



Draft Scoping Report

SUBMITTED FOR ENVIRONMENTAL AUTHORIZATIONS 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 THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (MPRDA) (AS AMENDED).

Name of Applicant Anglo Operations (Pty) Ltd: Greenside Colliery

Project Application for Environmental Authorisation for the East Block Underground Mining Project

Document Draft Scoping Report (for Public Comment)

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DMR Reference 304MR





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 Authorisation 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.

Objective of the Scoping Process

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

- a) identify the relevant policies 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 alternative 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 level of assessment to be undertaken, including the methodology to be applied, the expertise required as well as the extent 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.



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Details and expertise of the EAP

1.1. Details of the EAP

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1.2. Expertise of the EAP

Name	Qualifications and expertise
	Professional Engineer. M.Sc.: Environmental Engineering
Brian Hayes	Brian is a registered professional engineer (Chemical) with a master's degree in Environmental Engineering from the University of Nottingham. Brian has 25 years' experience in environmental management and environmental engineering.
Minnette Le Roux	Pri.Sci.Nat. BSc (Hons) – Environmental Science
	Minnette is a senior environmental consultant in the Mining Department with over 10 years consulting experience. She obtained her B.Sc. Hons degree from the University of Pretoria and is a registered Pr.Sci.Nat. She has been project manager and coordinator on a number of large environmental authorisations for predominantly industrial and mining clients.
	Minnette has extensive integrated environmental management experience, including amongst other; Environmental Impact Assessments, Scoping Reports, Basic Assessments, Environmental Management Plans, Environmental Management Programmes, Integrated Water Use Licence Applications, Integrated Water and Waste Management Plans, Waste Tyre Abatement plans, Biodiversity Action Plans, Screening Reports and Gap-Analysis, Waste Management Licence Applications, Mining and Prospecting Right Applications and various other Application Forms as part of the Environmental Application Process.

2. Description of the property

Greenside Colliery currently mines under the Greenside Mining Right number 304MR. The mining right area for Greenside Colliery includes Portion 1, 2, 3 and the Remaining Extent (RE) of the farm Groenfontein 331JS, Portion 1, 29 and the RE of the farm Blaauwkrans 323JS, the RE of the farm Weltevreden 324JS and Portion 7, 9, 10, 12, 13, 14, 15, 16 and 17 of the farm Vlaklaagte 330JS.

As part of the proposed East Block Underground Mining Project, Greenside Colliery propose to construct an additional ventilation shaft (including associated powerline), a downcast shaft and further



expand their underground mining operations. The activities as part of the proposed East Block Underground Mining Project is to be undertaken on Portion 2, 3 and the RE of the farm Groenfontein 331JS. included in the Greenside Mining Right number 304MR, and Portions 1, 27, 28 and 145 of the farm Klipfontein 322JS, included in the Kleinkopje Mining Right number 307MR as part of the Anglo Operations Proprietary Limited ("AOPL") Coal Reserve. The location of the proposed East Block Underground Mining Project in relation to the Greenside Mining Right and the AOPL Coal Reserve is depicted in Table 1 and Figure 1.

Table 1: Description of the properties applicable to this application

Fame Name	Portion 2, 3 and the RE of the farm Groenfontein 331JS (Greenside Mining Right 304MR)		
rame Name	Portions 1, 27, 28 and 145 of the farm Klipfontein 322JS (AOPL Coal Reserve)		
	RE of the farm Groenfontein 331JS - 654.75 Ha		
	Portion 2 of the farm Groenfontein 331JS - 1269.36 Ha		
	Portion 3 of the farm Groenfontein 331JS - 636.19 Ha		
Application Area (Ha)	Portions 1 of the farm Klipfontein 322JS - 238.20 Ha		
(1.00)	Portions 27 of the farm Klipfontein 322JS - 260.04 Ha		
	Portions 28 of the farm Klipfontein 322JS - 260.82 Ha		
	Portions 145 of the farm Klipfontein 322JS - 300.66 Ha		
Magisterial District The mining site is situated within the Nkangala District Municipality wiregional services council being the eMalahleni Local Municipal Mpumalanga Province South Africa.			
The closet major town to Greenside Colliery is eMalahleni, locate the north east. Blackhill Siding and an associated village are situ northwest of the mine infrastructure area. The Landau Colliery situated 1 km east of Greenside Colliery. The town of Ogies is km southwest of Greenside Colliery. The N12 highway linking John to eMalahleni runs northeast-southwest along the south eastern b Greenside Colliery.			
	T0JS0000000033100000		
	T0JS0000000033100002		
21-digit Surveyor	T0JS0000000033100003		
General Code for	T0JS0000000032200001		
each farm portion	T0JS0000000032200028		
	T0JS0000000032200027		
	T0JS0000000032200145		



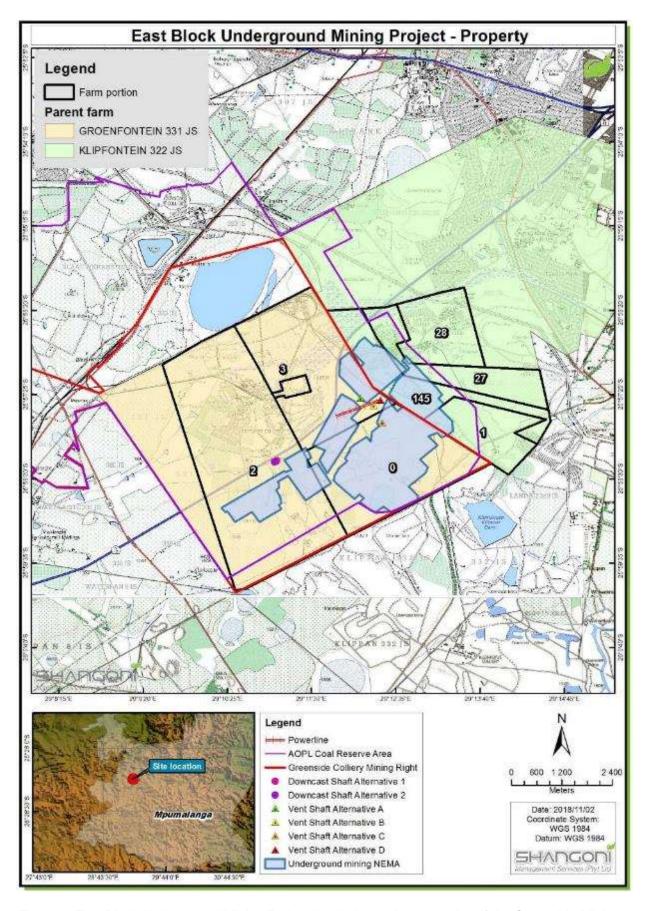


Figure 1: East Block Underground Mining Project in relation to the properties of the Greenside Mining Right and AOPL Coal Reserve



3. Locality map

3.1. Magisterial district and administrative boundaries

Greenside Colliery falls within the administrative boundaries presented in Table 2.

Table 2: Administrative boundaries

Province	Mpumalanga Province
District Municipality	Nkangala District Municipality
Local Municipality	Emalahleni Local Municipality
Ward	30
Department of Mineral Resources (DMR) Local Office	DMR (Emalahleni)
Department of Water and Sanitation (DWS) Local Office	DWS (Bronkhorstspruit)
Department of Environmental Affairs Local Office	Department of Agriculture, Rural Development, Land and Environmental Affairs (Mpumalanga)
Catchment Zone	Quaternary catchments B20G, B11G and B11F
Rainfall Zone	B1A, B1C and B2C
Water Management Area	Olifants River Catchment area
Water Forums	Olifants River Catchment Forum

3.2. Location of the mine

The closet major town to Greenside Colliery is eMalahleni, located 15 km to the north east. Blackhill Siding and an associated village are situated 2 km northwest of the mine infrastructure area. The Landau Colliery village is situated 1 km east of Greenside Colliery. The town of Ogies is located 20 km southwest of Greenside Colliery. The N12 highway linking Johannesburg to eMalahleni runs northeast-southwest along the south eastern boundary of Greenside Colliery. The regional setting of Greenside Colliery is indicated in Figure 2.

3.3. Location of the proposed activities

The activities as part of the proposed East Block Underground Mining Project is to be undertaken on Portion 2, 3 and the RE of the farm Groenfontein 331JS and Portions 1, 27, 28 and 145 of the farm Klipfontein 322JS. The location of the proposed activities are indicated in Figure 2.



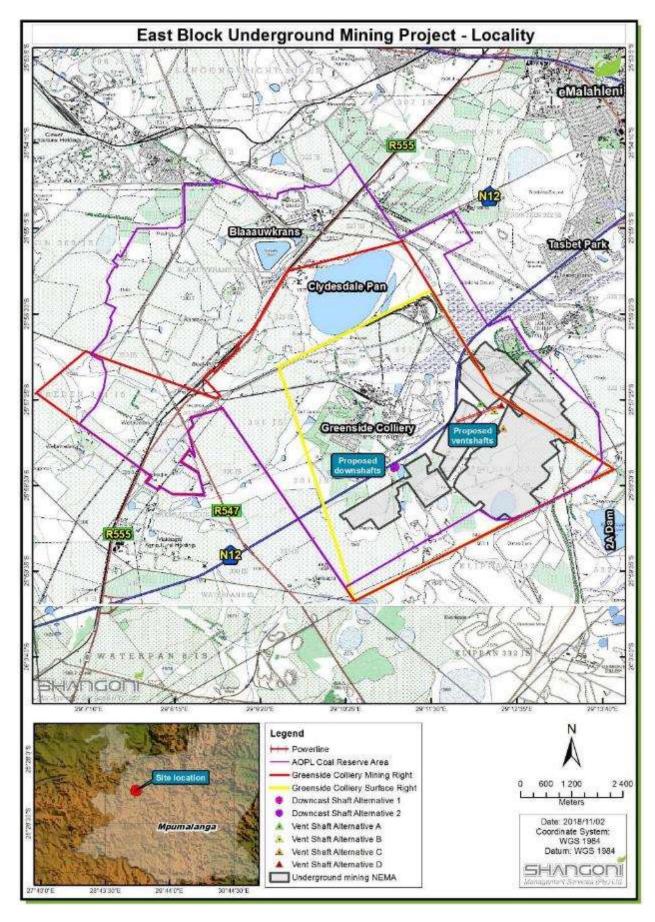


Figure 2: Locality of Greenside Colliery and the proposed activities



4. Description of the scope of the proposed overall activity

4.1. Listed and specified activities

Table 3: Activities and listed activities associated with the proposed project

Name of Activity	Arial Extent of Activity Ha or m ²	Listed Activity (Mark with X)	Applicable Listing Notice (GN R983, GN R984, GN R985)	Description	Waste Management Authorisation (Mark with X)
Surface infrastructure (ventilation shaft,	Ventilation shaft (+/- 1.4 Ha) Downcast shaft (<100m²)	X	Activity 12(ii)(a) and 12(ii)(c) of Listing Notice 1 (GNR 983 of GG 40772 of 7 April 2017, as amended): The development of— (ii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs— (a) within a watercourse; (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse.	The powerlines (4500 m²), the downcast shaft (<100 m²) and the proposed footprint area of the ventilation shaft (1.4 ha) will fall within a Seep wetland. Therefore, within a watercourse and within the 32 m of a watercourse.	N/A
downcast shaft, powerline)	22 kV powerline (+/-900m in length with footprint area of 4500m ²)	X	Activity 19 of Listing Notice 1 (GNR 983 of GG 40772 of 7 April 2017, as amended): 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.	The powerlines (4500 m²), downcast shaft (<100 m²) and the proposed footprint area of the ventilation shaft (1.4 ha) will fall within a Seep wetland. Construction of these facilities will require removing soil of more than 10 cubic metres from a watercourse.	N/A
		X	Activity 17 (a) of Listing Notice 2 (GNR 984 of GG 40772 of 7 April 2017, as amended):	The surface infrastructure (ventilation shaft, downcast shaft, powerline) are structures or infrastructure directly related to the	N/A



Name of Activity	Arial Extent of Activity Ha or m ²	Listed Activity (Mark with X)	Applicable Listing Notice (GN R983, GN R984, GN R985)	Description	Waste Management Authorisation (Mark with X)
			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—	extraction of a mineral resource. These structures are required for continuation of the underground mining to take place.	
			(a) associated infrastructure, structures and earthworks, directly related to the extraction of a mineral resource.		
Underground mining of coal with bord-and -pillar method.	3620 Ha	X	Activity 17 (b) of Listing Notice 2 (GNR 984 of GG 40772 of 7 April 2017, as amended): 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— (b) the primary processing of a mineral resource including winning, extraction, classifying, concentrating, crushing, screening or washing.	The underground mining of coal is directly related to the extraction of a mineral resource.	N/A



4.2. Description of the proposed activities to be undertaken

At the existing Greenside Colliery operations coal is extracted using the board-and-pillar mining method and is brought to the surface via conveyors to the coal beneficiation plants. The two beneficiation plants process coal, the coal is crushed and washed using dense medium separation ("DMS"). Any discard and slurry from the process is sent to the coal discard dump. The processed coal is then transported by conveyor to the rapid loading terminal ("RLT") from which the coal is transported by rail to international markets via the Richards Bay Coal Terminal ("RBCT"). Coal is also collected by truck from the beneficiation plant stockpile for sale to the local market.

Greenside Colliery proposes to expand their current underground mining operations into a south eastern direction (East Block area). At the proposed East Block area coal will be mined from the No. 4 Seam reserve (during 2019-2030), using the same board-and-pillar mining method. The bord-and-pillar method (Figure 3) is commonly used for flat or gently dipping bedded ores or coal seams. The method utilises a large machine with a rotating steel drum equipped with tungsten carbide teeth that scrapes ore from the coal seam. The method is utilised for bord and pillar type mining and produces a constant flow of ore from the working faces of the mine. Once the coal seam has been accessed, the ore is mined utilising a regular grid of mining tunnels and involves progressively excavating panels into the coal seam whilst leaving behind pillars of coal to support the mine. The miner rotates the oscillating steel drum to cut away designated sections of the coal bed. When the coal is extracted, a conveyor system is utilised to transport and load the coal from the seam. No surface subsidence is foreseen as the mine plan was developed in such a manner as to prevent pillar collapse and the destabilisation of the roof. Approximately 60-70% of the coal will be extracted while the rest will remain as pillars.

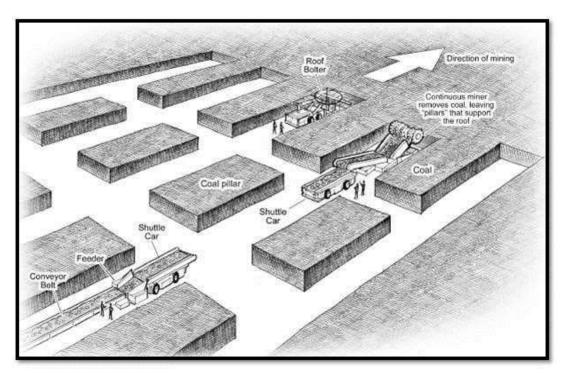


Figure 3: Typical bord and pillar mining



The activities as part of the proposed East Block Underground Mining Project fall within the existing Greenside Mining Right number 304MR and the AOPL Coal Reserve. The location of the proposed activities can be viewed in Figure 4. The mining schedules for the 4 Seam within the East Block area can be viewed in Figure 5. In support of the underground mining activities a ventilation shaft (with a footprint area of approximately 1.4 Ha), a downcast shaft (with a footprint area of less than 100 m²) and the associated 22 kV powerlines (approximately 900 m in length with a footprint area of 4500 m²) will be constructed. The downcast shaft is the shaft by which fresh air descends into the mine. The ventilation shaft will be operated to service the underground workings and will be a vertical passage that connects the underground workings at Greenside Colliery with the surface atmosphere. The operation of the fans will remove stale air from underground to ensure a safe working environment for the underground mine workers. The ventilation shaft will be positioned at a specified location in the underground workings to optimise ventilation efficiency. The general layout of the ventilation shaft is present in the Figure 6 below and described in detail in Table 4 below.

Table 4: Detailed description of the infrastructure associated with the ventilation shaft

Infrastructure	Description	
Ventilation shaft	A raised bore constructed ventilation shaft that will be drilled from a depth of approximately 60 m. The shaft diameter will be 4.5 m, which will supply fresh air to the underground workings.	
Associated civil and structural installations, including fan foundation	The associated civil and structural installations on surface will incorporate a shaft footprint area of approximately 75 x 85 m (6375 m²) including the concrete platform surrounding it. The shaft's outlet will be roughly 2.5 m high and have a diameter of 4.5 m. All civil and structural installations will be constructed on a terrace and enclosed by a high security fence.	
Outdoor yard (switch yard)	The outdoor yard (or switch yard) is a fenced enclosure with an access gate in which the electrical infrastructure will be situated. The powerline will feed into the outdoor yard prior to distribution to the substation, transformer and ventilation shaft and fans.	
Substation	A substation bay will be constructed adjacent to the outdoor / switch yard.	
Transformer bay	A transformer bay will be constructed adjacent to the outdoor / switch yard and the substation.	
Contractors yard	The contractors yard will be an enclosed area and only for the Construction Phase. Once the Construction Phase is complete and the yard is no longer required, the fence will be removed, and the footprint area rehabilitated.	
Gravel access road	The existing gravel roads will be used. The access road will branch off in two (2) directions, to the north east and to the west of the existing gravel road.	
Storm water infrastructure	Storm water infrastructure (storm water diversion berm) will be constructed upstream to divert clean surface water runoff around the ventilation shaft area.	
Powerlines	A 22 kV powerline will be constructed from the Greenside Colliery to supply power to the ventilation shaft.	



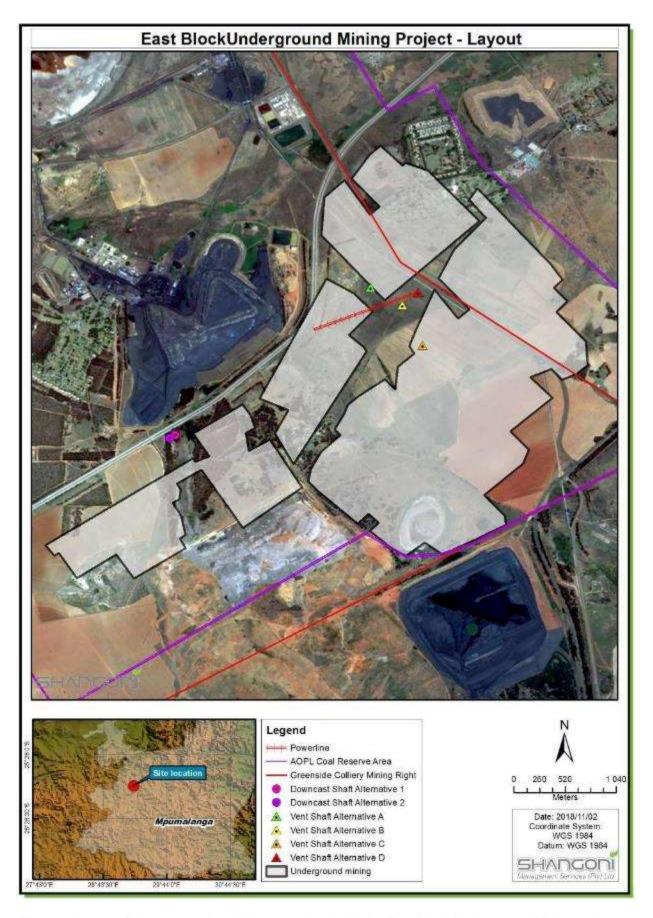


Figure 4: Layout of the proposed activities associated with the East Block Underground Mining project



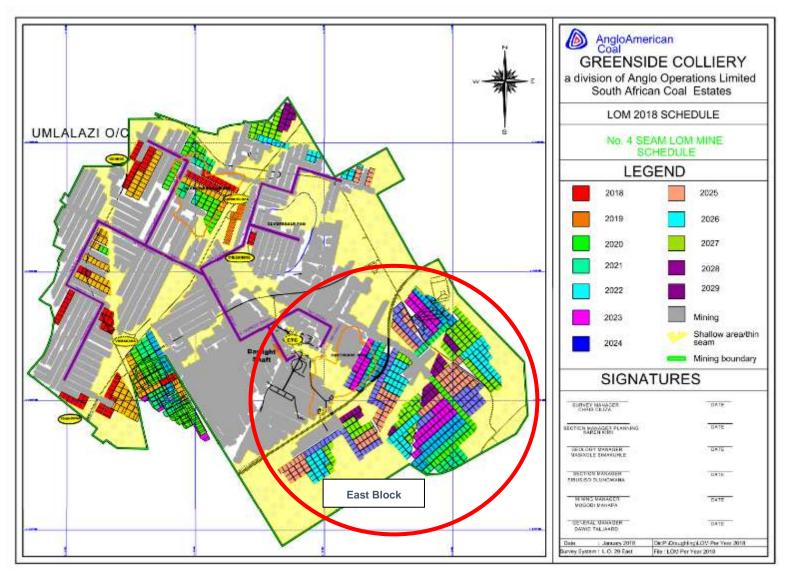


Figure 5: Greenside Colliery Life of Mine Plan inclusive of the East Block Underground Mining project



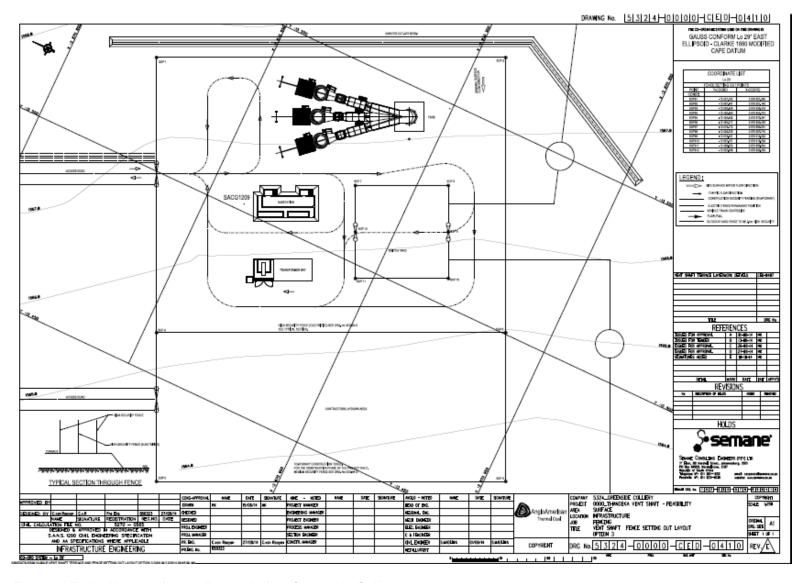


Figure 6: Typical layout of a ventilation shaft at Greenside Colliery



5. Policy and legislative context

The following table is a summary of the policy and legislative context applicable to the proposed development.

Table 5: Policy and legislative context

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 legislative and policy context)
The Constitution of the Republic of South Africa, 1996.	
The Mineral and Petroleum Resources Development Act (Act No. 28 of 2002, as amended).	
The Mineral and Petroleum Resources Development Regulations (GN R527 dated 2004).	Throughout this Scoping Report.
The National Environmental Management Act (Act No. 107 of 1998 as amended).	
The Environmental Impact Assessment Regulations (GN R982 dated 2014, as amended).	
The Environmental Impact Assessment Regulation. Listing Notice 1. (GN R983 dated 2014, as amended).	Part 4.1 of this Scoping Report.
The Environmental Impact Assessment Regulation. Listing Notice 2. (GN R984 dated 2014, as amended).	
Integrated Environmental Management Guideline: Guideline on Need and Desirability (2017).	Part 6.1 of this Scoping Report.
Mining and Biodiversity Guideline: Mainstreaming biodiversity into the mining sector.	Chapters E, F and L of Part 8.4.1; and Part 8.4.4 of this Scoping Report.
The National Water Act (Act No. 36 of 1998, as amended).	Chapter G and H of Part 8.4.1 of this Scoping Report.
Regulations on use of water for mining and related activities aimed at the protection of water resources published in terms of the National Water Act under Government Notice 704 of 4 June 1999 (GN R704).	Part 9.9 and Chapter G of Part 8.4.1 of this Scoping Report.



