updated every five years
		Training programme is implemented.	HR Department	Annually
		Staff skills levels and job performance improve	HR Department, with input from line managers	Annually
		Locally recruited construction workforce who received skill training is employed during the operational phase	HR Department	Once off at start of construction

		Skills levels in local communities improve.	HR Department with input from line managers	Annually
		AET programmes are implemented for both workers and people from local communities.	SLP Manager, Training Service Provider; Social Manager;	Annually
Mine Rehabilitation and Closure	Dependency on the Project for sustaining local economy (Social Closure)	Plan on file.	Social Manager with inputs form senior management	At least 3 years before closure
		Closure Plan implementation report.	Social Manager with inputs form senior management	After closure – once baseline conditions have established

29 ITEM 1(L): INDICATE THE FREQUENCY OF THE SUBMISSION OF THE PERFORMANCE ASSESSMENT REPORT

A monthly site visit and report needs to be written by the ECO to inspect all aspects of the EMPr, as required. A performance assessment will be undertaken on an annual basis after which a Performance Assessment Report will be submitted to the DMR, DEFF and other relevant governmental departments.

30 ITEM 1(M): ENVIRONMENTAL AWARENESS PLAN

30.1 ITEM 1(M)(1): MANNER IN WHICH THE APPLICANT INTENDS TO INFORM HIS OR HER EMPLOYEES OF ANY ENVIRONMENTAL RISK WHICH MAY RESULT FROM THEIR WORK

The purpose of an Environmental Awareness Plan is to outline the methodology that will be used to inform the mine's employees of any environmental risks which may result from their work and the manner in which the risks must be dealt with to avoid contamination or the degradation of the environment. The environmental awareness plan is primarily a tool to introduce and describe the requirements of the range of environmental and social plans for the proposed project during the life of the project.

The objective of this Environmental Awareness Plan is to:

- Inform employees and contractors of any environmental risks which may result from their work; and
- Inform employees and contractors of the manner in which the identified possible risks must be dealt with to prevent degradation of the environment.

The environmental awareness plan ensures that training needs are identified and appropriate training is provided. The environmental awareness plan should communicate:

- Importance of conformance with the environmental policy, procedures and other requirements of good environmental management;
- The significant environmental impacts and risks of an individual's work activities and the environmental benefits of improved performance;
- Individual's roles and responsibilities in achieving the aims and objectives of the environmental policy; and
- The potential consequences of not complying with environmental procedures.

In general, the purpose of implementing an Environmental Awareness Plan is to optimise the awareness of those partaking in the mining and related activities which have the potential to impact negatively on the environment and in doing so, promote the global goal of sustainable development.

Training and induction of employees, supervisors, sub-contractors, contractors and visitors will ensure that co-operation in terms of environmental management will occur. This will contribute to the successful implementation of the conditions set out in the EMPr and Environmental Authorisation, and thus to the environmental sustainability of the project. In addition, it will ensure the success of the proposed project regarding compliance with legislation, and avoid possible future liabilities and legal action due to a lack of environmental awareness.

30.2 ITEM 1(M)(2): MANNER IN WHICH RISKS WILL BE DEALT WITH IN ORDER TO AVOID POLLUTION OR THE DEGRADATION OF THE ENVIRONMENT

The effectiveness and efficiency of this plan will be monitored by the performance of annual audits aimed at testing the environmental awareness of employees directly and the analysis of the root causes of environmental incidents, including non-conformance to legal requirements, to determine which incidents were caused by a lack of environmental awareness and training. The evaluation of the Environmental Awareness Plan will be conducted by the SHEQ Department. This evaluation will entail the auditing of the operation during the construction and operation phase once the activity has commenced.

Management shall establish and maintain procedures for the internal communication between the various levels and functions of the organisation, and receiving, documenting and responding to relevant communication from external I&APs. The organisation shall consider processes for external communication on its significant environmental aspects and record its decision. Communication is a management responsibility. All line supervisors are responsible for effective communication within their own sections. Environmental risks will be dealt with through training and communication to ensure minimal degradation of the environment.