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 legislative and policy context)		
The National Environmental Management: Biodiversity (Act 10 of 2004, as amended).			
National Forests Act (Act No.84 of 1998).	Chapter E, F and L of Part 8.4.1 of this Scoping		
Alien and Invasive Species Regulations (GN R598 dated 2014).	Report.		
Conservation of Agricultural Resources (Act 43 of 1983).			
The National Environmental Management: Air Quality (Act 39 of 2004, as amended).	Chapter I of Part 8.4.1 of this Scoping Report.		
SABS Code of Practice 0103 of 2008: The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication. SABS Code of Practice 0328 of 2008: Environmental Noise Impact Assessments.	Chapter J of Part 8.4.1 of this Scoping Report.		
National Environmental Management: Waste Act (Act No. 59 of 2008, as amended).	Part 9.9 of this Scoping Report.		
National Heritage Resources Act (Act No. 25 of 1999, as amended).	Chapter K of Part 8.4.1 of this Scoping Report.		
DMR Guideline for Consultation with communities and Interested and Affected Parties. As required in terms of Sections 16(4)(b) or 27(5)(b) of the MPRDA, and in accordance with the standard directive for the compilation thereof as published on the official website of the Department of Mineral Resources.	Part 8.2 and 9.7 of this Scoping Report.		
Integrated Environmental Management Information Series. Criteria for determining alternatives in EIA.	Part 8.7 and Part 9.1 of this Scoping Report.		

6. Need and desirability of the proposed activities

6.1. Need and desirability in terms of the guideline on need and desirability, 2017

In 2017, the Department of Environmental Affairs published an Integrated Environmental Management Guideline, the Guideline on Need and Desirability. The following table indicates on how the guideline requirement were considered in this Scoping Report.



Table 6: Need and Desirability of the project

Requirement	Part where requirement is addressed/response		
1. How will this development (and its separate elements/aspects) impact on the ecological integrity of the area? ¹			
1.1 How were the following ecological integrity considerations taken into account?			
1.1.1 Threatened Ecosystems ²	The project will have a minimal impact on the ecological integrity of the area. Refer to Chapters E, F and L of Part 8.4.1 of this Scoping Report and Part 8.5 for potential impacts.		
1.1.2 Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure ³			
1.1.3 Critical Biodiversity Areas ("CBAs") and Ecological Support Areas ("ESAs").			
1.1.4 Conservation targets			
1.1.5 Ecological drivers of the ecosystem.			
1.1.6 Environmental Management Framework.	The Environmental Framework and Spatial Development Framework for eMalahleni Local		
1.1.7 Spatial Development Framework.	Municipality forms part of the Integrated Development Plan 2017/18 – 2021/22, which indicates that the mining industry contributes most to the local economy and employment in this municipal boundary and mining thus forms an important part of this municipality.		
	This application relates to progressive mining of an underground area and will have minimal impact on the ecological integrity of the area.		
1.1.8 Global and international responsibilities relating to the environment (e.g. RAMSAR sites, Climate Change, etc.) ⁴	On 4 May 2007 the Minister of Environmental Affairs and Tourism formally declared the eastern part of Gauteng and western part of Mpumalanga an air pollution hotspot, to be known as the "The Highveld Priority Area", a National air pollution		

¹ Section 24 of the Constitution and section 2(4)(a)(vi) of NEMA refer.



²Must consider the latest information including the notice published on 9 December 2011 (Government Notice No. 1002 in Government Gazette No. 34809 of 9 December 2011 refers) listing threatened ecosystems in terms of Section 52 of National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).

³ Section 2(4)(r) of NEMA refers.

⁴ Section 2(4)(n) of NEMA refers

Requirement	Part where requirement is addressed/response
	hotspot in terms of Section 18(1) of the National Environmental Management: Air Quality (Act 39 of 2004, as amended). By declaring a priority area, authorities recognise that air quality within these areas are generally regarded as being poor, and frequently meet or exceed ambient air quality standards. Authorities may impose measures on the mine and other mines and industries within this area in order to allow for improvements in the air quality of the region.
	Although the proposed project area is located in the Highveld Priority Area, the activities applied for relate to the underground mining and will, therefore, have a minimal impact on the air quality in the area. The impacts will be further discussed and assessed in greater detail as part of the EIAR and EMPr.
1.2 How will this development disturb or enhance ecosystems and/or result in the loss or protection of biological diversity? What measures were explored to firstly avoid these negative impacts, and where these negative impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts? ⁵	The preliminary potential impacts that have been identified and may occur as a result of the proposed activity has been discussed in Part 8.5 of this document. The impacts will be further
1.3 How will this development pollute and/or degrade the biophysical environment? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts? ⁶	discussed and assessed in greater detail as part of the EIAR and EMPr.
1.4 What waste will be generated by this development? What measures were explored to firstly avoid waste, and where waste could not be avoided altogether, what measures were explored to minimise, reuse and/or recycle the waste? What measures	No new waste will be generated by this project and all waste will be managed in accordance to the existing waste management activities at Greenside Colliery.



 $^{^{\}rm 5}$ Section 24 of the Constitution and Sections 2(4)(a)(i) and 2(4)(b) of NEMA refer.

 $^{^{\}rm 6}$ Section 24 of the Constitution and Sections 2(4)(a)(ii) and 2(4)(b) of NEMA refer

Requirement	Part where requirement is addressed/response
have been explored to safely treat and/or dispose of unavoidable waste? ⁷	
1.5 How will this development disturb or enhance landscapes and/or sites that constitute the nation's cultural heritage? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts? ⁸	Two graves have been identified in the proposed area. Alternatives have been considered for the location of the ventilation shaft in order to avoid the graves. Refer to Chapter K. It should be noted that the progressive mining of the underground area will have no impact on the cultural heritage of the area. Refer to Part 8.5 for the potential impacts on the different aspects of the environment.
1.6 How will this development use and/or impact on non-renewable natural resources? What measures were explored to ensure responsible and equitable use of the resources? How have the consequences of the depletion of the non-renewable natural resources been considered? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	The mining and removal of minerals (non-renewable resources) at the proposed project area will result in the localised destruction of the geological strata, which is a consequence of mining. Water from the underground mining areas will be
1.7 How will this development use and/or impact on renewable natural resources and the ecosystem of which they are part? Will the use of the resources and/or impact on the ecosystem jeopardise the integrity of the resource and/or system taking into account carrying capacity restrictions, limits of acceptable change, and thresholds? What measures were explored to firstly avoid the use of resources, or if avoidance is not possible, to minimise the use of resources? What measures were taken to ensure responsible and equitable use of the resources? What measures were explored to enhance positive impacts?	dewatered (for the safe continuation of mining and pumped to the Emalahleni Water Treatmer Plant (EWTP) for treatment. The potential impacts that may occur as a result of the proposed activity have been preliminarial identified and discussed in Part 8.5. The impact will be described and assessed in detail as part of the EIAR and EMPr.



 $^{^{\}rm 7}$ Section 24 of the Constitution and Sections 2(4)(a)(iv) and 2(4)(b) of NEMA refer

⁸ Section 24 of the Constitution and Sections 2(4)(a)(iii) and 2(4)(b) of NEMA refer.

⁹ Section 24 of the Constitution and Sections 2(4)(a)(v) and 2(4)(b) of NEMA refer

¹⁰ Section 24 of the Constitution and Sections 2(4)(a)(vi) and 2(4)(b) of NEMA refer

Requirement	Part where requirement addressed/response	is
1.7.1 Does the proposed development exacerbate the increased dependency on increased use of resources to maintain economic growth or does it reduce resource dependency (i.e. dematerialised growth)? (note: sustainability requires that settlements reduce their ecological footprint by using less material and energy demands and reduce the amount of waste they generate, without compromising their quest to improve their quality of life)	The mining of the East Block area reserves w maximise the utilisation of coal resources within the Greenside Colliery Mining Right and AOP coal reserve boundaries.	
1.7.2 Does the proposed use of natural resources constitute the best use thereof? Is the use justifiable when considering intra- and intergenerational equity, and are there more important priorities for which the resources should be used (i.e. what are the opportunity costs of using these resources this the proposed development alternative?)		
1.7.3 Do the proposed location, type and scale of development promote a reduced dependency on resources?		
1.8 How were a risk-averse and cautious approach applied in terms of ecological impacts? ¹¹	The project will have a minimal impact of ecological integrity of the area. Refer to Cha E, F and L of Part 8.4.1 of this Scoping R and Part 8.5 for potential impacts. A conservative approach will be followed in the identification and assessing environmental impacts associated with	terms of the
1.8.1 What are the limits of current knowledge	proposed project during the EIAR / EMPr pl	hase.
1.8.1 What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	Refer also to Part 8.6.2 of this Scoping Rep	ort.
1.8.2 What is the level of risk associated with the limits of current knowledge?	The level of risk associated with the limits current knowledge (during the Scoping Phas	
1.8.3 Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	can be considered low. The potential risks been identified in Part 8.5 and will be fu assessed in detail as part of the EIAR / I phase.	urther



¹¹ Section 24 of the Constitution and Section 2(4)(a)(vii) of NEMA refer.

Requirement	Part where requirement is addressed/response
1.9 How will the ecological impacts resulting from t right in terms following:12	his development impact on people's environmental
1.9.1 Negative impacts: e.g. access to resources, opportunity costs, loss of amenity (e.g. open space), air and water quality impacts, nuisance (noise, odour, etc.), health impacts, visual impacts, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	
1.9.2 Positive impacts: e.g. improved access to resources, improved amenity, improved air or water quality, etc. What measures were taken to enhance positive impacts?	All potential negative and positive impacts associated with the proposed activity have been preliminarily identified and discussed in Part 8.5 below. These impacts will be discussed,
1.10 Describe the linkages and dependencies between human wellbeing, livelihoods and ecosystem services applicable to the area in question and how the development's ecological impacts will result in socio-economic impacts (e.g. on livelihoods, loss of heritage site, opportunity costs, etc.)?	assessed and the significance determined during the EIAR / EMPr phase.
1.11 Based on all of the above, how will this development positively or negatively impact on ecological integrity objectives/targets/considerations of the area?	
1.12 Considering the need to secure ecological integrity and a healthy biophysical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the "best practicable environmental option" in terms of ecological considerations? ¹³	Refer to Part 8.1 of this report for an assessment of the alternatives identified.
1.13 Describe the positive and negative cumulative ecological/biophysical impacts bearing in mind the size, scale, scope and nature of the project in relation to its	A preliminary determination of the potential impacts associated with the proposed activity has been included in Part 8.5 of this document. These impacts (including the residual and cumulative impacts) will be described and

 $^{^{\}rm 12}$ Section 24 of the Constitution and Sections 2(4)(a)(viii) and 2(4)(b) of NEMA refer



¹³ Section 2(4)(b) of NEMA refer

Requirement	Part where requirement is addressed/response
location and existing and other planned developments in the area? ¹⁴	assessed in detail and the significance determined as part of the EIAR / EMPr phase of the project.
2 "Promoting justifiable economic and socia	I development" ¹⁵

- ustifiable economic and social development
- 2.1 What is the socio-economic context of the area, based on, amongst other considerations, the following considerations?
- 2.1.1 The IDP (and its sector plans' vision, objectives, strategies, indicators and targets) and any other strategic plans, frameworks of policies applicable to the area,
- 2.1.2 Spatial priorities and desired spatial patterns (e.g. need for integrated of segregated communities, need upgrade informal settlements, need for densification, etc.),
- 2.1.3 Spatial characteristics (e.g. existing land uses, planned land uses, cultural landscapes, etc.), and
- 2.1.4 Municipal Economic Development Strategy ("LED Strategy").
- 2.2 Considering the socio-economic context, what will the socio-economic impacts be of the development (and its separate elements/aspects), and specifically also on the socio-economic objectives of the area?
- 2.2.1 Will the development complement the local socio-economic initiatives (such as local economic development (LED) initiatives), or skills development programs?
- 2.3 How will this development address the specific physical, psychological, developmental, cultural and social needs and interests the relevant of communities?¹⁶
- 2.4 Will the development result in equitable (intra- and inter-generational)

The Environmental Framework and Spatial Development Framework for eMalahleni Local Municipality forms part of the Integrated Development Plan 2017/18 - 2021/22, which indicates that the mining industry contributes most to the local economy and employment in this municipal boundary and mining thus forms an important part of this municipality.

This application relates to extension of the existing Greenside Colliery underground mining and will continue to contribute to the Socio Economy in the area.



¹⁴ Regulations 22(2)(i)(i), 28(1)(g) and 31(2)(1) in Government Notice No. R. 543 refer

¹⁵ Section 24 of the Constitution refers.

¹⁶ Section 2(2) of NEMA refers

Requirement	Part where requirement is addressed/response
distribution, in the short- and long-term? ¹⁷ Will the impact be socially and economically sustainable in the short- and long-term?	
In terms of location, describe how the placement of	of the proposed development will:18
2.4.1 result in the creation of residential and employment opportunities in close proximity to or integrated with each other,	
2.4.2 reduce the need for transport of people and goods,	
2.4.3 result in access to public transport or enable non-motorised and pedestrian transport (e.g. will the development result in densification and the achievement of thresholds in terms public transport),	
2.4.4 compliment other uses in the area,	
2.4.5 be in line with the planning for the area,	
2.4.6 for urban related development, make use of underutilised land available with the urban edge,	This application relates to extension of the existing Greenside Colliery underground mining and will continue to contribute to the Socio
2.4.7 optimise the use of existing resources and infrastructure,	Economy in the area.
2.4.8 opportunity costs in terms of bulk infrastructure expansions in non-priority areas (e.g. not aligned with the bulk infrastructure planning for the settlement that reflects the spatial reconstruction priorities of the settlement),	
2.4.9 discourage "urban sprawl" and contribute to compaction/densification,	
2.4.10 contribute to the correction of the historically distorted spatial patterns of settlements and to the optimum use of existing infrastructure in excess of current needs,	

¹⁸ Section 3 of the Development Facilitation Act, 1995 (Act No. 67 of 1995) ("DFA") and the National Development Plan refer



¹⁷ Sections 2(2) and 2(4)(c) of NEMA refers.

Requirement	Part where requirement is addressed/response
2.4.11 encourage environmentally sustainable land development practices and processes,	Refer to Part 9.9. Detailed management and mitigation measures will be included in the EIAR / EMPr phase.
2.4.12 take into account special locational factors that might favour the specific location (e.g. the location of a strategic mineral resource, access to the port, access to rail, etc.),	The location of the proposed project area was determined based on the location of the ore reserve.
2.4.13 the investment in the settlement or area in question will generate the highest socioeconomic returns (i.e. an area with high economic potential),	This application relates to extension of the existing Greenside Colliery underground mining and will continue to contribute to the Socio Economy in the area.
2.4.14 impact on the sense of history, sense of place and heritage of the area and the socio-cultural and cultural-historic characteristics and sensitivities of the area, and	
2.4.15 in terms of the nature, scale and location of the development promote or act as a catalyst to create a more integrated settlement?	A conservative approach will be followed in terms of the identification and assessing of environmental impacts associated with the
2.5 How were a risk-averse and cautious approach applied in terms of socio-economic impacts? ¹⁹	proposed project during the EIA / EMPr phase.
2.5.1 What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)? ²⁰	
2.5.2 What is the level of risk (note: related to inequality, social fabric, livelihoods, vulnerable communities, critical resources, economic vulnerability and sustainability) associated with the limits of current knowledge?	Since the project is still in the scoping phase, the level of risk associated with the limits of current knowledge is considered to be low.
2.5.3 Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	



¹⁹ Section 2(4)(a)(vii) of NEMA refers

²⁰ Section 24(4) of NEMA refers

Requirement	Part where requirement is addressed/response
2.6 How will the socio-economic impacts resu environmental right in terms following	Iting from this development impact on people's
2.6.1 Negative impacts: e.g. health (e.g. HIV-Aids), safety, social ills, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	As mentioned previously, this application relates to extension of the existing Greenside Colliery underground mining and will continue to contribute to the Socio Economy in the area
2.6.2 Positive impacts. What measures were taken to enhance positive impacts?	Refer to Part 8.7 of this report for an identification of the positive impacts.
2.7 Considering the linkages and dependencies between human wellbeing, livelihoods and ecosystem services, describe the linkages and dependencies applicable to the area in question and how the development's socioeconomic impacts will result in ecological impacts (e.g. over utilisation of natural resources, etc.)?	The preliminarily identified impacts of the proposed activities are presented in Part 8.5 of this document.
2.8 What measures were taken to pursue the selection of the "best practicable environmental option" in terms of socio-economic considerations? ²¹	
2.9 What measures were taken to pursue environmental justice so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons (who are the beneficiaries and is the development located appropriately)? ²² Considering the need for social equity and justice, do the alternatives identified, allow the "best practicable environmental option" to be selected, or is there a need for other alternatives to be considered?	Refer to Part 8.1 of this report for an assessment of the alternatives identified and their potential impacts on the social environment.
2.10 What measures were taken to pursue equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing, and what special measures were taken to ensure access thereto by	Refer to point 2.6 (of this table) above.

²¹ Section 2(4)(b) of NEMA refers.



²² Section 2(4)(c) of NEMA refers.

Requirement	Part where requirement is addressed/response
categories of persons disadvantaged by unfair discrimination? ²³	
2.11 What measures were taken to ensure that the responsibility for the environmental health and safety consequences of the development has been addressed throughout the development's life cycle? ²⁴	The identification of the potential impacts has been presented in Part 8.5 below. The potential impacts will be further described and assessed in detail and the significance determined as part of the EIAR / EMPr phase of the project. Mitigation measures will also be provided for each potential impact that may occur.
2.12 What measures were taken to:	
2.12.1 ensure the participation of all interested and affected parties, 2.12.2 provide all people with an opportunity to	
develop the understanding, skills and capacity necessary for achieving equitable and effective participation, ²⁶	
2.12.3 ensure participation by vulnerable and disadvantaged persons, ²⁷	
2.12.4 promote community wellbeing and empowerment through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means, ²⁸	Refer to the Public Participation Report attached hereto as Annexure E. ²⁵
2.12.5 ensure openness and transparency, and access to information in terms of the process, ²⁹	
2.12.6 ensure that the interests, needs and values of all interested and affected parties were taken into account, and that adequate recognition were given to all	



²³ Section 2(4)(d) of NEMA refers.

²⁴ Section 2(4)(e) of NEMA refers.

 $^{^{\}rm 25}$ PP Report will be attached to the final scoping report for submission.

²⁶ Section 2(4)(f) of NEMA refers

²⁷ Section 2(4)(f) of NEMA refers.

²⁸ Section 2(4)(h) of NEMA refers.

²⁹ Section 2(4)(k) of NEMA refers.

Requirement	Part where requirement is addressed/response
forms of knowledge, including traditional and ordinary knowledge ³⁰ , and	
2.12.7 ensure that the vital role of women and youth in environmental management and development were recognised and their full participation therein were being promoted? ³¹	Refer to the Public Participation Report attached hereto as Annexure E. The Public Participation
2.13 Considering the interests, needs and values of all the interested and affected parties, describe how the development will allow for opportunities for all the segments of the community (e.g. a mixture of low-, middle-, and high-income housing opportunities) that is consistent with the priority needs of the local area (or that is proportional to the needs of an area)? ³³	Report ³² presents the details of all Interested and Affected Parties ("I&APs") that were identified, how the I&APs were notified and involved in the process, any issues and concerns raised by the I&APs and the final results of the Public Participation Process.
2.14 What measures have been taken to ensure that current and/or future workers will be informed of work that potentially might be harmful to human health or the environment or of dangers associated with the work, and what measures have been taken to ensure that the right of workers to refuse such work will be respected and protected? ³⁴	All contractors, sub-contractors and workers will attend compulsory environmental awareness training and inductions. This training will highlight the dangers associated with the workplace. Procedures relating to environmental risks will also be put in place and will be regularly updated.
2.15 Describe how the development will impact or	n job creation in terms of, amongst other aspects
2.15.1 the number of temporary versus permanent jobs that will be created,	
2.15.2 whether the labour available in the area will be able to take up the job opportunities (i.e. do the required skills match the skills available in the area),	As mentioned previously, this application relates to extension of the existing Greenside Colliery underground mining and will continue to
2.15.3 the distance from where labourers will have to travel,	contribute to the Socio Economy in the area.
2.15.4 the location of jobs opportunities versus the location of impacts (i.e. equitable distribution of costs and benefits), and	

³⁰ Section 2(4)(g) of NEMA refers.



 $^{^{\}rm 31}$ Section 2(4)(q) of NEMA refers.

³² PP Report will be attached to the final scoping report for submission.

³³ Section 2(4)(g) of NEMA refers.

³⁴ Section 2(4)(j) of NEMA refers

Requirement	Part where requirement is addressed/response
2.15.5 the opportunity costs in terms of job creation (e.g. a mine might create 100 jobs, but impact on 1000 agricultural jobs, etc.).	
2.16 What measures were taken to ensure:	
2.16.1 that there were intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment, and	Refer to the Public Participation Report ³⁵ attached hereto as Annexure E. Other government departments are included on the list of I&APs and stakeholders, and received the
2.16.2 that actual or potential conflicts of interest between organs of state were resolved through conflict resolution procedures?	notifications of the proposed activity as well as notifications on the availability of the report for review. All applicable environmental legislation was considered during the Scoping process.
2.17 What measures were taken to ensure that the environment will be held in public trust for the people, that the beneficial use of environmental resources will serve the public interest, and that the environment will be protected as the people's common heritage? ³⁶	During the initial Public Participation Process, all issues and concerns raised by the I&APs, stakeholders and the Organs of State are taken into account and responses provided.
2.18 Are the mitigation measures proposed realistic and what long-term environmental legacy and managed burden will be left? ³⁷	Mitigation measures for each of the identified impacts will be described in detail in the EIAR / EMPr phase. The proposed mitigation measures will be realistic to protect both the bio-physical and socio-economic environment in both the short- and long-term.
2.19 What measures were taken to ensure that the costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects will be paid for by those responsible for harming the environment? ³⁸	The applicant will be responsible for the costs of any remediation of pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects. The Financial Provisioning for the proposed project will be included and discussed in detail in the EIAR / EMPr phase.
2.20 Considering the need to secure ecological integrity and a healthy bio-physical environment, describe how the alternatives identified (in terms of all the different	The alternatives for the proposed project are described in Part 8.1 below and assessed in terms of the following four categories:

 $^{^{\}rm 35}$ PP Report will be attached to the final scoping report for submission.



³⁶ Section 2(4)(o) of NEMA refers.

 $^{^{\}rm 37}$ Section 240(1)(b)(iii) of NEMA and the National Development Plan refer.

³⁸ Section 2(4)(p) of NEMA refers.

Requirement	Part where requirement is addressed/response
elements of the development and all the different impacts being proposed), resulted in the selection of the best practicable environmental option in terms of socioeconomic considerations? ³⁹	 Environmental; Technical/Engineering; Economical; and Social. The alternatives will be further assessed in greater detail in the EIAR / EMPr phase
2.21 Describe the positive and negative cumulative socio-economic impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and other planned developments in the area? ⁴⁰	The preliminarily identified impacts have been presented in Part 8.5 below. The impacts will be further described and assessed and the significance determined as part of the EIAR / EMPr phase of project. All residual and cumulative impacts will also be described and assessed in the EIAR / EMPr.

7. Period for which environmental authorisation is required

The Greenside Colliery Mining Right has ±10 years Life of Mine (LOM) left. At the proposed East Block area, coal will be mined from the No. 4 Seam reserve (during 2019-2030). Therefore, the period for which environmental authorisation is required is at least 10 years (from the date of approval provided by the DMR).

8. Description of the process followed to reach the proposed preferred site

8.1. Details of alternatives considered

The following alternatives have been identified as part of the proposed project and will be further be assessed in the EIAR/EMPr.

8.1.1 Mining method alternative

Two alternatives in terms of mining method(MM) have been identified. These include:

- Opencast (surface) mining methods; and
- Underground mining method (board and pillar).

The following were taken into consideration when the mining methods were considered for the proposed mining area:



³⁹ Section 2(4)(b) of NEMA refers.

⁴⁰ Regulations 22(2)(i)(i), 28(1)(g) and 31(2)(1) in Government Notice No. R. 543 refer.

- Shape of the resource blocks;
- Depth, thickness, and distribution of the coal seams;
- Thickness of the coal seams:
- Parting thickness between the seams;
- Mining strip ratio;
- Quality of the coal;
- Potential markets;
- Potential price for the coal;
- · Capital required to extend the mining area; and
- · Cost of mining.

Due to the very high strip ratio over the total area, and the 4 Seam being too deep over the total area to mine economically by surface (opencast) mining methods, underground mining was confirmed as the preferred method. The preferred method is also likely to be much less invasive, with minimal ecological disturbance, low air quality impact, no additional noise impacts and low impact onto the surrounding community expected, as will be confirmed within the EIAR.

8.1.2 Site alternatives for the ventilation shaft

It had initially been indicated on earlier versions of the surface infrastructure plans that the ventilation shaft be located within an area identified as Seep wetland habitat. Subsequent to the delineation of the wetland it was recommended by the wetland specialist that alternative locations for the ventilation shaft be investigated, with 4 alternatives proposed (refer to Figure 7 below). Alternatives A and B fall predominantly within delineated Seep wetland habitat and are considered unsuitable. Alternative C falls completely outside delineated wetland habitat within a cultivated field and is considered the preferred alternative from a wetland perspective, though it has been indicated that it may be unsuitable from a mining perspective. Alternative D is located outside delineated wetland habitat and is also considered suitable from a wetland perspective. Alternative D is the preferred location for the ventilation shaft from a wetland and mining perspective, however, these alternatives will be further assessed as part of the EIAR.

8.1.3 Site alternatives for the downcast shaft

Two alternative locations have been proposed for the required downcast shaft (refer to Figure 8 below). Alternative 1 is located within the delineated wetland habitat and is considered an unsuitable location from a wetland perspective. Alternative 2, located outside wetland habitat, is considered the preferred location. The two locations for the downcast will be further assessed as part of the EIAR.

8.1.4 No-go option

While the 'No Project' option is not yet considered to be the preferred alternative, it will not be discarded. The 'No Project' option will be further assessed as part of the EIA process for the proposed project. If the project area reserves are not mined, the status quo environmental conditions within the mining right area will continue.



Physical and biophysical environment – The proposed project is not expected to create significant negative environmental impacts, should the alternatives be considered and the mitigation measures implemented.

Socio-economic – As per above, the proposed project is an extension of the existing underground mining activities. A number of positive social impacts will continue as a result from the proposed project, such as skills development, local economic development and job opportunities. As per the Social and Labour Plan, the mine (at full production) employs 697 permanent staff.



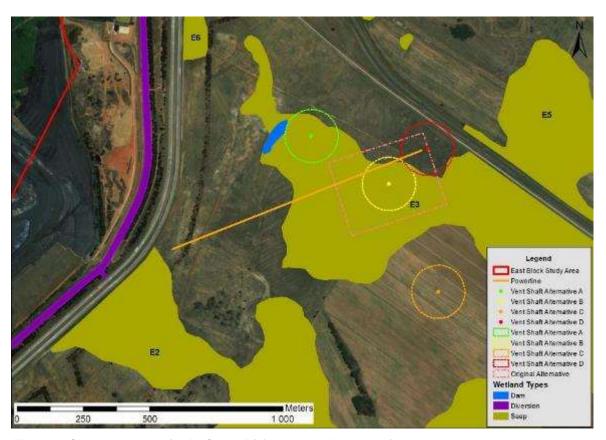


Figure 7: Site alternatives (A, B, C and D) for the ventilation shaft

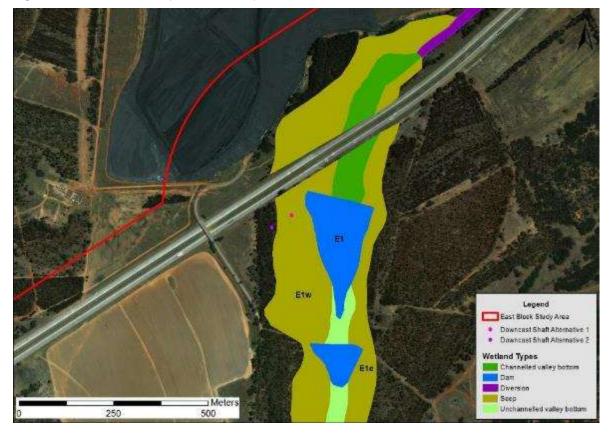


Figure 8: Site alternatives (1 and 2) for the downcast shaft



8.2. Details of the Public Participation Process followed

A detailed public participation process was undertaken as part of the initial application- and scoping phase for the proposed project. The following has been conducted as part of the Environmental Authorisation Application (proof hereof will be included in the final Public Participation Report to be submitted to the DMR along with the Final Scoping Report) (will be attached as Annexure E to this report):

- Advertisements.
 - A Newspaper advertisement was placed in the Witbanknews on the 16th of November 2018.
- Site notices.
 - Five (5) site notices were placed around the proposed project site as well as at the existing
 Mine.
- Written notices.
 - Written notices (including BIDs) were distributed to Interested and Affected Parties (I&APs).
- Availability of Scoping Report for public review
 - This Scoping Report will be made available for public and stakeholder review for a period of at least 30 days (from 20 November 2018 to 14 January 2019). Notices providing the detail of the public viewing station and review period, were sent to registered I&APs via e-mail. This notification also formed part of the above-mentioned advertisement and site notices.

8.3. Summary of issues raised by I&APs

Table 7 below will be completed when the final Scoping Report is compiled and will provide a summary of the comments and issues raised and reaction to those responses.



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Table 7: Summary of the issues raised by the I&APs

	Interested and Affected Parties	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 Responses Were Incorporated.
To be completed upon completion of the public participation process.					



8.4. The environmental attributes associated with the development footprint alternatives. a baseline environment

8.4.1 The type of environment affected by the proposed activity

A baseline description or "status quo" of the of the present environmental situation is provided in this part of the document. The following attributes / aspects have been described in detail, in the following respective chapters:

- Chapter A: Geology;
- Chapter B: Climate;
- Chapter C: Topography;
- Chapter D: Soils, Land Use and Land Capability;
- Chapter E: Vegetation;
- Chapter F: Fauna;
- Chapter G: Surface water;
- Chapter H: Groundwater;
- Chapter I: Air Quality;
- Chapter J: Noise;
- Chapter K: Archaeology and cultural history;
- Chapter L: Sensitive landscapes;
- · Chapter M: Visual aspects; and
- Chapter N: Regional socio-economic structure.

Section 8.4.1 provides both a summary of the baseline environment as applicable to the proposed mining and related activities, informed by:

- The approved Environmental Management Programme (EMPr) titled: Aligned Environmental Management Programme Report for Anglo American Thermal Coal: Greenside Colliery, DMR Reference: MP30/5/1/2/2/304MR, dated April 2014 compiled by WSP Environmental (Pty) Ltd;
- Geohydrological investigation as part of undermining of Waterpan and wetlands at 3A North and East Block, compiled by Shangoni Management Services (Pty) Ltd., dated 2018.
- Wetland Assessment Report for the East Bock Underground Mining Project, compiled by Wetland Consulting Services (Pty) Ltd., dated 2018.
- A Fauna and Flora Report for Greenside Mineral Residue Discard Facility, compiled by Digby Wells Environmental, dated October 2013.
- A Phase 1 Heritage Impact assessment (HIA) study for Anglo Operations Limited Greenside Colliery's new Discard Facility near eMahlahleni on the Eastern Highveld in the Mpumalanga Province, dated November 2014, and compiled by Dr. Julius Pistorius.
- Greenside Colliery New Discard Facility, eMalahleni Local Municipality, Mpumalanga Province, Farm: Portion 0, 2 and 3 Groenfontein 331JS, Palaeontological Impact Assessment: Phase 1 Field study, dated November 2014 compiled by Dr. Fourie,.



Chapter A: Geology

The geology underlying the East Block mining area is dominated by near horizontally embedded (although wavy) succession of shales, sandstones and coal layers developed at the base of the Ecca Group of the Karoo Sequence (see the figure below for the generalised stratigraphic of the area). This succession of sedimentary rocks generally overlies the well consolidated conglomerates and diamictites of the Dwyka Formation, but, in places, the Ecca Group rocks rest directly on the igneous felsites and granites of the pre-Karoo Basement rocks below. Locally the coal bearing sediment of the Vryheid Formation contain the No.1, 2, 3, 4 and 5 seams of the Witbank Coalfield, although the No.3 Seam is of no economic importance as it is very thin.

A north-south striking normal fault is developed across the site, and a number of north-east/south-west trending dolerite dykes have intruded in places. The fault cuts through the eastern side of an existing dome structure, resulting in variable throws along its strike. The doming structure has resulted in the sub-outcropping of a number of coal seams against the deeply (10 to 12 m) weathered overburden above.

There are four major coal seams at Greenside Colliery, the No.1, 2, 4 and 5 seams. The No. 2 and 5 seams have been mined extensively. The No.1 Seam is not economic at present, but may be included in future considerations.

The coal seams are relatively horizontal in the east -west direction, although local undulations do occur. The No. 5 seam thickness is on average 2 m. The No. 4 seam consists of three horizons: the 4A seam, 4U seam and 4L seam. These three seams reach a combined thickness of 3 to 5 m. The No. 2 seam is consistently the thickest, on average 4 to 6 m. The No. 1 seam is on average 2 to 2.5 m thick.

Currently, Greenside Colliery mines only the No.4 Seam, which is laterally continuous over the whole of the mining area, and conformably overlies the parting to No.3 Seam. Economically, this is the most important mining horizon on Greenside Colliery, and the life of mine tonnes will be sourced from this seam. The undermining of the East Block area will include the mining of the No.4 Seam.



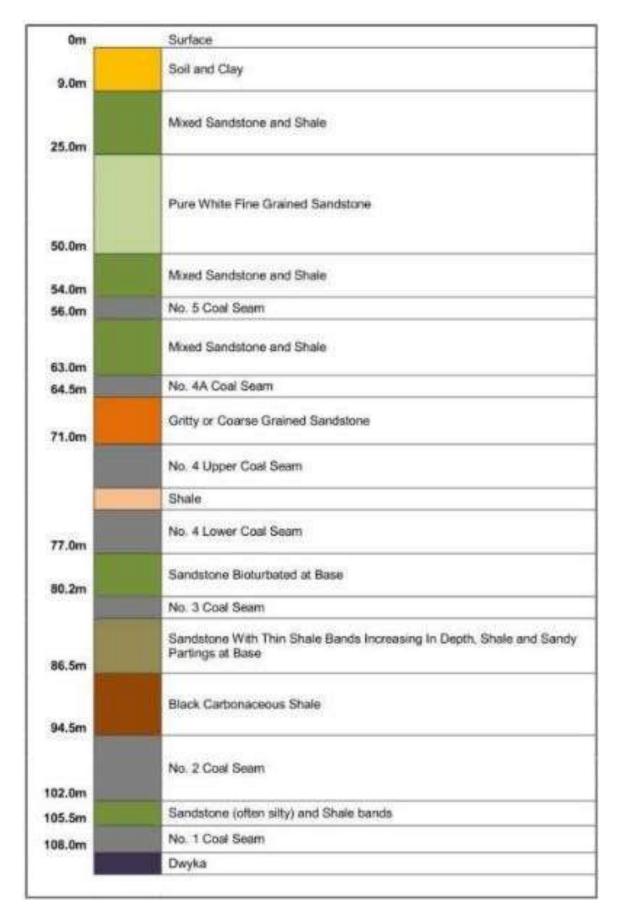


Figure 9: Generalised geological stratigraphic profile for the area



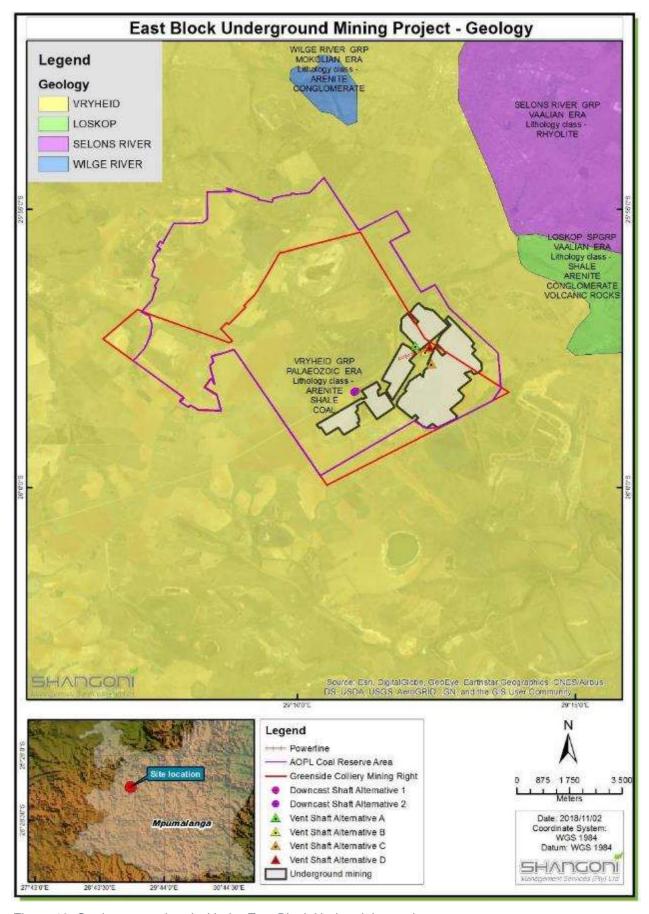


Figure 10: Geology associated with the East Block Undermining project



Chapter B: Climate

The region lies in the summer rainfall region (Highveld) of Southern Africa, with cold and dry winters, and warm and wet summers. Temperatures range from 9°C to 32°C in summer and from 6°C to 22°C in winter. Frost occurs frequently between May and September. During summer months, prevailing winds are northerly or easterly and during the winter months prevailing winds are north westerly to south westerly.

Greenside Colliery is situated in Mpumalanga and falls in the summer rainfall region, which is characterised by thunder storm activity and relatively low average rainfall. The mean annual rainfall is 700 mm, with most of this falling in the high rainfall months between October and March, compared to the mean annual potential evaporation of 1700 mm.

Table 8: Monthly rainfall data from weather station B1E005 (Witbank Dam)

Month	Mean Rainfall (mm)
January	131.5
February	91.8
March	73.8
April	39.3
May	13.4
June	7.0
July	2.9
August	7.9
September	20.7
October	78.3
November	123.8
December	116.7
Annual	702.7

Evaporation is measured at station B1E001 for an S-class pan. Table 9 below lists the average evaporation recordings.

Table 9: Monthly evaporation data (S Class Pan) from weather station B1E001 (Witbank Dam)

Month	Mean Evaporation (mm)
January	164.5
February	138.4
March	129.8
April	97.4



Month	Mean Evaporation (mm)
May	79.8
June	65.3
July	72.5
August	98.8
September	137.3
October	163.7
November	158.5
December	163.6
Annual	1476.2

Chapter C: Topography

The eastern region of the Mpumalanga is characterised by a gently undulating plateau with fairly broad to narrowly incised valleys such as the Olifants River Valley. The general elevation of the area lies between 1 400 and 1 600 metres above mean sea level (mamsl).

The site has gently undulating topography with elevation ranging from 1 532 to 1 608 mamsl, giving a total relief of 76 m. Although the highest natural point on the site is in the south-western corner, the crest of the old slimes dam of the coal discard dump is up to 10 m greater in elevation. Coal stockpiles are located adjacent the two beneficiation plants; however, the height of these stockpiles is kept to a minimum. The natural slope is towards wetlands in the northeast, with an average gradient of 5°.



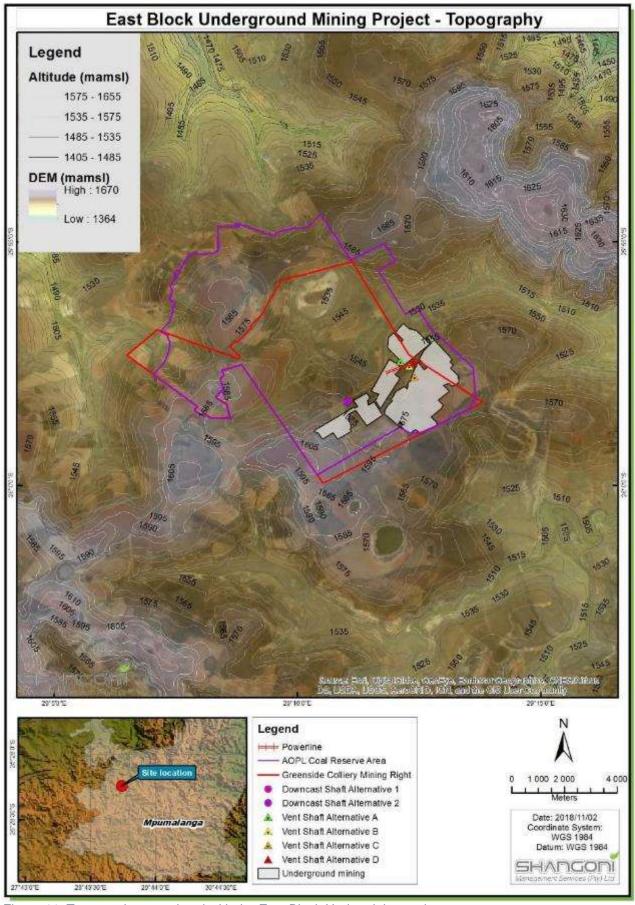


Figure 11: Topography associated with the East Block Undermining project



Chapter D: Soils, land use and land capability

Ten soil forms were identified over the historical opencast areas of Greenside Colliery. These include: Avalon; Clovelly; Dresden; Glenco; Griffin; Hutton; Longlands; Mispah, Westleigh; and Witbank. Red soils include Hutton soils and are found in the southwest corner of Greenside Colliery. Yellow brown soils found over the mine include Clovelly, Glencoe, Griffin and Avalon soils. Westleigh and Mispah forms are shallow soils and are found on stooped areas. From the soil map for Greenside Colliery the following soil classes have been identified; S21 – Glenrosa and/or Mispah forms (other soils may occur), lime rare or absent in the entire landscape; S17 – One or more of: vertic, melanic, red structured diagnostic horizons, undifferentiated; S2 – Plinthic cantena: dystrophic and/or mesotrophic, red soils widespread, upland duplex and margalitic soils rare; and S3– Red-yellow apedal, freely drained soils; red, dystrophic and/or mesotrophic.

Prior to mining, much of the under-mined land was still used for agriculture, while wetlands, pans and dams covered 13.5% of the site. Pre-mining land capability for the area was mostly agricultural (61.3% for crop farming; 25.2% for grazing) with wilderness and wetland land capabilities making up the remainder. Erosion potential is low due to gentle slopes and vegetation cover.

The details for the pre-mining and post-mining land capability hectares are shown in the table below.

Table 10: Pre- and Post-Mining Land Capability

Land Capability	Pre-Mining Post-Mining			
Class	На	%	На	%
Arable	1761.8	61.3%	1726.5	61.9%
Grazing	726.2	25.2%	753.6	26.9%
Wilderness	241	8.4%	178.7	6.4%
Wetlands	145.2	5.1%	132.8	4.7%
Total	2874.2	100%	2791.6	100%



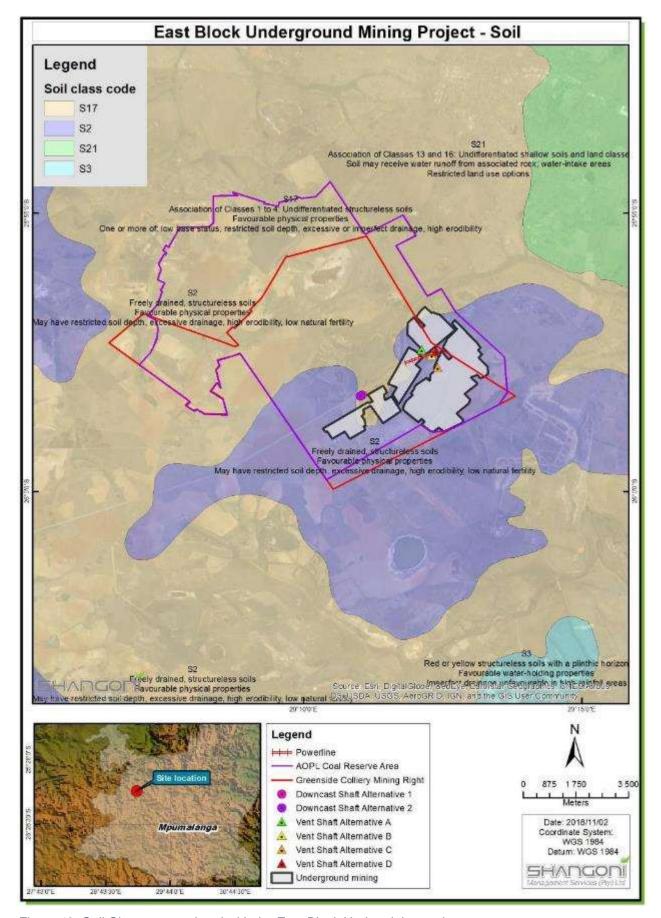


Figure 12: Soil Classes associated with the East Block Undermining project



Chapter E: Vegetation

According to the Vegetation Map of South Africa, Lesotho and Swaziland (Mucina and Rutherford, 2006), the study area falls within the Grassland Biome and the Mesic Highveld Grassland Bioregion. The dominant vegetation type found on site is Eastern Highveld Grassland (Gm12). Also occurring within the study area and associated with most of the larger pans in the area, the azonal Eastern Temperate Freshwater Wetland vegetation type is also indicated as occurring. Under the National List of Ecosystems that are Threatened and in Need of Protection (GN1002 of 2011), the vegetation type is considered Vulnerable. A Flora study was conducted for the study area by Digby Wells Environmental in October 2013 titled: A Fauna and Flora Report for Greenside Mineral Residue Discard Facility. The aim of the floral study was to describe the location and ecological state of floral communities associated within the area by means of undertaking a literature review of the available specialist studies which have been completed for the operations, as well as by incorporating site specific field information and is described below.

Vegetation Communities

The study area comprises largely of grassland which is typical of the area, as well as seasonal wetlands and 'wet' vegetation surrounding the dams. Areas which have previously been developed have poor vegetation which can be described as secondary plant community. A proportion of the land is currently under crop cultivation. Furthermore there exists an alien vegetation community (Eucalyptus stand). Vegetation communities which were delineated for the Greenside Project area are as follows;

- Remnant Natural Grassland Community;
- Secondary Grassland Community;
- Wetland Community;
- Dam Vegetation Community;
- Transformed Areas; which comprise of Agricultural fields (predominantly maize), Alien Vegetation (plantations of Eucalyptus etc.), and Development (Mining infrastructure and residential buildings).