The Environmental Awareness Plan should be sufficient to make all those involved with the project aware of those risks that may occur as well as the necessary mitigation required to minimise these risks. Vandabyte and its contractors should take the Environmental Awareness Plan seriously in order to show that they are sensitive to the environment's well–being, empowerment of the local people and returning the land to appropriate use once the reclamation activities have been completed.

Non-compliance should be dealt with by the SHEQ and site manager on a case-to-case basis. Secondary offenders or serious offences should be dealt with immediately, and where necessary disciplinary hearings and suspension should be considered.

31 ITEM 1(N): SPECIFIC INFORMATION REQUIRED BY THE COMPETENT AUTHORITY)

All information committed to in the scoping report and as requested by the DMR to date has been incorporated in the EIA/EMPr.

The financial provision for the environmental rehabilitation and closure requirements of mining operations is governed by NEMA (as amended), which provides in Section 24P that the holder of a mining right must make financial provision for rehabilitation of negative environmental impacts. The financial provision will be reviewed annually as required by the DMR.

32 ITEM 2: UNDERTAKING

The EAP herewith confirms:-

2(a) the correctness of the information provided in the reports;

2(b) the inclusion of comments and inputs from stakeholders and I&APs;

2(c) the inclusion of inputs and recommendations from the specialist reports where relevant; and

2(d) the acceptability of the Project in relation to the finding of the assessment and level of mitigation proposed.

32.1 REGARDING CORRECTNESS OF INFORMATION

I **Corné Niemandt** herewith undertake that the information provided in the foregoing report is correct, and that the comments and inputs from stakeholders and Interested and Affected Parties has been correctly recorded in the report.

____

Signature of the EAP

____

Date

32.2 REGARDING LEVEL OF AGREEMENT

I **Corné Niemandt** herewith undertake that the information provided in the foregoing report is correct, and that the level or agreement with Interested and Affected Parties and stakeholders has been correctly recorded and reported herein.

____

Signature of the EAP

____

Date

33 REFERENCES

Bromilow, C. 2010. Problem Plants and Alien Weeds of South Africa. Briza Publications. Pretoria, South Africa.

Census 2011: Statistics South Africa (2011) South African Population Census 2011. Indicators derived from the full population Census https://wazimap.co.za/profiles/municipality-MP313-steve-tshwete/

DEA. 2013. Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, and South African National Biodiversity Institute. Mining and Biodiversity Guideline: Mainstreaming biodiversity into the mining sector. Pretoria. 100 pages.

Department of Mineral Resources. 2011. A beneficiation Strategy for the minerals industry of SA. http://www.foresightfordevelopment.org/sobipro/55/1291-a-beneficiation-strategy-for-the-minerals-industry-of-south-africa

Department of Water and Sanitation. 2014. A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Secondary: [W5 (for example)]. Compiled by RQIS-RDM http://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.aspx.

Eskom. 2017. ASH MANAGEMENT IN ESKOM: Generation Communication CO 0004 Revision 13 (June 2017). http://www.eskom.co.za/AboutElectricity/FactsFigures/Documents/CO0004AshManagementRev13.pdf

GEOTERRAIMAGE. 2015. 2013 - 2014 South African National Land Data User Report and Metadata.

MUCINA, L. AND RUTHERFORD, M.C. (eds.). 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelizia 19. South African National Biodiversity Institute, Pretoria.

SANBI (South African National Biodiversity Institute). Mining and Biodiveristy Guidelines 2012 [Raster] 2012. Available from the Biodiversity GIS website

TDP. 2017. The Eskom Transmission Development Plan 2018 to 2027. http://www.eskom.co.za/Whatweredoing/TransmissionDevelopmentPlan/Pages/Transmission_Development_Plans.aspx