Remnant Natural Grassland

This vegetation community is a medium to tall grassland with relatively high aerial cover, as illustrated in Figure 13 below. Dominant species include *Hyparrhenia hirta*, *Themeda triandra* and *Setaria sphacelata*. Other common and conspicuous species include *Elionurus muticus*, *Cymbopogon excavatus*, *Aristida bipartita*, *Scabiosa columbaria*, *Senecio inornatus*, *Justicia anagalloides*, *Ranunculus multifidus*, *Eragrostis plana*, *Oenothera rosea*, *Brachiaria eruciformis*, *Hyparrhenia dregeana*. The community is found adjacent to the marsh wetlands in the study area and consists of those areas of terrestrial vegetation that have not been cultivated. In many cases it contains species that suggest that these grasslands are ephemeral wetlands or hydrophytic grasslands, occurring within areas with periodically wet soils. It is the most widespread natural vegetation type remaining in the study area.





Figure 13: Primary Grassland Community, Greenside Colliery

The species richness of terrestrial grasslands is moderate low for grasslands and is 26.5 species per 100 m², which is also fairly typical of grasslands in floodplain areas. The grasslands are in relatively poor condition due to the high disturbance regime in the study area as well as apparent overgrazing. Some exotic species occur in these grasslands, including *Verbena bonariensis*, but these usually occur at low frequency and density. These grasslands are considered to have a moderate sensitivity and conservation value. This is due primarily to the high rates of transformation of this vegetation at a national scale and the poor rates of conservation as well as the important buffer role they play adjacent to the seasonal marsh wetlands. Only a few fragmented areas of untransformed grassland remain within the region of the highveld within which the study area is situated.

Secondary Grassland Community

Past cultivation and mining activities have led to the disturbance of the original natural grassland vegetation. Secondary grassland has developed in areas where cultivation has ceased or an effort toward land rehabilitation has occurred where mining previously occurred. These areas are dominated by species such as *Cynodon dactylon*, *Eragrostis curvula* and *Cyperus esculentus*. Common and conspicuous species include *Verbena bonariensis*, *Pseudognaphalium oligandrum*, *Gomphocarpus fruticosus*, *Bidens bipinnata* and *Tagetes minuta*, many of which are weeds of disturbed places or typical of post-disturbance succession. Some of these species are illustrated in Figure 14 below.

Species richness is 11.0 species per 100 m², the lowest of all the natural plant communities in the study area. Due to the low species richness, high proportion of alien weeds and indigenous species that are indicative of disturbance, and disturbed nature of these areas which is therefore regarded to have a low ecological sensitivity and low conservation value.





Figure 14: Alien invasive flora species which have colonised in degraded grasslands at Greenside Colliery; (left to right) Wild Verbena (Verbena bonariensis), Khakhi Bush (Tagetes minuta) and Brown Nut Sedge (Cyperus esculentis)

Wetland Vegetation

Wetland vegetation exists along the shallow drainage lines that drain the study area. The vegetation of is composed primarily of tall reed stands dominated by bulrushes (*Typha capensis*) and Common Reeds (*Phragmites australis*) as seen in

Figure 15 below. In seasonal wetland areas the vegetation cover is composed of a typical variety of grasses and sedges which thrive in moist conditions.



Figure 15: Wetland Vegetation (left to right) Common Reed (Phragmites australis) and Bulrushes (Typha capensis), Greenside Colliery

Two major vegetation zones were distinguished by De Castro and Brits (2006) in the wetland area based on the vegetation structure (e.g. vegetation physiognomy, life form structure and floristic composition) of the constituent plant communities. The major factors influencing the distribution of the zones include frequency and duration of inundation and/or elevated soil moisture levels. The major zones are as follows:

Zone A:

This is the central zone of the drainage lines, where the soils are usually permanently inundated. This zone consists of dense 'reedbeds' of *Typha capensis*, with smaller patches of *Phragmites australis*. The species diversity is 5.0 species per 100 m² in this zone. Common and conspicuous species that occur



amongst the reedbeds and especially near the margins of these reedbeds include *Leersia hexandra*, *Cotula anthemoides* and *Verbena bonariensis*.

Zone B:

This is the zone of transition between wetland vegetation and terrestrial grassland and the plant community contains floristic elements of both vegetation units. The soils are probably only briefly inundated and then only during very wet years, but are likely to have seasonally saturated soils. Dominant grasses include *Andropogon appendiculatus*, *Hemarthria altissima* and *Cynodon dactylon*. Common and conspicuous species include *Senecio inornatus*, *Pennisetum sphacelatum*, *Eragrostis plana*, *Oenothera rosea*, *Hypoxis acuminata*, *Setaria nigrirostris*, *Verbena bonariensis*, **Paspalum urvillei* and *Typha capensis*. The species diversity is 24.0 species per 100 m² in this zone.

The overall species richness of the wetlands is 14.9 species per 100 m². This compares favourably with species richness in wetlands within grassland areas of other parts of the country. The wetlands have been affected by canalisation and damming in various parts of the study area and are not always in pristine condition.

However, they have a high sensitivity and conservation due to the fact that they perform an important ecological function, e.g. maintaining water purity and supply and reducing soil erosion. In addition to this they provide habitats for various wild animal and bird populations and contain many plant species that are restricted to this habitat such as the near threatened (NT) (SANBI, 2012) plant *Nerine gracilis*, illustrated in Figure 16 below, which is known to occur in similar habitats in the region.



Figure 16: Nerine gracilis (NT), which could potentially occur within the wetland areas within Greenside Colliery

Transformed areas:

Agriculture

Agriculture consists of a variety of crops, primarily maize. Cultivation is considered to be a complete transformation of natural vegetation. The cultivated areas were not studied in detail, but are considered to have a low ecological sensitivity and low conservation value.



Alien vegetation

According to the Conservation of Agricultural Resources Act (Act No. 43 of 1983) a number of plant species recorded on site are exotics and six are declared aliens Species include; *Eucalyptus camaldulensis*, *Pinus* sp., *Populus deltoides* and *Salix babylonica* (declared invaders category 2), *Cirsium vulgare* (declared weed category 2) and *Pennisetum clandestinum* (proposed declared weed). Outside of the Alien Vegetation Unit the majority of these are found within wetland environments. It is likely that there are other Declared Weeds or Alien Invasive species occurring at the Mine that were not recorded in the April 2006 survey ((De Castro and Brits (2006)). Photographs of transformed vegetation is presented Figure 17.

Parts of the study area exotic trees, primarily *Eucalyptus* species. Most of these have been planted as formal woodlots or plantations to harvest commercially. Other exotic species occurring in the study area, primarily as invasive species along parts of the drainage lines include *Pinus* species, *Populus* x *canescens* and *Salix babylonica*. The areas dominated by alien trees are considered to have a low ecological sensitivity and low conservation value, except where they may provide important habitat for birds or other animals.







Figure 17: Transformed Vegetation (left to right); Agricultural crop; Maize (Zea mays), Weeping Willow (Salix babylonica) and River Gum (Eucalyptus camaldulensis)

Developed areas; Mine infrastructure, urban areas, homesteads

Areas within the project area of Greenside Colliery have undergone complete transformation of natural vegetation as a result of development. 'Development' describes buildings, infrastructure, roads, mining operations (including open-cast pits and dumps), railways, etc. and has largely resulted in degradation of the surrounding surface ecology, with a high number of exotic and alien invasive species colonising in these area.

Red List Plant Species

No threatened species were encountered during the field survey of the study area. Lists of historical occurrences of Red List plant species obtained from the PRECIS Database of the SANBI for the quarter degree square 2529CC as well as for three adjacent grids in which similar habitats are found (2529CD, 2629AA and 2629AB), this is presented in Table 11.



This information was supplemented with expert knowledge, of additional species that potentially occur in this part of Mpumalanga, gained through a number of previous studies done in this region, as well as from the threatened species Database of the Mpumalanga Parks Board, the Red Data list for South Africa (Golding, 2002), regional flora treatments, atlases and taxonomic treatments of relevant groups.

Table 11: Red Data flora species which could occur within the Greenside Colliery project area (SANBI, 2012)

Family	Species	Status
APOCYNACEAE	Aspidoglossum validum	Threatened
ASTERACEAE	Callilepis leptophylla	Declining
MESEMBRYANTHEMACEAE	Frithia humilis	Endangered
AMARYLLIDACEAE	Crinum bulbispermum	Declining
AMARYLLIDACEAE	Crinum macowanii	Declining
APOCYNACEAE	Pachycarpus suaveolens	Vulnerable
AQUIFOLIACEAE	llex mitis	Declining

Four species are listed to be declining, (Callilepis leptophyll, Crinum bulbispermum, Crinum macowanii, Ilex mitis). Aspidoglossum validum is threatened, Pachycarpus suaveolens is listed to be vulnerable. Frithia humilis is listed as endangered. Ilex mitis listed as Declining is not likely to occur on the site since it is found on substrates and habitats not found within the study area.

Callilepis leptophyll, Crinum bulbispermum, Crinum macowanii, and Aspidoglossum validum could occur within the study area within the Seasonal Wetland vegetation unit and adjacent areas of moist grassland. Frithia humilis has previously been found in an area between Bronkhorstspruit and Witbank, and occurs on shallow, sandy soils associated with sheets of bedrock. Within the study area, there is no potentially suitable habitat for this species and it is therefore considered unlikely that this species occurs within the study area.



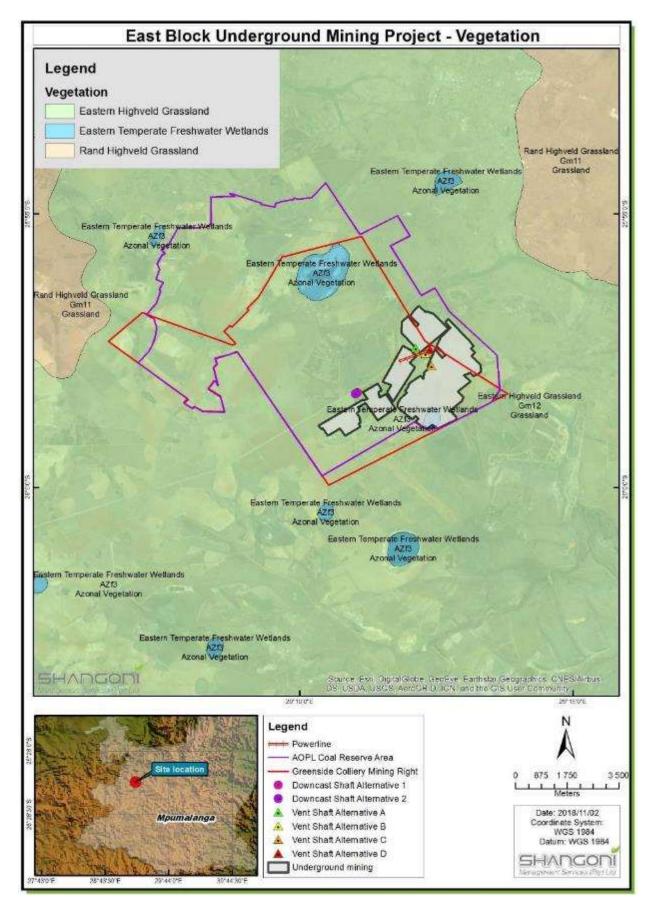


Figure 18: Vegetation map associated with the East Block Undermining project



Chapter F: Fauna

A fauna study was conducted by Digby Wells Environmental in October 2013 titled: A Fauna and Flora Report for Greenside Mineral Residue Discard Facility. The aim of the fauna assessment was to determine the faunal composition of the study area and in so doing, establish its ecological integrity. This was achieved with the following objectives:

- To determine fauna species that occur on site including mammals, birds, reptiles and amphibians;
- To identify Red Data, threatened, protected or keystone species found within the study area;
- To determine important habitat areas for Species of Concern; and
- To describe the different habitats which occur within the area of concern and evaluate their conservation importance and significance with reference to the possible presence of threatened species at the collieries.

The environment at Greenside Colliery is largely disturbed. Large parts of the project area have been modified and disturbed as a result of mining and agriculture. Few small patches of natural vegetation in the form of what can be termed primary grassland and secondary grassland have not been transformed, or are in a state of rehabilitation. These lie fragmented throughout the area. These patches support higher levels of biodiversity and provide suitable habitat which contrasts their largely modified, inhospitable surrounds. Other natural areas which are not considered modified are wetlands, which lie along the drainage lines which provide varied habitat for a number of species and the Dam areas, which are similarly host to a number of species surrounding the open water.

The following habitat types were identified within the project area:

- Natural Grassland Habitat;
- Natural Secondary Grassland Habitat
- Wetland Habitat;
- Dam Habitat; and
- Transformed habitat (Including Residential and mining development).

Various natural and introduced species were identified within these habitats during the field survey undertaken by De Castro and Brits (De Castro Brits, 2006), Two mammal species, 75 bird species, two reptile and one frog species were recorded at Greenside Colliery and has also been confirmed from additional reconnaissance surveys conducted in 2013. These low species numbers reflect the habitat modification and disturbance which has occurred within the Greenside Colliery area.

Mammals

A number of mammals were expected to exist within the Greenside Colliery, with only two species being identified. These are listed in Table 12 below.

Table 12: Expected and identified mammals at Greenside Colliery, Mpumalanga

Scientific Names	Common Names	Status	Identified
Aonyx capensis	Cape Clawless Otter	LC	
Atelerix frontalis	Southern African Hedgehog	LC	
Atilax paludinosus	Water Mongoose	LC	
Canis mesomelas	Black-backed Jackal	LC	
Civettictus civetta	African Civet	LC	
Cryptomus hottentotus	Common Mole-rat	LC	х
Cynictus penicillata	Yellow mongoose	LC	х
Genetta	Small-spotted Genet	LC	
Genetta tigrina	Large-spotted Genet	LC	
Hyaena brunnea	Brown Hyena	VU	
Hystrix africaeaustralis	Porcupine	LC	
Ictonyx striatus	Striped Polecat	LC	
Lepus saxatilis	Scrub Hare	LC	
Mellivora capensis	Honey Badger	LC	
Orycteropus afer	Aardvark	LC	
Otomys irroratus	Vlei Rat	LC	
Proteles cristatus	Aardwolf	LC	
Raphicerus campestris	Steenbok	LC	
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	LC	
Slender mongoose	Slender mongoose	LC	
Sylvicapra grimmia	Common Duiker	LC	
Tatera brantsii	Highveld Gerbil	LC	
Thryonomys swinderianus	Greater Cane Rat	LC	

The natural areas that exist within the project area potentially provide the most optimum habitat for these species, while the transformed areas provide a source of food. Transformed areas are less suitable for permanent inhabitation by these species. Expected species are illustrated in Figure 19 below.





Figure 19: Mammals, Greenside Colliery (Left to right) Yellow Mongoose (Cynictus penicillata), Scrub Hare (Lepus saxatilis) and Steenbok (Raphicerus campestris)

Red Data Mammals

Brown Hyena (*Hyaena brunnea*), listed as Vulnerable (VU) could potentially occur on site, or move through the area.

Birds

The remnant natural vegetation patches provide habitat for numerous bird species that were identified throughout the survey. The diversity and density numbers can be directly linked to these areas. The species observed in these habitat types are considered to be typical reflection of what would be expected to be found in these areas.

Due to the alteration of the natural hydrology of the wetland by the construction of dams in the upper reaches of the river there has been an increase in the open surface water. This attracts a number of waterfowl which have a preference for this habitat type; such as Red-knobbed Coot (*Fulica cristata*). However, it has also resulted in the loss of species which were attracted to the 'marsh' habitat of the wetland. The integrity of this system has been altered however this has resulted in the transformation of habitat type and resulting species transformation. Biodiversity levels remain good. A sample of the birds observed at the Greenside Colliery is visible in Figure 20.





Figure 20: Birds at Greenside Colliery (left to right); Blacksmith Plover (Vanellus armatus), Red Knobbed Coot (Fullica cristata) and Black-sparrow Hawk (Accipiter melanoleucus).

The alien vegetation that exists within the area also supports relatively rich bird diversity. The *Eucalyptus* stand offers ideal habitat for species occupying different niches and vertical strata, e.g. leaf-litter, scrub and canopy areas. Several primary and secondary cavity nesting species such as Black-collared Barbet (*Lybius torquatus*) and Red-throated Wryneck (*Jynx ruficollis*) were recorded during the survey. These species create habitat for several other cavity nesting/roosting species. A Black-sparrow



Hawk (*Accipiter melanoleucus*) was observed in the southern corner of the study area. These birds habitually nest in stands of exotic trees and the study area almost certainly forms part of a breeding territory.

The mine infrastructure including office buildings, operational and residential areas were surveyed. Species observed in these areas were typical urban exploiters such as House Sparrow (*Passer domesticus*), Cape Glossy Starling (*Lamprotornis nitens*) and Laughing Dove (*Spilopelia senegalensis*).

The species identified on site and their threat Status according to the International Union of Conservation of Nature (IUCN) are listed in Table 13: Birds observed during the field survey below.

Table 13: Birds observed during the field survey

Scientific Names	Common Names	Status
Accipiter melanoleucus	Black Sparrowhawk	LC
Acridotheres tristis	Common Myna	LC
Acrocephalus gracilirostris	Lesser Swamp-Warbler	LC
Alopochen aegyptiaca	Egyptian Goose	LC
Amaurornis flavirostris	Black Crake	LC
Anas capensis	Cape Teal	LC
Anas erythrorhyncha	Red-billed Teal	LC
Anas smithii	Cape Shoveler	LC
Anhinga rufa	African Darter	LC
Anthus cinnamomeus	African Pipit	LC
Apus affinis	Little Swift	LC
Ardea cinerea	Grey Heron	LC
Ardea melanocephala	Black-headed Heron	LC
Ardeola ralloides	Squacco Heron	LC
Asio capensis	Marsh Owl	LC
Bostrychia hagedash	Hadeda Ibis	LC
Bradypterus baboecala	Little Rush-Warbler	LC
Bubulcus ibis	Cattle Egret	LC
Burhinus capensis	Spotted Thick-knee	LC
Charadrius tricollaris	Three-banded Plover	LC
Cinnyris talatala	White-bellied Sunbird	LC
Cisticola fulvicapilla	Neddicky	LC



Scientific Names	Common Names	Status
Cisticola juncidis	Zitting Cisticola	LC
Cisticola textrix	Cloud Cisticola	LC
Colius striatus	Speckled Mousebird	LC
Columba guinea	Speckled Pigeon	LC
Columba livia	Rock Dove	LC
Cossypha caffra	Cape Robin-Chat	LC
Cypsiurus parvus	African Palm-Swift	LC
Elanus caeruleus	Black-shouldered Kite	LC
Estrilda astrild	Common Waxbill	LC
Euplectes afer	Yellow-crowned Bishop	LC
Euplectes orix	Southern Red Bishop	LC
Euplectes progne	Long-tailed Widowbird	LC
Fulica cristata	Red-knobbed Coot	LC
Gallinula chloropus	Common Moorhen	LC
Hirundo fuligula	Rock Martin	LC
Jynx ruficollis	Red-throated Wryneck	LC
Lanius collaris	Common Fiscal	LC
Larus cirrocephalus	Grey-headed Gull	LC
Lybius torquatus	Black-collared Barbet	LC
Macronyx capensis	Cape Longclaw	LC
Malaconotus blanchoti	Grey-headed Bush-Shrike	LC
Megaceryle maximus	Giant Kingfisher	LC
Mirafra africana	Rufous-naped Lark	LC
Motacilla capensis	Cape Wagtail	LC
Numida meleagris	Helmeted Guineafowl	LC
Onychognathus morio	Red-winged Starling	LC
Ortygospiza atricollis	African Quailfinch	LC
Passer domesticus	House Sparrow	LC
Passer melanurus	Cape Sparrow	LC
Phalacrocorax africanus	Reed Cormorant	LC
Phylloscopus trochilus	Willow Warbler	LC



Scientific Names	Common Names	Status
Platalea alba	African Spoonbill	LC
Plectropterus gambensis	Spur-winged Goose	LC
Plegadis falcinellus	Glossy Ibis	LC
Ploceus velatus	Southern Masked-Weaver	LC
Porphyrio madagascariensis	African Purple Swamphen	LC
Pternistis swainsonii	Swainson's Spurfowl	LC
Pycnonotus tricolor	Dark-capped Bulbul	LC
Quelea quelea	Red-billed Quelea	LC
Saxicola torquatus	African Stonechat	LC
Scopus umbretta	Hamerkop	LC
Sporaeginthus subflavus	Orange-breasted Waxbill	LC
Spreo bicolor	Pied Starling	LC
Streptopelia semitorquata	Red-eyed Dove	LC
Streptopelia senegalensis	Laughing Dove	LC
Tachybaptus ruficollis	Little Grebe	LC
Telophorus zeylonus	Bokmakierie	LC
Threskiornis aethiopicus	African Sacred Ibis	LC
Trachyphonus vaillantii	Crested Barbet	LC
Upupa africana	African Hoopoe	LC
Vanellus armatus	Blacksmith Lapwing	LC
Vanellus coronatus	Crowned Lapwing	LC
Vidua macroura	Pin-tailed Whydah	LC
Zosterops virens	Cape White-eye	LC

Red Data Birds

No Red Data bird species were identified on site, however, it is possible that Red Data birds do move into the vicinity of the Greenside and Kleinkopje Collieries.

Alien Invasive Birds

Large numbers of the Common Myna (*Acridotheres tristis*) listed as one of the Top 100 World's Worst Invaders by the Invasive Species Specialist Group, have been recorded on site. The species is known to impact negatively upon indigenous fauna by competing with native avifauna and small cavity nesting mammals for nest-hollows and by breaking eggs and eating nestlings.



Reptiles

Only one reptile was identified during the field survey, namely the Striped Skink, however, it is expected that a number of reptiles exist within the Greenside Colliery project area. The expected and identified species are listed in Table 14 below.

Table 14: Expected and identified reptiles at Greenside Colliery, Mpumalanga

Scientific Names	Common Names	Conservation status	Identified
Acontias gracilicauda	Thin-tailed Legless Skink	Endemic	
Aparallactus capensis	Cape Centipede Eater	LC	
Bitis arietans	Puff Adder	LC	
Cordylus vittifer	Transvaal Girdled Lizard	Endemic	
Crotaphopeltis hotamboeia	Herald Snake	LC	
Dasypeltis scabra	Common Egg Eater	LC	
Duberria lutrix	Common Slug Eater	LC	
Elapsoidea sunderwallii	Sundevall's Garter Snake	Endemic	
Gerrhosaurus flaviguaris	Yellow-throated Plated Lizard	LC	
Hemachatus haemachatus	Rinkhals	LC	
Homoroselaps lacteus	Spotted Harlequin Snake	Endemic	
Lamprophis aurora	Aurora House Snake	Endemic	
Lamprophis fuliginosus	Brown House Snake	LC	
Lamprophis guttatus	Spotted House Snake	Endemic	
Leptotyphlops conjunctus	Cape Thread Snake	LC	
Leptotyphlops scutifrons	Peter's Thread Snake	LC	
Lycodonomorphus rufulus	Common Brown Water Snake	Endemic	
Lycophidion capense	Cape Wolf Snake	LC	
Mabuya striata	Striped Skink	LC	Х
Mabuya varia	Variable Skink	LC	
Nucras ornata	Delelande's Sandveld Lizard	Endemic	
Pachydactylus affinis	Transvaal Thick-toed Gecko	Endemic	
Pelomedusa subrufa	Marsh Terrapin	LC	
Philothamnus hoplogaster	Green Water Snake	LC	
Psammophis brevirostris	Short-snouted Grass Snake	LC	
Psammophis crucifer	Montane Grass Snake	LC	



Scientific Names	Common Names	Conservation status	Identified
Psammophylax rhombeatus	Spotted Skaapsteker	LC	
Pseadaspis cana	Mole Snake	LC	
Typhlops bibronii	Bibron's Blind Snake	Endemic	
Varanus albigularis	Rock Monitor	LC	
Varanus niloticus	Water Monitor	LC	

Amphibians

Only one frog was identified during the field survey, namely the common River Frog. It is expected that a large number of amphibians occur within the area, especially in the vicinity of the wetland and other habitat in close proximity to water. The expected and identified species are listed in Table 15 below.

Table 15: Expected and identified amphibians at Greenside Colliery, Mpumalanga

Scientific name	Common name	Conservation status	Identified
Afrana angolensis	Common River Frog	LC	Х
Bufo guttaralis	Guttural Toad	LC	
Cacosternum boettgeri	Boettger's Caco	LC	
Kassina senegalensis	Bubbling Kassina	LC	
Phrynobatrachus natalensis	Snoring Puddle Frog	LC	
Ptychadena porosissima	Striped Grass Frog	LC	
Pyxicephalus adspersus	Giant Bullfrog	NT	
Schismaderma carens	Red-backed Toad	LC	
Semnodactylus wealii	Rattling Frog	LC	
Strongylopus fasciatus	Striped Stream Frog	LC	
Tomopterna cryptosis	Tremolo Sand Frog	LC	
Tomopterna natalensis	Natal Sand Frog	LC	
Xenopis laevis	Common Platanna	LC	

Provincial Conservation Plans

The Mpumalanga Biodiversity Sector Plan 2013 terrestrial biodiversity assessment indicates extensive transformation of habitats in the study area and surrounds, with most of the study area classified as heavily modified – a consequence of mining and cultivation. Only small areas in the north and north east of the study area are classified as Critical Biodiversity Areas (CBA).



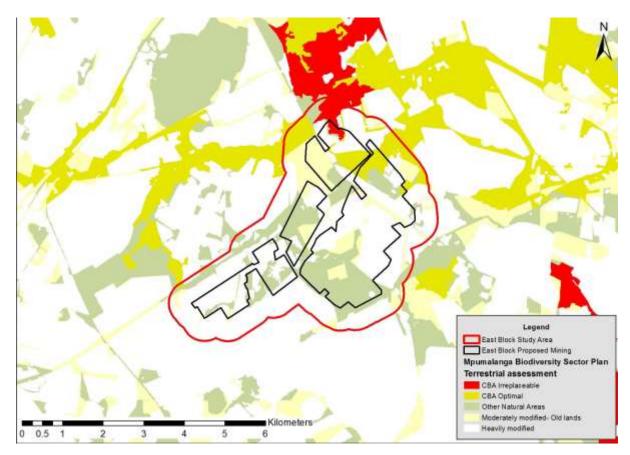


Figure 21: Extract from the Mpumalanga Biodiversity Sector Plan 2013 terrestrial biodiversity assessment.

Chapter G: Surface Water

Water Management Area

Greenside Colliery is situated within the Olifants River water management area. The Mpumalanga Department of Water and Sanitation (DWS) is the responsible water authority.

East Block Underground project is located within the Primary Catchment B and extends across 2 quaternary catchments:

- Catchment B11G is drained by the Olifants River and its tributary the Noupoortspruit; and
- Catchment B11F is drained by the Olifants River and its tributary the Tweefonteinspruit.

The bulk of the proposed mining area is located in catchment B11G.

Freshwater Ecosystem Priority Areas

The Atlas of Freshwater Ecosystem Priority Areas ("FEPA") in South Africa (Nel et al, 2011) (The Atlas) that represents the culmination of the National Freshwater Ecosystem Priority Areas project ("NFEPA"), a partnership between SANBI, CSIR, WRC, DEA, DWA, WWF, SAIAB and SANParks, provides a series of maps detailing strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. FEPA's were identified through a systematic biodiversity planning approach that incorporated a range of biodiversity aspects such as ecoregion, current



condition of habitat, presence of threatened vegetation, fish, frogs and birds, and importance in terms of maintaining downstream habitat.

A number of wetland types are indicated as occurring within the study area:

- · Pan wetland; and
- Seep wetlands.

No wetland FEPA's are indicated as occurring on site or in the immediate vicinity.

Surface Water Hydrology

The mine is situated in the headwaters of the Naauwpoortspruit and drains in a catchment area of 36.51 km². The origin of the Naauwpoortspruit is about 2 km west of the mine. The Naauwpoortspruit flows into eMalahleni Dam some 15 km east of the mine. The Greensidespruit is a tributary of the Naauwpoortspruit, and originates on the mine site. Most of the area contributing runoff to the Greenside catchment lies upstream of the mine complex. The Greensidespruit was diverted in 1983 to flow around the waste dump at Greenside Colliery.

As indicated in the Water Use Licence Application dated 2004 and compiled by Golder Associates, the mean annual runoff for the whole Upper Olifants river catchment was estimated at 122 million m³ per annum. The dry weather flow (April to September) for the Olifants River catchment was calculated at 31, 07 million m³ per annum (26% of the MAR). The corresponding base flow for the Greenside sub catchment is estimated at 0.34 million m³ per annum.

Table 16: Mean annual runoff computed

Location	Area (km²)	Winter base flow (10 ⁶ m ³ / annum)	MAR (10 ⁶ m ³ / annum)
Witbank Dam	3302	31,07	122,14
Naauwpoortspruit	91	0,85	3,08
Greenside Colliery	37	0,34	1,24
Upstream of mine	32	0,30	1,08

Aquatic environment

The following information was extracted from the report titled: *Greenside Colliery Biomonitoring Report* – *March 2018 Survey*, dated March 2018, prepared by Clean Stream Biological Services (Pty) Ltd.

Four water resources were selected for bio-toxicity analyses. These are the Golf Club Dam ("GCD"), Dam 3 ("D3"), Y2K Dam ("Y2K") and Greensidespruit Dam ("GSD") (Table 17; Figure 22).



Table 17: Latitude/Longitude of selected sampling sites for the biomonitoring programme

Monitoring site	Site description	Coordinates	Monitoring protocol
GCD	Golf Course Dam (clean water dam, upstream from potential Greenside Colliery impacts)	S25.96152 E29.16722	Quarterly toxicity testing
D3	Dam 3 (Greenside Colliery pollution control dam)	S25.95166 E29.19127	Quarterly toxicity testing
Y2K (Lake Lucy)	Y2K Dam (Greenside Colliery pollution control dam). Emergency dam, downstream from Lake Lucy.	S25.95251 E29.18589	Quarterly toxicity testing
GSD	Greensidespruit Dam (neighbouring colliery pollution control dam)	S25.97871 E29.18571	Quarterly toxicity testing
Site 3	Naauwpoortspruit, at road crossing, downstream from potential Greenside Colliery impacts.	S25.94513 E29.19838	Annual SASS5 macro- invertebrate monitoring and quarterly toxicity testing





Figure 22: Biomonitoring points at Greenside Colliery



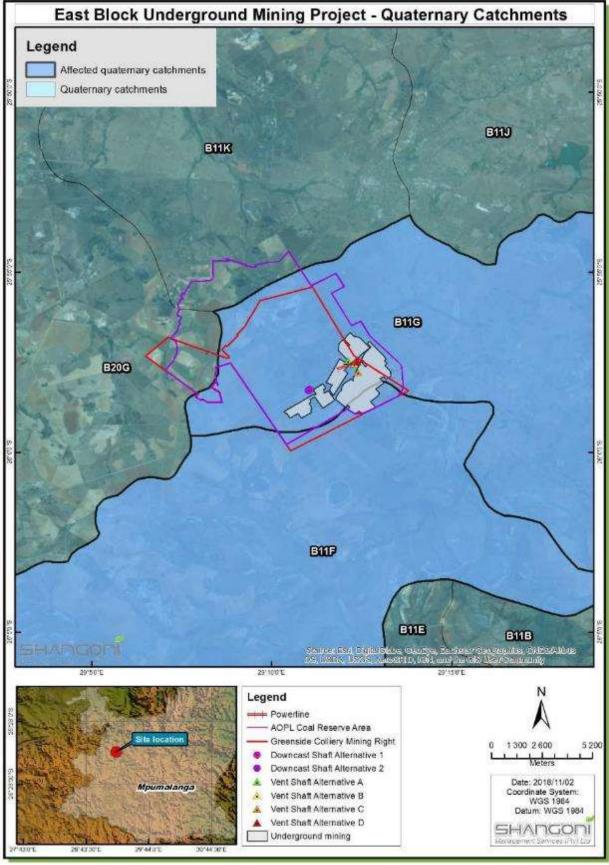


Figure 23: Quaternary catchments associated with the East Block Undermining project



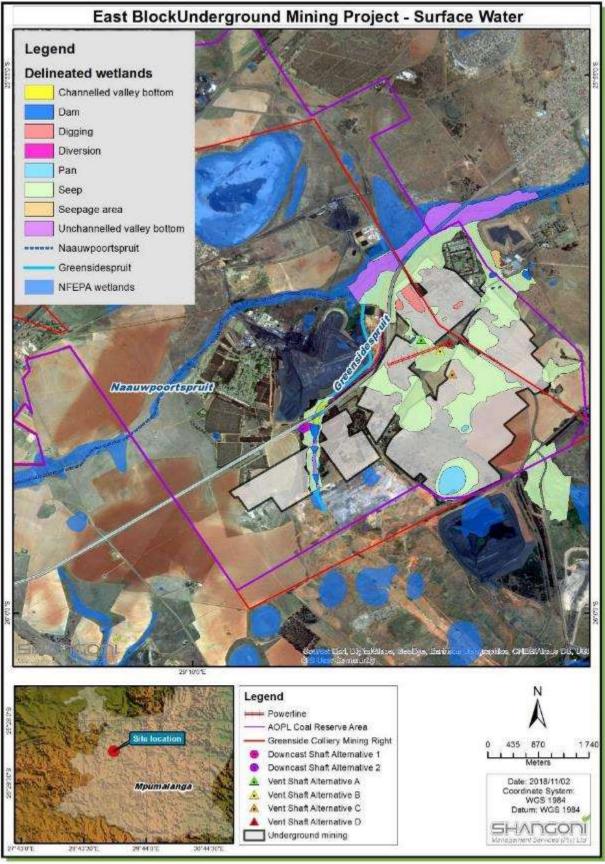


Figure 24: Surface water features associated with the East Block Undermining project



Chapter H: Groundwater

The following information was extracted from the report titled: *Anglo Operations Ltd: Greenside Colliery: Geohydrological investigation as part of undermining of Waterpan and wetlands at 3A North and East Block*, dated 2018 and prepared by Shangoni AquiScience.

Hydrogeology

The permeability and thickness of the unsaturated zone are some of the main factors determining the infiltration rate, the amount of runoff and consequently the effective recharge percentage of rainfall to the aquifer. The type of material forming the unsaturated zone as well as the permeability and texture will significantly influence the mass transport of surface contamination to the underlying aquifer(s). Factors like ion exchange, retardation, bio-degradation and dispersion all play a role in the unsaturated zone.

The thickness of the unsaturated zone was determined by subtracting the undisturbed static water levels in the study area from the topography. Water level measurements showed that the depth to water level, and thus the unsaturated zone, generally varies between 0 and 29 meters below ground level.

Lithologies and geological features that are potentially water bearing in the study area include alluvium, weathered and fractured Karoo rocks and coal and host rock contact zones. The following types of natural groundwater bearing horizons are present:

- Seasonal perched aquifer, also associated with wetlands.
- Weathered horizon (secondary, semi-confined with moderate aquifer potential).
- Regional fractured horizon (secondary, confined/semi-confined & moderate aquifer potential).
- Geological contact zones such as those between volcanic and Karoo rocks.
- Bedding planes and coal seams (moderate aquifer potential).
- Dwyka tillite aquifer (no aquifer potential).

Perched horizon

Wetlands commonly occur in these areas. It is characteristic of shallow perched aquifers that occur in the lower lying areas or depressions where a low permeable, clayey, ferricrete layer is overlain by alluvium and transported hillwash material. The perched aquifer remains unimpacted by underground mining activities where aquitards within a confined to semi-confined aquifer.

Weathered Karoo horizon

A weathered water bearing horizon is defined as groundwater saturated strata which possesses a secondary porosity associated with weathering of rock strata. Weathered horizons are typically confined to semi-confined aquifers. The weathered water bearing horizon may or may not be hydraulically connected with the regional fractured water bearing horizon, depending on the presence, thickness and weathering of confining layers (typically horizontal sills or shale layers). The weathered horizon is typically not regarded as good aquifers but suitable for household supply, with yields ranging between



0.1 and 1.0 l/s. Where the weathered aquifer does become significant is from a pollution transport perspective. This aquifer extends to depths of around 5-20 mbs, depending on the limit of weathering. In the project area, this aquifer is relatively clay-rich, with relatively low aquifer parameters. This aquifer is, therefore, not considered to be a major aquifer, although it can be utilised for household use and plays a role in recharge to the deeper hard-rock aquifers.

The weathering depth varies from 5 to 20 mbs. The weathering profile for this area can be summarised as follows:

- Highly weathered (~5 mbs);
- Weathered (5 10 mbs);
- Slightly weathered (10 20 mbs).

Fractured Karoo horizon (Ecca)

A fractured water bearing horizon is defined as a groundwater saturated stratum displaying secondary porosity due to fracturing. Fractured horizons are common in sedimentary host rock of the Karoo Supergroup. The pores within the Karoo sedimentary rocks are well cemented and are not expected to allow any significant groundwater flow. Therefore, groundwater flow in the sedimentary rocks is expected only along fractures. This horizon is confined but may be semi-confining at places of extreme weathering. The aquifer depth extends from a depth of ±20-100 mbs with limited yields at depth, indicating the absence of major water bearing fractures and low permeability of host rock/s at depth. Aquifer tests within the study area also confirmed this low permeable groundwater zones. The aquifer can be regarded as heterogeneous having a moderate fracture network formed in the consolidated and mostly impervious matrix because of tectonic and depositional stresses. Movement of groundwater is mostly restricted to fracture and aperture flow although the sandstone/shale matrix may also contribute as seepage, albeit very little.

The fractured rock aquifer is a more reliable source of groundwater compared to the weathered zone aquifer although salinity may be somewhat higher due to longer exposure times of the water with the rock. Yields from this aquifer would be sufficient to supply drinking, sanitation and irrigation (small scale) water for a household but would not be sufficient to be exploited for mining related process water. Typical characteristics of the fractured flow aquifer are:

- They are present as either confined or semi-confined aquifers. In the former instance, the aquifer is overlain by sediments or rock of a confining nature, thus limiting direct recharge from rainfall.
- Although deeper fracture flow systems do exist, the quality of the water within the deeper systems is generally not acceptable for human consumption.
- They contain between 0.001 0.1% water by aquifer volume.
- Recharge from rainfall is generally low and totals between 1 --3% of the annual rainfall.
- Characteristics of the aguifer vary greatly over short distances.
- Contaminant transport through fracture flow aquifers is comparatively fast.



- There is hardly any attenuation of pollutants in the fractures.
- Borehole yields from fracture flow aquifers vary greatly within a few metres.

Dwyka horizon

The succession of sedimentary rocks generally overly the well-consolidated glacial tillites of the Dwyka Group, but in places the Ecca Group rocks rest directly on the felsites and granites of the pre-Karoo Basement rocks. The permeability of fresh tillite is generally and widely regarded as very low. The Dwyka tillite may form a separate aquifer but because of its negligible aquifer forming properties it is generally discussed as one with the Ecca aquifer. The aquifer permeability of the Dwyka tillite is estimated to be between 0.0002- and 0.015 m/d. Due to its low hydraulic conductivity, the Dwyka tillite where present, forms a hydraulic barrier between the overlying mining activities and the basal floor.

Pre-Karoo aquifer

The pre-Karoo rocks, consisting mainly of felsites of the Bushveld Igneous Complex, are present below the Dwyka group tillites/diamictite. The Ecca Group rocks do however, at places, rest directly on the felsites and granites of the pre-Karoo Basement rocks. Groundwater is mostly present in very small and low yielding fractures. The pre-Karoo is considered not to be a reliable source of groundwater given its great depth, compactness of the host rock and inability to fracture, inferior quality associated with felsites and granites (mostly fluoride), including low recharge because of the overlying impermeable Dwyka tillite. However, reliable sources of groundwater may be encountered on bedding plane fractures or lithological contact zones.

Hydraulic conductivity

Table 18 provides the hydraulic conductivities that was used and calibrated in the SACE Complex Groundwater Model as generated by Delta H (2016). The initial conductivity values are derived from site specific test literature which were further refined during the model calibration process.

Table 18: Hydraulic conductivities of the SACE Complex Groundwater Model (Delta H, 2016)

Aquifor	Hydraulic conductivity	
Aquifer	m/s	m/d
Weathered Karoo	6x10-6	0.52
Backfilled spoil	2x10-5	1.73
Fractured Karoo (&coal seams)	2x10-7	0.02
Dykes	1x10-9	8.6x10-5
Underground mine workings	1x10-3	86.4

Transmissivity is the product of the aquifer thickness and the hydraulic conductivity (K) of the aquifer, usually expressed as m²/day. Other studies, in areas surrounding the Greenside mining area indicate



that the transmissivity in the fracture zone can vary on average between approximately 1 and 2.0 m²/day. The estimated transmissivity of the matrix is typically less than 0.25 m²/day.

Storativity (or the storage coefficient) is the volume of water that a permeable unit will absorb or expel from storage per unit surface area per unit change in piezometric head. Storativity (a dimensionless quantity) cannot be measured with a high degree of accuracy in slug tests or even in conventional pumping tests. It has been calculated by numerous different methods with the results published widely and a value of 0.002 to 0.01 is taken as representative for the Karoo Supergroup sediments.

Groundwater levels

A hydrocensus survey of boreholes on and surrounding the Greenside boundary was conducted (*Clean Stream Scientific Services*, *2012*) during which all private groundwater were surveyed in vicinity of Greenside. During the hydrocensus, all available details of boreholes and borehole-owners were collected. This information was used to identify the Interested and Affected Parties that may be impacted upon by the activities at Greenside. The hydrocensus boreholes were subjected to water level measurements including chemical analysis to evaluate the chemical characteristics of the groundwater and to establish baseline data.

The hydrocensus conducted by Clean Stream Scientific Services located 62 privately owned boreholes. Most of the boreholes are located in the town of Clewer situated on the western perimeter of Landau Navigation Section while some were surveyed to the south-west of Greenside Colliery. The majority of boreholes are not in use. The positions of the privately-owned boreholes relative to the underground mine voids are shown in Figure 25. Included in the map are Greenside's monitoring boreholes consisting of shallow (weathered and fractured) drilled boreholes.

The water levels for the privately-owned boreholes measured between 0 mbgl and 4.50 mbgl. One (1) borehole, *MOYO01*, were recorded as artesian. Static water levels (not influenced by pumping) ranged between 0 mbgl and 4.47 mbgl with an average of 2.18 mbgl while dynamic (in-use boreholes) water levels ranged between 1.28 mbgl and 4.50 mbgl with an average of 2.95 mbgl.

The water levels for the monitoring boreholes that were drilled into the shallower weathered and/or fractured aquifer (*mine surface boreholes*) typically have water levels ranging between 2.3 and 6.9 mbs while the deeper boreholes drilled into underground mine voids typically have deeper water levels ranging between 26 and 78 mbs.



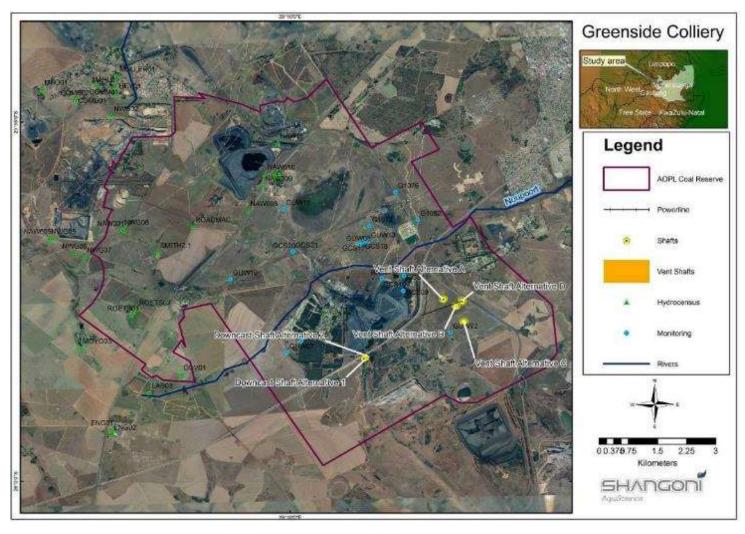


Figure 25: Hydrocensus of privately owned boreholes and Greenside's monitoring boreholes



Groundwater potential contaminants

Pyrite (FeS₂) is generally the major sulphide phase within the Vryheid coal seams; it is the most abundant detrital heavy mineral.

Acid mine drainage (AMD) occurs when sulphide minerals, such as pyrite (FeS₂), are exposed to air and water and undergo oxidation. This occurs primarily in coal (and gold) mines. After air contact in the presence of sulphide (mostly pyrite) this water is often acidic, because of sulphide oxidation that forms sulphuric acid, and cannot be used for any regular uses such as irrigation and requires treatment before discharge. The production of AMD depends on the rate of pyrite/sulphide oxidation, the presence of acidophilic bacteria and the influence of carbonate minerals in the host rock. Moreover, upon infiltration by rainwater, mine spoil heaps leach highly acidic acid mine drainage that mobilizes toxic metal species and contaminates groundwaters. AMD has a pH of about 2 and a total dissolved solids (TDS) in the order of 4000- 5000 mg/l. Acidification has several negative consequences and most notably includes the solubilisation of a variety of trace metals and metalloids in toxic concentrations. Sulphate is also present at unacceptably high concentrations. As AMD has the potential to impact significantly on surface and groundwater quality, it is necessary to quantify acid generating capability of ore to be mined as well as any overburden, interburden or other mine residue deposit. This is typically done through static or kinetic tests including acid-base-accounting, nett acid generation tests, sulphur speciation assays, etc.

Acidic water has been found associated with many mine wastes including underground flows, mine decant and mine reside deposits. During the oxidation process of sulphide ores, the sulphidic component (S_2^-) in pyrite is oxidised to sulphate (SO_4^{2-}) ; acidity (H^+) is generated in the process and ferrous iron (Fe^{2+}) ions are released. The following reaction steps show the general accepted sequence of pyrite oxidation (Stumm and Morgan, 1996):

Acidity (H⁺), Fe²⁺ and SO₄ are released into the water when the mineral FeS₂ is exposed to water and oxygen:

$$FeS_2(s)+3.5O_2+H_2O \rightarrow Fe^{2+}+2SO_4^{-2}+2H^+$$

2 The highly soluble Fe²⁺ species oxidise to relatively insoluble Fe³⁺ in the presence of oxygen – the reaction is slow but is increased by microbial activity:

$$Fe^{2+}+0.25O_2+H^+ \rightarrow Fe^{3+}+0.5H_2O$$

3 Fe³⁺ is then hydrolysed by water (at pH >3) to form the insoluble precipitate ferrihydrate $Fe(OH)_3(s)$ (also known as yellow-boy) and more acidity:

$$Fe^{3+}+3H_2O \rightarrow FeOH_3(s)+3H^+$$

4. In addition to reacting directly with oxygen, FeS₂ may also be oxidised by dissolved Fe³⁺ to produce additional Fe²⁺ and acidity:

$$FeS_2(s)+14Fe^{3+} \rightarrow 15Fe^{2+} + 2SO_4^{2-} + 16H^+$$

Reaction 4 uses up all available Fe³⁺ and the reaction may cease unless more Fe³⁺ is made available (Appelo and Postma, 1999). Reaction 2, the re-oxidation of Fe²⁺, can sustain the pyrite oxidation cycle



(Nordstrom and Alpers, 1999). The rate determining step is the oxidation of Fe²⁺ to Fe³⁺ (reaction 2), usually catalysed by autotrophic bacteria.

The overall reaction as given by Nordstrom and Alpers (1999) is:

$$FeS_2(s)+3.75O2 + 3.5H2O \rightarrow Fe(OH)_2(s) + 2SO_4^{2-}+4H^+$$

Acidity (H⁺), Fe and SO₄²⁻ are the end products of the above reactions. Reaction (1) is an abiotic process occurring at a pH >4.5 due to spontaneous oxidation of the pyrite. Process (2) is the transformation of Fe²⁺ to Fe³⁺. This is an abiotic process when pH is >4.5, but slows down and becomes biotic at pH <4.5. At a pH below 2.5 the biotic process is most prominent. Reaction (3) produces ferric hydroxide (yellow boy), and further lowers the acidity by releasing protons (H⁺). The Fe³⁺ oxidises the pyrite in reaction 4 even when oxygen in absent.

Process (2) is the rate limiting process in this mechanism. This process requires oxygen, therefore, the prevention of oxygen ingress and the creation of reducing conditions within the workings is crucial to slow down the oxidation of pyrite and the resulting low pH conditions. However, if the reaction has proceeded past reaction 2 to where Fe³⁺ is produced oxygen is no longer required for the reaction to continue. Fe³⁺ will continue to oxidise the pyrite releasing Fe, SO₄ and acidity until all the pyrite, or other sulphidic mineral, has been oxidised.

The contaminant generation potential is pronounced where the source minerals of contaminants are in direct contact with water and oxygen underground. Sulphides are the main minerals which react and contribute to the formation of AMD. Mining sections that are not in contact with groundwater flow paths i.e. flooded or stagnant sections are unlikely to contribute to AMD formation. AMD formation may be enhanced and continue at high rates if there are active flow paths through sections. Where water is flowing through moist sections, ideal conditions for sulphide mineral oxidation exist.

Many sulphide ores have a mixture of sulphide minerals such as pyrrhotite (FeS), arsenopyrite (FeAsS), chalcopyrite (CuFeS₂), galena (PbS), cobaltite (CoAsS), gersdorffite (NiAsS) and millerite (NiS). If pyrite is dominant it initiates acid formation resulting in leaching of metal sulphides and oxides. The result of AMD is, therefore, a mixture of very acidic pH, high SO₄ and soluble and precipitated Fe including toxic heavy or trace metals, metalloids and/or radionuclides in solution (Nordstrom and Alpers, 1999). Sulphidic waste rock dumps and tailings dams are proposed to be the major sources of AMD. This is due to their sheer volume, porosity and surface to volume ratios increased by mining and blasting.

Underground mining takes place when the coal seams are too deep to be able to afford to remove the overburden. Typically, this occurs when the coal seam is >40 m deep. The deposit is mined by extracting square "rooms" about 10 m wide and leaving behind pillars to hold up the roof. The pillars also represent a large surface area, and sulphur compounds in the coal can be slowly oxidized and hydrated by water as the compartment/s fill up with water, and so give rise to AMD. Fortunately mines in the Witbank coalfields are below the local groundwater level, and once the mines are abandoned and fill up with water, air cannot reach the coal and acid production stops.



The generation, release, mobility and attenuation of AMD are complex processes governed by a combination of physical, chemical and biological factors. Whether it ultimately enters the environment depends largely on the characteristics of the sources, pathways and receptors involved. A generalised conceptual model of sources, pathways and receiving environments is shown in

Figure 26. The sources include the mine and process wastes and mine and process facilities that contain reactive sulphide and potentially neutralising minerals involved in mitigation of acidity. The characteristics and relative abundance of these sulphide minerals, which play a critical role in determining the nature of the discharge being generated, may vary as a function of commodity and ore deposit type, type of mining and waste disposal strategy. The pathways and transport mechanisms are related to climate and seasonal effects and its hydraulic characteristics. The receptors (i.e., the receiving environment) may also alter the nature of the mine drainage. Examples of receiving environments include groundwater, surface water and wetlands. Al of these receiving environments can alter the original characteristics of the mine discharge through a combination of physical mixing, chemical and biological reaction.

AMD when generated is very difficult and costly to remediate and once the process has succeeded past reaction 2 and has precipitated Fe^{3+} , oxygen is no longer the rate limiting step since Fe^{3+} can chemically oxidise FeS_2 in the absence of oxygen - the AMD reaction sequence will, therefore, continue until all the FeS_2 has been oxidised. It is, therefore, important to mitigate and have effective management measures in place to control or prevent AMD generation at the source.

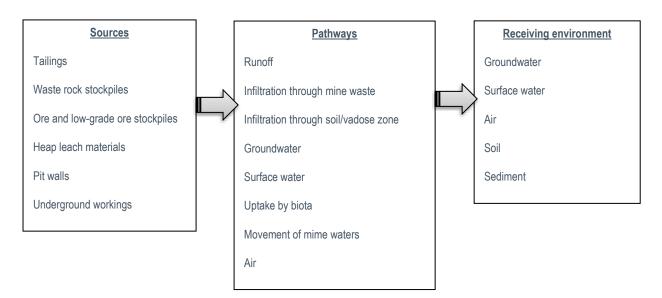


Figure 26: Generalised conceptual model of sources, pathways and receiving environment at a mine or processing site

Groundwater quality

Groundwater quality of privately owned boreholes

The following general remarks can be made with regards to the groundwater quality for the privately owned surveyed boreholes (as recorded by *Aquatico*, 2012):



- The privately used groundwater is of good quality and fit for human consumption.
- The groundwater qualities indicate no/little impact from coal mining activities.

Groundwater quality of Greenside shallow/surface monitoring boreholes

The following general remarks can be made with regards to the groundwater quality for the shallow/surface monitoring boreholes at Greenside (*Groundwater Complete*, 2015):

- Monitoring information display clear impacts from mining activities, especially downgradient of the co-disposal facility and the pollution control dams.
- Elevated sulphate concentrations together with a decrease in pH indicate the presence of acidmine drainage reactions.
- Groundwater quality in the Greenside mining area, especially downgradient of the Greenside dump and PCD's is of poor quality.
- During the 2015 monitoring year, elevated sulphate concentrations confirm impacts from the coal mining activities.
- Magnesium, manganese, iron and calcium concentrations often exceeded Class 1 standards for domestic use.
- Most monitoring boreholes plot in field 5 of the Expanded Durov diagram, which represents groundwater dominated by sulphate and clearly impacted on by the coal mining activities.

This water quality is expected in the mining area and the important factor is to ensure that water management is such that the affected water is not released into the receiving environment through discharge, decant or even plume movement but remain within the closed affected water circuit.

Groundwater quality of Greenside underground workings

Figure 27 and Figure 28 show long-term pH and sulphate (SO₄) concentrations monitored in underground workings at five boreholes in the 1 Seam and 2 Seam workings at Greenside Colliery (data from Groundwater Complete, 2015 and referenced by Delta H, 2016). The following comments apply to the water quality datasets (from Groundwater Complete, 2015):

- The pH generally lies in the range 6 to 8 (mean 6.6).
- GUW07 and GUW02 have higher sulphate concentrations than the other boreholes and there is considerable variation in concentrations.
- Evidence of the beginning of acid mine drainage reactions can be observed.
- The qualities in the majority of the boreholes are marginal to poor.
- The expanded Durov and Stiff diagrams confirm the domination of sulphate in the qualities of only GUW02, 05, 07, 11 and G1076.
- Average groundwater levels vary between 30 and 80 meters below surface.



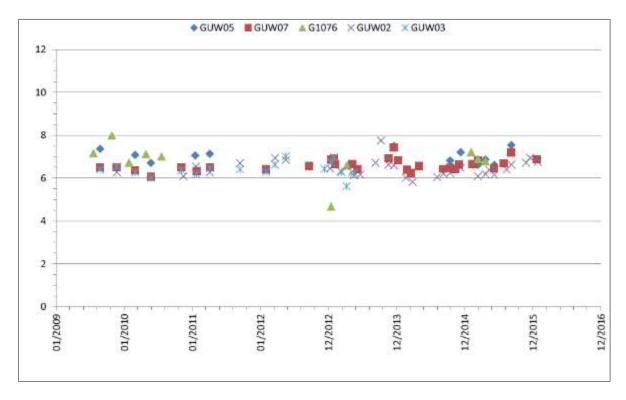


Figure 27: Underground water pH in 1 Seam and 2 Seam at Greenside (from Delta H, 2016)

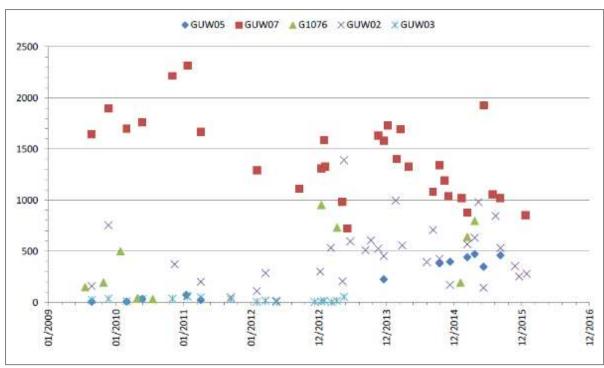


Figure 28: Underground water sulphate (SO₄) in 1 Seam and 2 Seam at Greenside (from Delta H, 2016)



Chapter I: Air Quality

The following information was extracted from the report titled: *Anglo American Operations: Greenside Colliery – Integrated Air Quality Management Plan*, dated April 2017 and prepared by WSP Environment and Energy South Africa.

On 4 May 2007 the Minister of Environmental Affairs and Tourism formally declared the eastern part of Gauteng and the western part of Mpumalanga an air pollution hotspot, to be known as the "The Highveld Priority Area", a national air pollution hotspot in terms of Section 18(1) of the National Environmental Management: Air Quality Act (Act No. 39 of 2004). By declaring a priority area, authorities recognise that air quality within these areas is generally regarded as being poor, and frequently exceed ambient air quality standards (DEA, 2010).

The Highveld Priority Area extends from the eastern parts of Gauteng, to Middelburg in the north and the edge of the escarpment in the south and east. Major towns occurring within this region include Emalahleni (Witbank), Middelburg, Secunda, Standerton, Edenvale, Boksburg, Benoni and Balfour. The area incorporates portions of the Gauteng and Mpumalanga Provinces. The area is contained within one metropolitan municipality (Ekurhuleni) and three district municipalities (Sedibeng, Gert Sibande and Nkangala) and more specifically nine local municipalities: Lesedi Local Municipality (Sedibeng); Govan Mbeki Local Municipality (Gert Sibande); Dipaleseng Local Municipality (Gert Sibande); Lekwa Local Municipality (Gert Sibande); Msukaligwa Local Municipality (Gert Sibande); Pixley ka Seme Local Municipality (Gert Sibande); Delmas Local Municipality (Nkangala); Emalahleni Local Municipality (Nkangala); and Steve Tshwete Local Municipality (Nkangala).

The Greenside Colliery is located in the Emalahleni Local Municipality in the Nkangala District and, therefore, falls within the boundaries of the Highveld Priority Area. This implies that authorities may impose measures on Greenside Colliery and other mines and industries within this area in order to improve on in air quality in the region.

Potential air pollution sources within the Emalahleni local municipality, surrounding the Greenside Colliery include: coal fired power stations; coal mining operations; domestic fuel burning; biomass burning (during late winter and early spring); agricultural activities; vehicular emissions; and emissions from industries in Emalahleni and surrounding towns (Figure 29).

To the north of Greenside is an industrial area with numerous large industries, which borders Kwa-Guqa. On the southern side of the N4, north of the colliery, the largest industries in the area are Evraz Highveld Steel and Trans Alloys. To the south and east of the colliery is the Anglo Thermal Coal Kleinkopje Colliery, while to the north and west is the Anglo Thermal Coal Landau Colliery. All of these industries potentially contribute emissions to the ambient air. Numerous large industries are also located to the east of Greenside, with the largest being the brick works and Duvha Power Station. In addition to the industries, numerous road networks exist in close proximity to Greenside, potentially contributing high levels of NOx, SO₂ and PM10 to the ambient air. Domestic fuel burning results in high particulate matter emissions, with the main domestic fuel burning areas located to the north of Greenside (Kwa-Guqa informal residential area). Due to the close proximity of Greenside to Emalahleni, emissions



associated with Emalahleni will potentially disperse towards Greenside, with sources including vehicles and small industries.

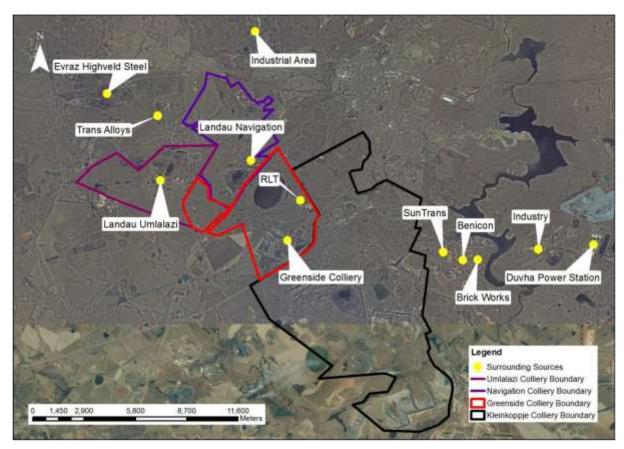


Figure 29: Neighbouring sources within the vicinity of Greenside Colliery

In addition to the above mentioned neighbouring sources, numerous areas of exposed lands (agricultural land) and unpaved roads exist surrounding the Greenside Colliery, all contributing high levels of particulate matter emissions to the ambient air.

Dust fallout monitoring at the Greenside Colliery commenced in March 2000. Dust fallout monitoring units were installed at locations within the Greenside Colliery property boundary, in the residential areas surrounding the mining areas. Descriptions and location of these units is presented in Table 19.

A summary of monthly dust fallout for 2017, obtained from the Air Quality Monitoring Report for Greenside Colliery dated December 2017 and compiled by WSP, is presented in Figure 31 and Table 19 below.

Table 19: Dust Fallout monitoring locations and installation dates

Site	Site ID	Classification	Date Commissioned	Date Decommissioned	
Pine Avenue	GNR 01	Residential	March 2000	On going	
South / East village	GNR 02	Residential	March 2000	On going	
Weir / Highway	GNR 03	Residential	March 2000	On going	



Site	Site ID	Classification	Date Commissioned	Date Decommissioned	
Hostel Kitchen	GNR 04	Residential	March 2000	On going	
Shaft	GNR 05	Industrial	April 2002	December 2003	
Ke Nako 01	GNR 06	Industrial	February 2010	May 2012	
Ke Nako 02	GNR 07	Industrial	February 2010	May 2012	
Ke Nako 03	GNR 08	Industrial	February 2010	May 2012	

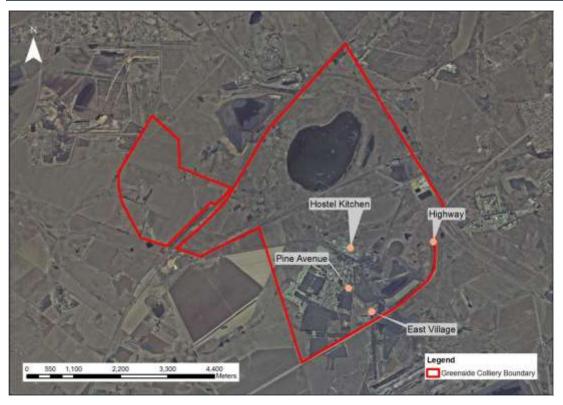


Figure 30: Location of dust fallout monitoring units at the Greenside Colliery

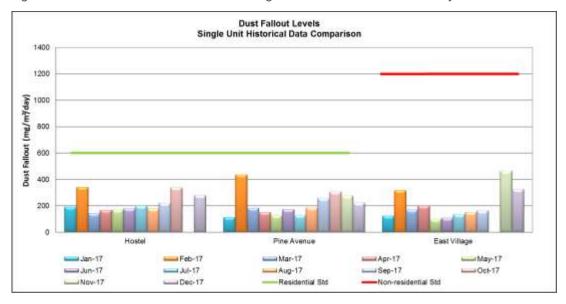


Figure 31: Historical dust fallout results for the past twelve months



Table 20: Dust fallout results for 2017

Dust Fallout (mg/m2/day)									Osmalisat					
Sample Location Classifi	Classification	assification Jan-	Feb- 17	Mar- 17	Apr- 17	May- 17	Jun- 17	Jul- 17	Aug- 17	Sep-	Oct- 17	Nov- 17	Dec- 17	Compliant (2017)
Hostel	Residential	1921	3402	142	168	171	179	1993	177	2224	339	277	280	Yes
Pine Avenue	Residential	1131	4372	183	150	130	172	1313	187	2584	306	466	224	Yes
East Village	Non-residential	1241	3192	169	201	99	108	1353	151	1644	-	221	325	Yes
Pine Avenue N	Residential	1341	3062	20	41	39	85	-	-	-	265	230	406	Yes
Pine Avenue S	Residential	3071	4592	138	61	118	106	-	-	-	389	401	241	Yes
Pine Avenue E	Residential	1511	4382	53	65	62	74	-	-	-	310	371	290	Yes
Pine Avenue W	Residential	771	3592	144	24	81	137	-	-	-	362	293	220	Yes
East Village N	Non-residential	1901	4812	96	150	71	108	893	182	2114	-	249	473	Yes
East Village S	Non-residential	1451	4502	129	73	86	122	1583	174	2504	-	217	206	Yes
East Village E	Non-residential	1541	6652	99	76	107	123	1223	172	-	-	194	211	Yes
East Village W	Non-residential	1241	4882	85	78	95	123	1223	192	3114	-	266	125	Yes
Notes:	1		1	1	1						1			

Notes:

(1) 56 days of exposure

(2) 14 days of exposure

(3) 35 days of exposure

(4) 36 days of exposure



Chapter J: Noise

Although there are agricultural activities to the west of the prosed site the study area is characterised by the presence of major exiting noise sources. There are major coal mining activities at Kleinkopje in the south, Greenside Colliery in the north and Landau I the East. The N12 highway, which crosses the area immediately to the North of the proposed site, carries a large amount of traffic. This includes a very significant amount of heavy vehicles. Other busy roads crossing the area are the R547, the road connecting the R544 and the R547 past Kleinkopje, and the road leading from Kleinkopje, past Landau village to Clewer. Residential areas consist of villages associated with the mines of the area.

Chapter K: Archaeology and Cultural History

Heritage Resources

A brief overview of pre-historical and historical information can be obtained from the document titled: A Phase 1 Heritage Impact assessment (HIA) study for Anglo Operations Limited Greenside Colliery's new Discard Facility near eMahlahleni on the Eastern Highveld in the Mpumalanga Province, dated November 2014, and performed by Dr. Julius Pistorius contextualises the Eastern Highveld and the study in particular. This information is necessary to understand the meaning and significance of heritage resources which may exist in the study area. The Phase I HIA study for the proposed study area revealed two graveyards located within the study area.

Table 21: Coordinates for graveyards near the study area

Graveyards	Coordinates
GY01.Graveyard with two visible graves of the Ntuli family near Eskom's power lines. Older than sixty years.	25° 58.734'S 29° 12.911'E
GY02. Located near a disturbed area where earlier mine infrastructure may have existed. Older than sixty years. Approximately 9 graves.	25° 57.426'S 29° 12.135'E

Both graves are fitted with cement headstones. Inscriptions on the headstones read as follow:

- 'Mss SAR Ntuli Ilangalo Kuealwa Lekufa 25-11-37 Jesus Christ Church.'
- 'Mr De Vidi Ntuli Ilangalo Zalwa 27-05-41 Jesus Christ Church.'

Graveyard (GY01) is located near Eskom's power lines south of the study. At least two graves of members of the Ntuli family are visible. It is possible that more graves may exist as they may be undecorated and also covered with vegetation. GY01 is older than sixty years.





Figure 32: GY01 is located near Eskom's power lines and hold the remains of two members of the Ntuli family.

Graveyard 02 (GY02) is demarcated with a fence and is located on the edge of former mining activities to the north-east of the project area. It holds at least nine visible graves of which the majority are those of children. More unmarked graves may exist.

Some of the graves are fitted with cement headstones with no inscriptions. One of the graves is fitted with a piece of iron plate with holes punched in the plate which spell out the following name:

• 'Seliena Mogidi Gemsbokspruit'

It is highly likely that all the graves in GY02 are older than sixty years.



Figure 33: GY02 is demarcated with a fence and holds at least nine partly decorated graves. Most of the graves belong to children.



Paleontological Resources

A paleontological study is generally warranted where rock units of low to very high palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large scale projects with high potential heritage impact are planned; and where the distribution and nature of fossil remains in the proposed area is unknown.

A Palaeontological Impact Assessment (PIA) was conducted by Dr. Fourie titled: *Greenside Colliery New Discard Facility, eMalahleni Local Municipality, Mpumalanga Province, Farm: Portion 0, 2 and 3 Groenfontein 331JS, Palaeontological Impact Assessment: Phase 1 Field study, dated November 2014, to document resources in the study area and identify both the negative and positive impacts that the project brings to the receiving environment. The PIA therefore identifies palaeontological resources in the area to be developed and makes recommendations for protection or mitigation of these resources.*

According to the above mention study formations present are part of the Karoo Supergroup. The Karoo Supergroup is renowned for its fossil wealth. The Vryheid Formation (Pe,Pv), Ecca Group is rich in plant fossils such as the Glossopteris flora represented by stumps, leaves, pollen and fructifications. This formation is early to mid-Permian in age and consists of sandstone, shaly sandstone, grit, conglomerate, coal and shale. Coal seams are present in the Vryheid Formation within the sandstone and shale layers. Fossils are mainly present in the grey shale which is interlayered between the coal seams.



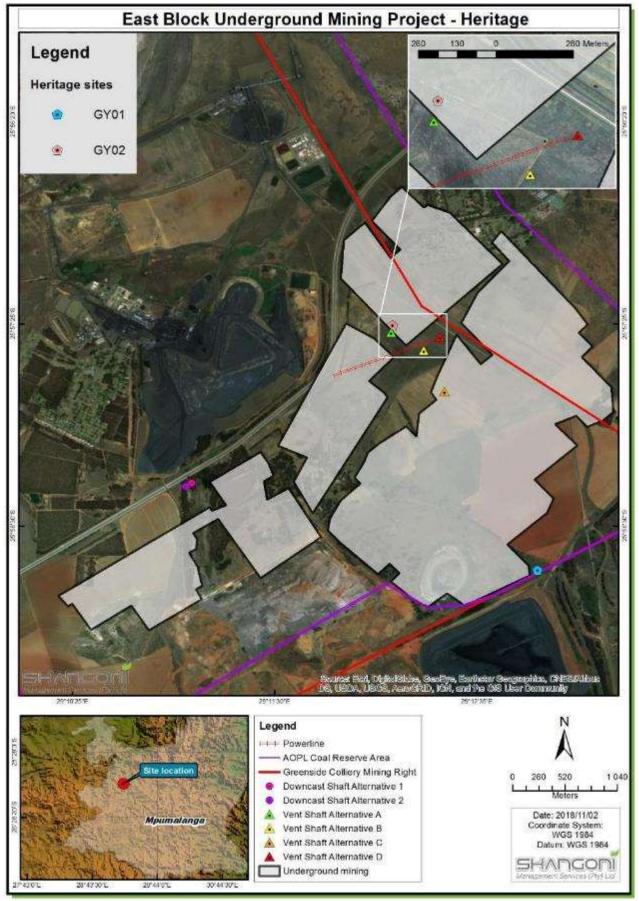


Figure 34: Heritage Resources associated with East Block Underground Mining project



Fossils in South Africa mainly occur in rocks of sedimentary nature and not in rocks from igneous or metamorphic nature. Therefore, if there is the presence of Karoo Supergroup strata the palaeontological sensitivity is generally low to very high.

The Ecca Group may contain fossils of diverse non-marine trace, *Glossopteris* flora, mesosaurid reptiles, palaeoniscid fish, marine invertebrates, insects, and crustaceans (Johnson 2009). *Glossopteris* trees rapidly colonised the large deltas along the northern margin of the Karoo Sea. Dead vegetation accumulated faster than it could decay, and thick accumulations of peat formed, which were ultimately converted to coal. It is only in the northern part of the Karoo Basin that the glossopterids and cordaitales, ferns, clubmosses and horsetails thrived (McCarthy and Rubidge 2005).

The Glossopteris flora is thought to have been the major contributor to the coal beds of the Ecca. These are found in Karoo-age rocks across Africa, South America, Antarctica, Australia and India. This was one of the early clues to the theory of a former unified Gondwana landmass (Norman and Whitfield 2006).

Fossils likely to be found in the study area are mostly plants such as 'Glossopteris flora' of the Vryheid Formation refer to Figure 37 below. The aquatic reptile Mesosaurus and fossil fish may also occur with marine invertebrates, arthropods and insects. Trace fossils can also be present (Johnson 2009).



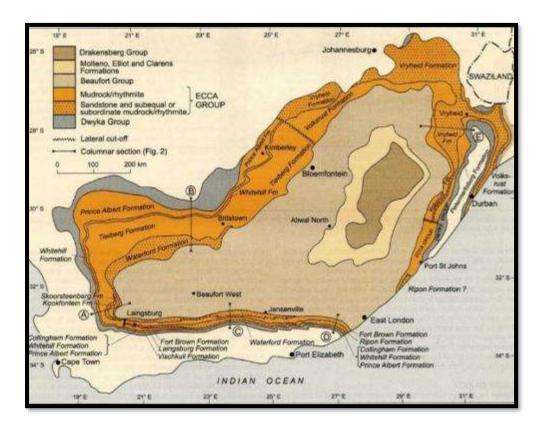


Figure 35: Map from Johnson (2009) to show extent of the Ecca Group, more specifically the Vryheid Formation.

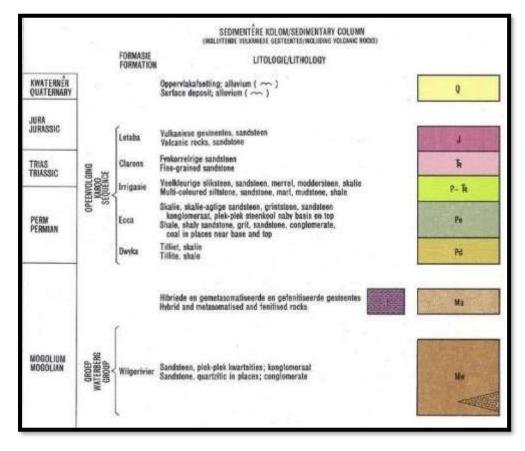


Figure 36: Lithostratigraphic column to show the Ecca Group within the Karoo Supergroup.



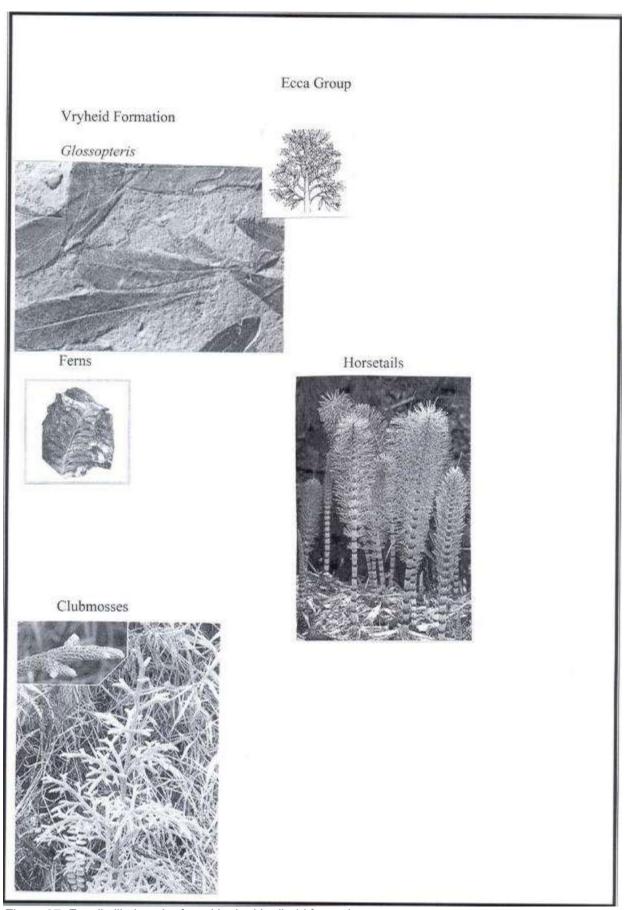


Figure 37: Fossils likely to be found in the Vrydheid formation



Chapter L: Sensitive Landscapes

Within the study area, three different hydro-geomorphic (HGM) wetland types were identified, namely:

- · Seep wetland;
- Channelled Valley Bottom wetland;
- Unchannelled Valley Bottom wetland; and
- Pan wetland.

Seep wetlands were by far the most common and extensive wetland type on site, making up more than 87 % of the delineated wetland habitat and covering over 19 % of the surface area within the study site.

Several small farm dams were also identified covering a total of 6.66 hectares. Man-made wetland areas, including a stream diversion and a seepage area adjacent to the Landau III Dump cover a further 7.5 ha. The wetlands within the study area cover approximately 399.2 hectares, or 22 % of the study area (study area covers 1 816 ha). The delineated wetland areas are illustrated in the map below, while Table 22 provides information on the actual extent of the wetlands. Each of these wetlands is described in greater detail below.

Table 22: Summary of the different wetland types and habitats recorded within the study area. Wetland Type Area (ha) % of wetland area % of study area

Wetland Type		Area (ha)	% of wetland area	% of study area
Channelled bottom	valley	2.63	0.7%	0.1%
Unchannelled bottom	valley	30.71	7.7%	1.7%
Seep		349.04	87.4%	19.2%
Pan		16.81	4.2%	0.9%
TOTAL		399.20	100.0%	22.0%
Dam		6.66		0.4%
Diversion		4.57		0.3%
Seepage area		2.89		0.2%



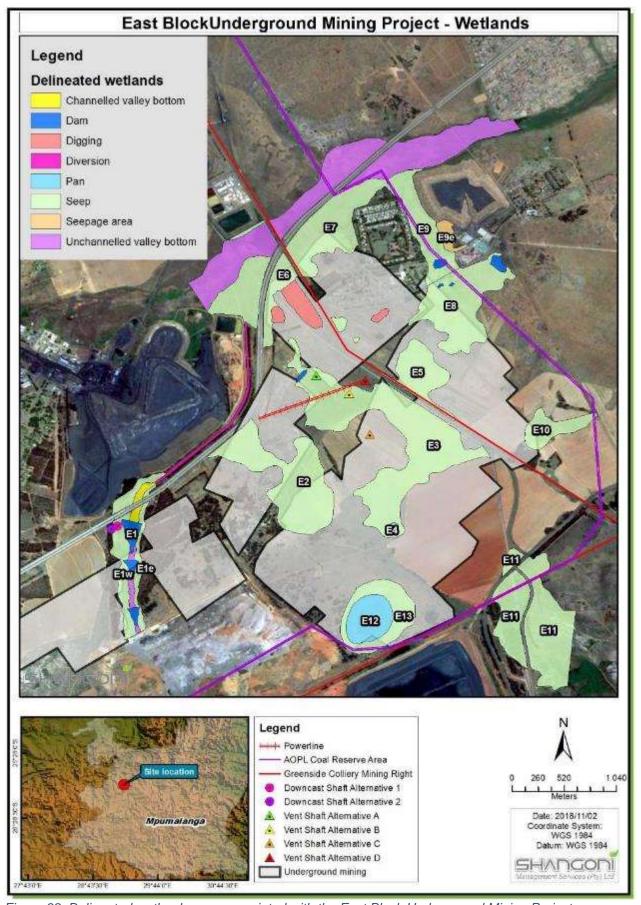


Figure 38: Delineated wetland areas associated with the East Block Underground Mining Project



E1 - Channelled Valley Bottom with Seep wetland

Wetland system E1 consists of a Channelled Valley Bottom wetland with adjacent Seep wetlands along the footslopes of either bank. The upper reach of this wetland system and its upper catchment have been previously opencast mined, with the opencast pit only partially rehabilitated. As such this wetland system receives not flow from upstream.

The Channelled Valley Bottom wetland is generally weakly channelled within the study area and drains in a northerly direction, forming a tributary of the Noupoortspruit. 3 dams have been constructed across the wetland. At the time of the site visit, the upper most dam was dry (no surprise, as not upstream flows enter the wetland), with the lowest dam storing the largest volume of water. In addition to the loss of flow from upstream, flow within this wetland is further reduced by extensive stands of alien vegetation flanking the wetland, mostly Eucalyptus trees. Downstream of the N12, this wetland enters a diversion around a large discard dump, before entering the Noupoortspruit.

The eastern Seep wetland represents a narrow footslope seep and is completely dominated by alien trees (*Eucalyptus sp.*) with no natural habitat remaining. The trees have resulted in significant drying out of the wetland.

A further Seep wetland occurs along the western bank of the Channelled Valley Bottom Wetland, though this wetland is wider than the eastern Seep wetland. Although alien trees again occur along the wetland margin, the bulk of the wetland is characterised by a grass/sedge mosaic. The wetland is seasonal in nature, being maintained by sub-surface seepage derived from the adjacent terrestrial soils.



Figure 39: Photographs of wetland habitat associated with the Channelled Valley Bottom wetland and Seep wetlands of wetland E1. The bottom right photo shows the upstream opencast mining and remaining void preventing any upstream flow from entering the wetland.



E2 - Seep wetland

This Seep wetland drains in a north-westerly direction towards the N12 and eventually into the stream diversion to the north of the N12. The wetland covers 52 hectares. The wetland appears impacted by historical mining activities, specifically within the central regions where the wetland narrows. The 1:50 000 topographical maps indicate opencast mining in the central area of the hillslope seepage wetland (where the narrow constriction of the system occurs) as well as a shaft area in the complex. These activities have impacted significantly on habitat integrity of the wetland.

A large excavated trench enters the wetland from the south just upslope of the historical mining disturbance. The trench runs northwards, before turning to the north east in the centre of the wetland. The purpose of the trench and associated shallow berm could not be determined on site, as the trench appeared to slope upwards out of the wetland in both directions, i.e. the trench did not convey flow out of the wetland.

Upslope of the trench cultivated fields extend into the Seep wetland, with roughly 13 ha of the wetland habitat currently under maize cultivation.

In addition to the disturbances already listed, scattered alien trees occur within the wetland, mostly along the margins, while a number of small roads and tracks also cross the wetland habitat.

E3 - Seep wetland

Wetland unit E3 has also been classified as a Seep wetland. This is a very large expanse of temporary to seasonal wetland habitat that drains in a north-north westerly direction towards the N12, but peters out before reaching the N12. The wetland unit covers 92 hectares.

The central reaches of the wetland are currently cultivated, with cultivated fields occupying roughly 45 hectares or 50 % of the wetland habitat. The presence of several shallow contour drains running perpendicular to the contour (i.e. running directly downs the slope) within the cultivated fields seem to suggest attempts to partially drain the wetland and make the soils more suitable for cultivation. Upslope and downslope of the cultivated fields the wetland is characterised by more natural vegetation.

Immediately downstream of the cultivated fields the wetland is at its wettest and is considered to be seasonal in nature, i.e. soil saturation occurs on an annual basis for an extended period during the rainfall season. The large trench referred to under wetland E2 above also traverses this wetland (see also photos in Figure 40). The trench runs diagonally across the wetland roughly from southwest to northeast, before turning northwest near the eastern boundary of the wetland. Once again the purpose of the trench and associated shallow berm was not apparent. Within the wetland the trench was filled with water at the time of the site visit, which coincided with the middle of winter. Water within the trench was assumed to reflect intercepted seepage through the wetland sediments, supporting the notion of extended seasonal saturation of this section of the wetland.

A shallow water-filled excavation was observed near the bottom end of the wetland. The wetland habitat ends within a disturbed area that has been subjected to past excavations. This area is indicated on the 1:50 000 topographical maps as "Diggings", and is rather extensive, extending across the full width of the wetland and beyond. It is not clear whether these past excavations have resulted in the loss of



wetland habitat and whether these excavations are the reason for the wetland habitat petering out in this area.



Figure 40: Photos of wetland habitat associated with Seep wetland E3. Note the larger water-filled trench and extensive cultivation in upper reaches of the wetland.

E4 - Pan wetland

This Pan wetland covers less than 1 ha and is located within the Seep wetland of wetland unit E3. The wetland occurs as a shallow, poorly defined depression within the greater Seep wetland and was characterised by tall, dense grass cover. Shallow water remained in the Pan during the site visit on 24 July 2017. The pan is expected to be seasonal in nature, being supported by direct rainfall and interflow.



Figure 41: Photos of the Pan wetland E4.



E5 – Seep wetland

This Seep wetland is in essence a continuation of the Seep wetland E3, being separated from E3 only by the public tar road and adjacent coal conveyor. A landing strip also traverses the wetland.

The wetland, which extends over 19.6 hectares, is mostly cultivated, with cultivated fields covering 13 ha. At the time of the site visit these cultivated lands were fallow but appeared to have been ploughed in the previous season.

The wetland is temporary in nature and can be described as very marginal wetland habitat. Saturation of the soil profile is likely to occur only following high rainfall periods, with saturation also being somewhat patchy, resulting in a mosaic of wetland and terrestrial areas. The vegetation within the wetland reflects this, being characterised more by species associated with disturbance rather than typical wetland species.

At least one hole in the ground was observed within the wetland that appears to be surface subsidence. This could however not be confirmed.

E6 – Seep wetland

Wetland E6 covers 10 hectares and consists of a Seep wetland draining into the Noupoortspruit wetland system to the north, though the affected wetland is separated from the Noupoortspruit by the N12 highway. The wetland is located downslope of a number of historical excavations, including the excavation located at the downslope end of wetland E3. It is therefore possible that wetland E3 and E6 were connected in the past, prior to the excavation impacts.

Numerous disturbances associated with historical mining activities and ongoing agricultural activities have impacted on this wetland, while a number of linear infrastructures (including a public tar road, a coal conveyor and a long trench) also impact the wetland. The wetland is considered seasonal in nature and is characterised by secondary vegetation dominated by grass species such as *Imperata cylindrica*, *Agrostis lachnantha* and *Eragrostis curvula*.

E7 – Seep wetland

Wetland 7 consists of a Seep wetland draining in a northerly direction into the Noupoortspruit wetland. The wetland is characterised by secondary and disturbed vegetation with numerous stands of alien trees occurring within the wetland, specifically along its eastern edge bordering the demolished mine village. A number of further disturbances associated with tracks/roads and historical infrastructure were observed within the wetland, including the N12 highway which separates the hillslope seepage wetland from the Noupoortspruit valley bottom, and an old conveyor servitude that remains as a raised berm/linear disturbance through the wetland.

E8 – Seep wetland

This wetland represents the upper reach of the Seep wetland draining across the golf course and passed the Landau III Dump into wetland unit 1 (see wetland E9 below). The wetland covers 43 hectares, 5 hectares of which fall within the golf course.



The entire wetland is characterised by secondary vegetation and disturbance related to past activities associated with mining. A number of dams/excavations occur within the wetland; these dams appear to have been associated with historical mining activities and are not currently actively utilised, though the dams still support wetland vegetation and likely store some rainwater. A water pipeline runs in close proximity to the wetland, with a reservoir and pumping station also observed. A number of minor leaks along the pipeline support small patches of wetland habitat. Several tracks and minor roads cross the wetland. Old sports fields occur within and adjacent to the wetland area, while some active cultivation of the upper edge of the wetland also occurs.

E9 - Seep wetland

This wetland has also been typed as a Seep wetland. The wetland drains in a northerly direction between the Landau III Dump to the east and a demolished mine village to the west. The wetland is maintained by flows from the upstream Seep wetland (wetland E 8) and its upper catchment that pass through the golf course, as well as surface runoff from the Landau III Dump and the Anglo Projects Offices. Within the golf course a number of small dams occur. From the bottom dam, flows discharge into a trench that spills into the seepage wetland further downstream.

The wetland is highly disturbed and altered due to the surrounding landuse activities. Extensive deposits of coal fines/carbonaceous sediments occur within the portions of wetland in close proximity to the Landau III Dump. As a consequence of these disturbances the affected reach of wetland is dominated almost entirely by Imperata cylindrica, with a scattering of alien trees (Eucalyptus and Pinus species). The wetland receives surface water inputs via stormwater from the Anglo Projects Office area, surface water runoff from the Landau III Dump as well as what appears to be sewage inputs presumably from failing sewage infrastructure.

As a consequence of all of the above, the wetland unit is highly disturbed and extensively modified from its natural condition





Figure 42: Photographs of wetland E9. Note the vegetation dominated by Imperata cylindrica, the presence of alien trees, and the presence of extensive carbonaceous sediments within the wetland area.

E10 - Seep wetland

This hillslope seepage wetland appears to be an isolated wetland system with no surface connection to adjacent water resources. The wetland, which is considered seasonal in nature, is located within an agricultural setting, with cultivated fields along its entire perimeter. Some alien trees occur in the form of small stands of black wattle (Acacia mearnsii). The wetland is dominated by species such as Imperata cylindrica, Agrostis lachnantha, and Bidens formosa (cosmos). The vegetation is likely to be secondary in nature. The entire Seep seems to occur as a shallow depression in the landscape, but is located on a gentle slope and has no basin as such.



Figure 43: Photographs of wetland E10 - Seep wetland.



E11 - Seep wetland

This wetland falls only partially within the study area. The wetland system has been typed as a Seep wetland. Only a section of the greater Seep wetland falls within the study area. The remainder of the wetland extends to the south of the study area and drains into the 2A Dam.

The greater wetland system covers a total of 177 hectares of which only 11.9 hectares falls within the East Block study area. Downstream of the study area this wetland drains into 2A Dam. It is important to note that this is a dirty water dam and that water from 2A Dam is pumped to the eMalahleni Water Reclamation Plant for treatment. 2A Dam is not permitted to overflow and no surface water link exists from the 2A Dam to the downslope Tweefonteinspruit and Olifants River. *The 2A Dam and associated Seep wetland thus represent an isolated, dirty water system*. It is also proposed to mine the downstream Seep wetland via opencast mining, an application which to our knowledge has already obtained approval.

The northern portion of the Seep wetlands which falls within the study area is typically temporary to seasonal wetland habitat and seldom has areas of surface water, with flows taking place within the soil profile (interflow) or as diffuse sheet flow following large storm events. As such, this type of wetland is often classed as moist grassland. The wetland is characterised by a typical Highveld assemblage of grass species with occasional sedges. Key wetland indicator species observed included *Imperata cylindrica*, *Eragrostis gummiflua*, *Cynodon dactylon*, *Agrostis lachnantha*, and *Kyllinga erecta*. The small shrub *Seriphium plumosum* typically occurred along and just outside the wetland edge.



Figure 44: Photo of the affected reach of Seep wetland E11.

E12 - Seep wetland

This Seep wetlands surrounds Berry's Pan (see below) and covers 20.8 ha.

The Seep wetland contains areas of bare soil, interpreted to be a remnant of past inundation with mine contaminated water. The presence of species such as Phragmites australis within the seepage wetland also suggest higher water levels in the past. Salt precipitate observed on sediments and plants within the Seep wetland suggest contaminated water entering the system and reflect the poor water quality observed within the pan basin. Numerous species of alien trees occur within the pan catchment, though most have been recently cut.





Figure 45: Photo of Seep wetland E11.

E13 - Pan wetland

Known as Berry's Pan (Error! Reference source not found.), this Pan wetland is located to the north of the large Klippan discard dump and east of partially rehabilitated opencast mining activities. Water quality within the pan has been impacted by seepage from the adjacent discard dump – EC was recorded at over 3 999 μ S/cm. *Tamarix* shrubs line the pan shoreline, a further indication of the highly saline water. It appears from observations on site, and corroborated from historical aerial imagery, that the pan water level was in the past maintained at much higher levels, presumably due to discharge of water into the pan, though no information confirming this has been obtained.

Despite the saline water, large numbers of water birds were observed, especially large numbers of Black-winged Stilt and several Greater Flamingos.

Berry's Pan was recently selected as a target pan for implementation of the wetland offset strategy required for the 2A Dam opencast pit. The offset strategy seeks to maintain and improve the wetland habitat associated with the Pan wetland and surrounding Seep wetland. It is therefore critical that the proposed underground mining does not impact on the integrity of the pan.



Figure 46: View across Berry's Pan, with associated Seep wetland habitat in the foreground.

Functional assessment

The bulk of the wetlands assessed are classed as Seep wetlands. As alluded to earlier, Seep wetlands are maintained by shallow sub-surface interflow, derived from rainwater. Rainfall infiltrates the soil profile, percolates through the soil until it reaches an impermeable layer (e.g. a plinthic horizon or the underlying sandstone), and then percolates laterally through the soil profile along the aquitard (resulting



in the formation of a perched water table). Such a perched water table occurs across large areas of the Mpumalanga Highveld, not only within Seep wetlands, but also within terrestrial areas, only at greater depth. The Seep wetlands are merely the surface expression of this perched water table in those areas where a shallow soil profile results in the perched water table leading to saturation of the profile within 50cm of the soil surface. The importance of individual seepage wetlands in temporarily storing and then discharging flows to downslope wetlands (flow regulation) varies and depends on a number of factors. Generally, Seep wetlands associated with springs and located adjacent to terrestrial areas characterised by deep, well-drained soils are more likely to play an important role in flow regulation than Seep wetlands where the wetland and catchment are characterised by shallower soils. Such Seep wetlands are likely often maintained mostly by direct rainfall and lose most of their water to evapotranspiration, and surface run-off during large storm events.

Seep wetlands can support conditions that facilitate both sulphate and nitrate reduction as interflow emerges through the organically rich wetland soil profile, and are thus thought to contribute to water quality improvement and/or the provision of high quality water. The greatest importance of the Seep wetlands on site is thus taken to be the movement of clean water through the Seep wetlands and into the adjacent valley bottom wetlands.

As Seep wetlands, for the most part, are dependent on the presence of an aquiclude, either a hard or soft plinthic horizon, they are not generally regarded as significant sites for groundwater recharge (Parsons, 2004). However, by retaining water in the landscape and then slowly releasing this water into adjacent valley bottom wetlands, some Seep wetlands can contribute to stream flow augmentation, especially during the rainy season and early dry season, and can contribute to surface runoff generation during the wet season when the soils of the Seep wetlands are saturated. However, the longer the water is retained on or near the surface the more likely it is to be lost through evapo-transpiration (McCartney, 2000), implying the Seep wetlands are also "water users". Seep wetlands are not generally considered to play an important role in flood attenuation, though early in the season, when still dry, the seeps have some capacity to retain water and thus reduce surface run-off. Later in the rainy season when the wetland soils are typically saturated, infiltration will decrease and surface run-off increase. Further flood attenuation can be provided by the surface roughness of the wetland vegetation; the greater the surface roughness of a wetland, the greater is the frictional resistance offered to the flow of water and the more effective the wetland will be in attenuating floods (Reppert et al., 1979). In terms of the Seep wetlands on site, the surface roughness is taken to be moderately low, given that most of the Seep wetlands are characterised by typical grassland vegetation, thus offering only slight resistance to flow.

The linear nature of valley bottom wetlands within the landscape and their connectivity to the larger drainage system provides the opportunity for these wetlands to play an important role as an ecological corridor allowing the movement and migration of fauna and flora between remaining natural areas within the landscape. Although modified in certain respects, the wetlands still provide a natural refuge for biodiversity, and within the study area and surroundings, the valley bottom wetlands with associated



footslope seepage wetlands represent the most significant extent of remaining natural vegetation, further enhancing their importance from a biodiversity support function.

Channelled valley bottom wetlands, through the erosion of a channel through the wetland, indicate that sediment trapping is not always an important function of these wetlands, except where regular overtopping of the channel occurs and flows spread across the full width of the wetland. Under low and medium flows, transport of sediment through, and out, of the system are more likely to be the dominant processes. Erosion may be both vertical and/or lateral and reflect the attempts of the stream to reach equilibrium with the imposed hydrology. From a functional perspective channelled valley bottom wetlands can play a role in flood attenuation when flows over top the channel bank and spread out over a greater width, with the surface roughness provided by the vegetation further slowing down the flood flows. These wetlands are considered to play only a minor role in the improvement of water quality given the short contact period between the water and the soil and vegetation within the wetland.

The pan wetlands of the area are considered to be most important from a biodiversity support perspective. Although the impacted state of water quality within Berry's Pan (E13) would have impacted on and altered the aquatic diversity of the system, the pan still supports a diverse array of avifauna, specifically also species associated with somewhat saline waters. Notable amongst these are the Red Data listed Greater Flamingos, which were observed at Berry's Pan during several of the site visits to the area.

Present Ecological Status

A WET-Health Level 1 assessment was undertaken for wetlands within the study area and likely to be affected by the proposed project activities. As should be clear from the wetland descriptions provided above, the wetlands within the study area have been considerably impacted by a range of activities and land uses, most especially by mining and related activities as well as extensive cultivation. As a consequence, none of the wetlands on site are considered to still be in a natural or largely natural condition. All of the wetlands have been modified to some degree, with the bulk of the wetlands (more than 75 % of wetland area) assessed as being Largely Modified (PES category D), and a further 5 % considered Seriously Modified (PES category E). The remaining 20 % of wetland area was considered to be Moderately Modified (PES category C).



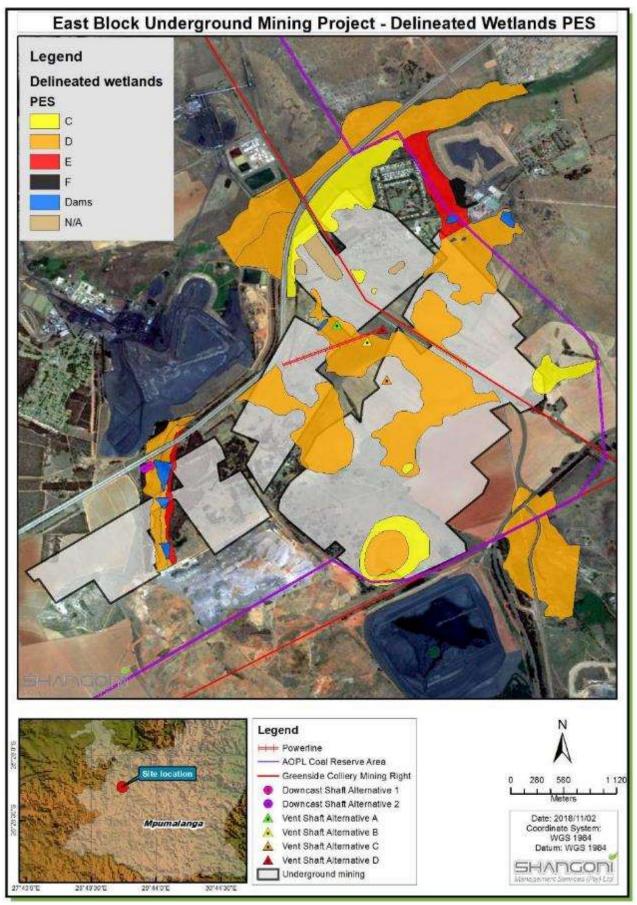


Figure 47: Present ecological status of the wetlands in the project area



Sensitivity and Importance

The wetlands within the study area form part of the Olifants River Primary catchment which is a heavily utilised and economically important catchment. Wetlands and rivers within the Olifants River Catchment upstream of Loskop Dam have been greatly impacted upon by various activities, which include mining, power stations, water abstraction, urbanization, agriculture etc. As a result of these impacts serious water quality and quantity concerns have been raised within the sub-catchment. Given this situation, and the fact that wetlands can support functions such as water purification and stream flow regulation, a high importance and conservation value is placed on all remaining wetlands and rivers within the catchment that have as yet not been seriously modified. Within this context an EIS assessment was conducted for every hydro-geomorphic wetland unit identified within the study area. Further considerations that informed the EIS assessment include:

- The location of the study area within a vegetation type (Eastern Highveld Grassland) considered extensively transformed and threatened, having been classed as Vulnerable.
- The wetland vegetation types of the area, Mesic Highveld Grassland Group 4, which is considered to be Least Threatened and Not Protected.
- The fragmented and isolated nature of many of the wetland habitats located within an agricultural and mining landscape.
- The generally moderately to largely modified state of the wetlands and watercourse within the study area, with many of the surrounding wetlands considered largely or evenly seriously modified.

It is these considerations that have informed the scoring of the systems in terms of their importance and sensitivity.



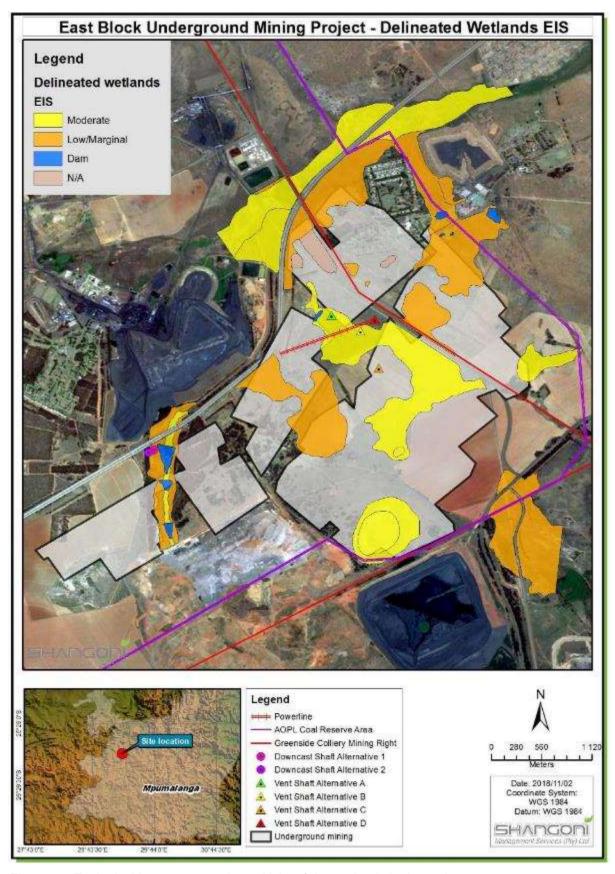


Figure 48: Ecological Importance and sensitivity of the wetlands in the project area



Chapter M: Visual Aspects

Due to the fact that Greenside Colliery is an underground mine, there are minimal visual impacts. However, the coal discard dump is significant in both extent and height, and is located adjacent to the N12, in some cases, less than 100 m away. However, Greenside Colliery has established tree screens to minimise the aesthetic impact. Greenside Colliery is proposing to retreat the coal discard, which will reduce the visual impacts from the mine.

Chapter N: Regional Socio-Economic Structure

The socio-economic structure within which Greenside Colliery is situated, is discussed in the Integrated Development Plan (IDP) titled: *eMalahleni Local Municipality Integrated Development Plan (IDP) 2017 - 2022*.

Population growth

According to StatsSA (Community Survey 2016 – CS2016) Emalahleni's population has increased from 395 466 in 2011 to 455 228 people in 2016. It is the 3rd largest population in the province and 31.5% of total population of Nkangala in 2016. Population grew by 59 762 in the relevant period and recorded a population growth rate of 3.2% per annum between 2011 and 2016. The population number for 2030 is estimated at more or less 707 530 people given the historic population growth per annum.

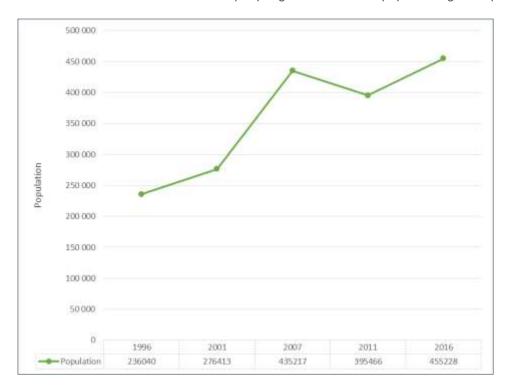


Figure 49: Population growth between 1996 and 2016(source: IDP, 2017-2022)



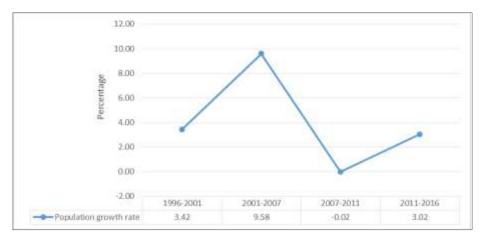


Figure 50: Percentage population growth between (source: IDP, 2017- 2022)

Population distribution

eMalahleni is composed of all racial groups with 391,982 Black African, which shows an increase since 2011; Coloured 5 450; Indian or Asian 3 762 and White 54 033. The tables above show an increase in both African/Black and Indian/Asian and decrease in both Coloured and White population since 2011.

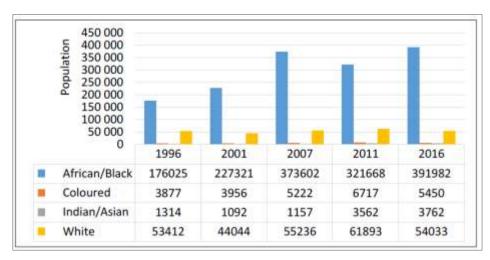


Figure 51: Population group for Emalahleni (source: IDP, 2017- 2022)

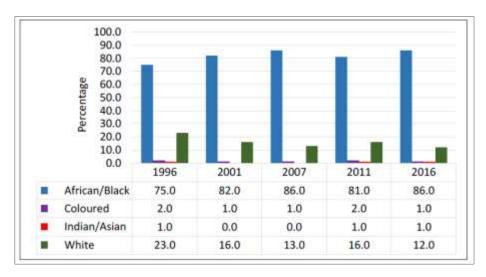


Figure 52: Population group for Emalahleni (%)(source: IDP, 2017- 2022)



Economic indicators

Emalahlani is one of the municipalities which experienced population growth rates higher than their economic growth rates, which is not positive at all. This has implications from a Gross Domestic Product (GDP) per capita and an infrastructure, service delivery, job creation point of view. Average annual economic growth rate for Emalahleni is at 2.4% over the period 1996 to 2015, the forecasted average annual GDP growth for Emalahleni for 2015-2020 is more or less 2% per annum in line with national and provincial growth expectations.

The below diagrams show that the municipal economy is dominated by mining and, therefore, a high dependence on the mining industry. Other industries in the area are making contribution to the local economy; these include trade and community services.

Emalahleni contribution to the Mpumalanga economy is the highest in the province at more than 20% and as the largest economy in the province should be protected as far as possible. The size of the economy in 2015 was estimated at more or less R60 billion in current prices. Tourism expenditure in the area as a percentage of the local GDP is low at 1.9% and tourism spending only R1.1 billion per annum.

The graphs below indicate a decreasing unemployment rate in eMalahleni which was 38.4% in 2001 and 27.3% in 2011. In terms of youth labour i.e. between ages 15-34, the rate is also decreasing from 50.2% in 2001 to 36.0% in 2011. The municipality has developed strategies and plans of curbing the unemployment challenges. The municipality has a well-established Local Economic Development unit which also focuses at creating job within the municipality for the purpose of creating an attractive and conducive environment for sustainable economic development and tourism.

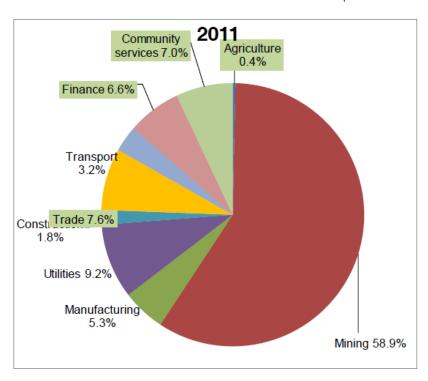


Figure 53: Contributions to municipal economy in 2011 (%)(source: IDP, 2017-2022)



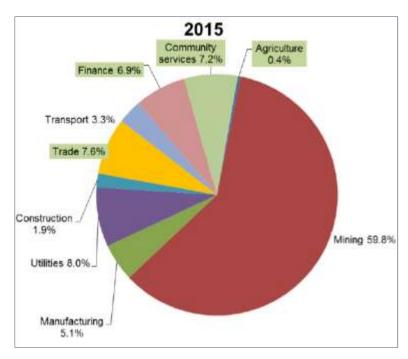


Figure 54: Contributions to municipal economy in 2015 (%)(source: IDP, 2017-2022)

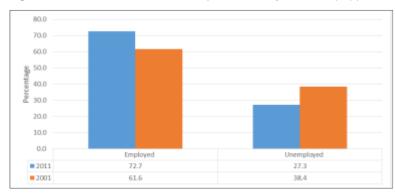


Figure 55: Labour indicators for the working age people: 15 – 64 (source: IDP, 2017-2022)

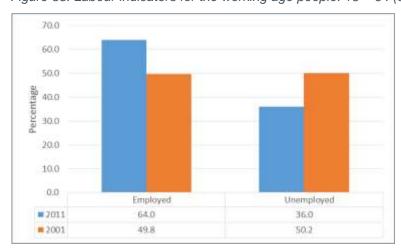


Figure 56: Labour indicators for the youth: 15 – 34 (source: IDP, 2017-2022)



8.4.2 Description of the current land uses

The major land-use activity within the Greenside Colliery mining area and its immediate surrounds is agriculture in the form of maize cultivation. Some livestock farming occurs but very little natural grazing remains as the vast majority of the landscape has been historically ploughed and is still under cultivation today.

Greenside Mining Area is a semi natural landscape, which has been largely transformed and impacted by agricultural and mining activity. There are a few remaining areas of natural vegetation that have not been transformed due to their unsuitability for agriculture, however, the biodiversity value of these areas is considered to be moderate to low as a result of the negative land use impacts.

The current land use associated with the East Block area is agricultural.

8.4.3 Description of specific environmental features and infrastructure on the site

Flora

The topography of the surface rights area of the mine is gently undulating with elevation ranging from approximately 1525 m to 1575 m sloping gently down from the southwest to east of the mine.

The area is vegetated by the Moist Sandy Highveld Grassland vegetation type (*Low & Rebelo, 1998*). Moist Sandy Highveld Grassland is dominated by the grasses. Acocks (1988) describes the same area as Bankenveld and considers it to be a sour vegetation type in which forbs are an important component. The most recent vegetation classification for South Africa places the study area within Eastern Highveld Grassland.

This variation occurs on flattish sandy country. The vegetation type is considered to be Endangered nationally with none conserved and 43% altered, primarily by cultivation. Any remaining areas of natural grassland within this vegetation type should, therefore, be considered to have a high conservation value.

Fauna

The study area is situated within the Grassland biome. Within this biome two vegetation types were identified within the project area, Eastern Highveld Grassland and Eastern Temperate Freshwater Wetlands (*Mucina and Rutherford, 2007*).

Only a small section of the grassland is conserved due to the constant cultivation and mining of this vegetation type. Only 5% of the wetlands are conserved for this vegetation type. This was reflected during the field survey as most of the project area has already been impacted by agricultural or mining activities.

Wetlands

A variety of wetland types are associated with the project area, possibly with the Clydesdale Pan considered to be the most well-known system. The remaining wetland types include valley bottom systems and additional depressions (pans). These systems all have the potential to contribute to the



water quality enhancement and maintenance of biodiversity for the catchment area. These wetland areas have all been impacted on by the local mining and agricultural activities.

Aquatics

The Greenside Colliery lies within the Olifants Water Management Area, which is classified as the Highveld region. The surface water system associated with the Greenside Colliery is known as the Nauwpoortspruit. This 1st order, perennial stream is located within the quaternary catchment B11G. The stream source lies approximately 2 km west of the Greenside Colliery. The mine works are within the headwaters of the Nauwpoortspruit. The Nauwpoortspruit catchment drains a 36.51 km² area and flows in an Easterly direction for approximately 15 km before entering into the Witbank dam. The Noupoort River catchment is known to contain a variety of pans and minor impoundments. The stream also has a variety of infrastructure which crosses over it including railways and national roads. From the source of the stream the predominant land use is agriculture.

Agriculture

Approximately 17% of the Greenside Colliery consists of cultivation composed of a variety of crops, primarily maize. The cultivated areas are considered to have a low ecological sensitivity and low conservation value.

Alien vegetation

Twelve of the plant species recorded on site are exotics and six are declared aliens according to the Conservation of Agricultural Resources Act (Act No. 43 of 1983). Only 17% of the floral species recorded on site are naturalized exotic and invader species, which is low given the disturbed nature of the mine lease area. The declared weeds or alien invader species are *Eucalyptus camaldulensis*, *Pinus sp., Populus deltoides* and *Salix babylonica* (declared invaders category 2), *Cirsium vulgare* (declared weed category 2) and *Pennisetum clandestinum* (proposed declared weed). Outside of the Alien Vegetation Unit the majority of these are found within wetland environments. It is likely that there are other declared weeds or alien invader species occurring at the mine that were not recorded.

Various parts of the Greenside Colliery were under exotic trees, primarily Eucalyptus species. Most of these have been planted as formal woodlots or plantations to harvest commercially. Other exotic species occurring in the study area, primarily as invasive species along parts of the drainage lines include Pinus species, *Populus x canescens* and *Salix babylonica*. The areas dominated by alien trees are considered to have a low ecological sensitivity and low conservation value, except where they may provide important habitat for birds or other animals.

Development

This consists of all buildings, infrastructure, roads, mining operations (including open-cast pits and dumps), railways, etc. and constitutes almost 40% of the Greenside Colliery area. It is considered to be a complete transformation of natural vegetation and also often results in degradation in the areas surrounding it. They are considered to have a low ecological sensitivity and low conservation value.

A number of servitudes cross the Greenside Colliery mine site and include:

RLT and rail siding;



- Overland conveyor from Landau Colliery to the RLT;
- N12 Highway;
- Mine siding rail line;
- District roads; and
- Overhead power lines.

The specific environmental features and infrastructure on the site associated with the East Block area includes wetlands and agricultural land (maize farming).

8.4.4 Environmental and current land use map

Refer to the figure below for an indication of the current land use and environmental features present.



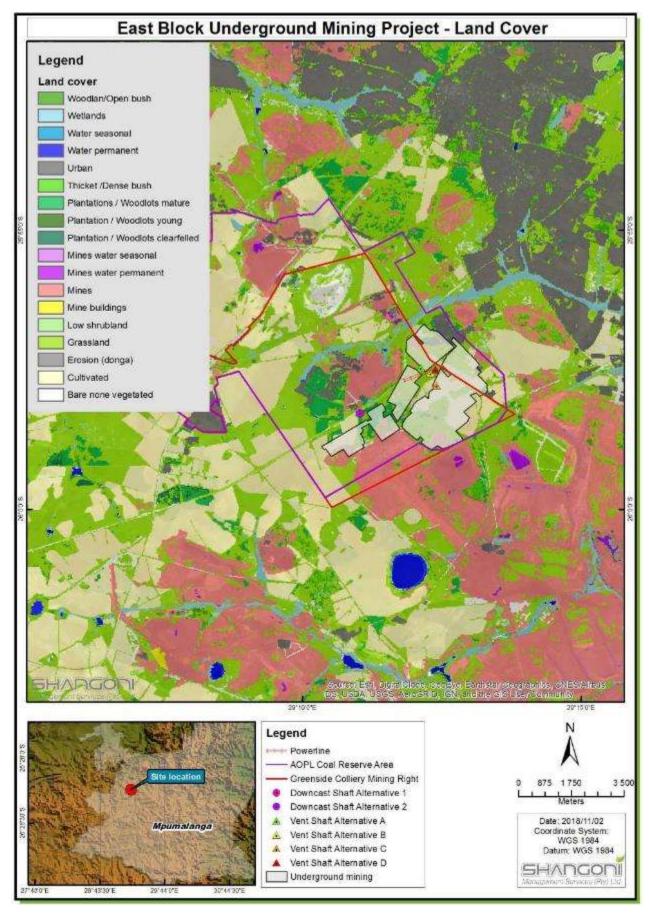


Figure 57: Land Use Map associated with the East Block Underground Mining project



8.5. Impacts and risks identified

Table 23 below contains preliminary potential impacts that have been identified for the activities described in the final site layout plan. A detailed risk assessment will be undertaken as part of the EIAR and EMPr Phase, in which the duration, probability, magnitude and reversibility of the impacts will be determined and the significance of the impact calculated. Potential cumulative impacts have also been determined and are presented in Table 24.

Table 23: Preliminary determination of potential impacts

Environmental component (Aspects affected)	Activity	Potential Impact
	Underground mining (board and pillar)	The coal seams will be removed by underground mining methods, permanently altering the geological sequence.
Geology	Surface infrastructure (ventilation shaft, downcast shaft, powerline)	There are no impacts identified to Geology as a result of the surface infrastructure.
Topography, Soils Land use and land capability	Underground mining (board and pillar) and undermining of wetland.	Subsidence and / or fracturing of rocks may impact on overlying geological strata, alter topography and/or reduce land capability, as well as cause an increased risk of erosion within wetlands.
	Surface infrastructure (ventilation shaft, downcast shaft, powerline)	There are no impacts identified to topography as a result of the surface infrastructure.
Fauna and Flora	Underground mining (board and pillar) and undermining of wetland.	Loss of a portion of high sensitivity vegetation that is representative of an endangered vegetation type and reduction of wetland and untransformed grassland habitat for fauna through subsidence of soil.
	Surface infrastructure (ventilation shaft, downcast shaft, powerline)	No significant biodiversity impacts of more than Low significance (with the possible exception of bird mortalities caused by collision with, or electrocution by, power lines) are expected as a result of shaft or power line construction assuming standard construction management best practice, and the mitigation measures are adhered to.
Surface water Underground mining (board and pillar)		During the operational phase, the mining will be active that will require dewatering of the deep aquifer(s). Dewatering of the water table may also result in moisture loss from overlying wetlands and pans while decant of poor water quality may jeopardise the ecological integrity of these systems. Historic monitoring records have confirmed that the perched, and source water for



Environmental component (Aspects affected)	Activity	Potential Impact
		wetland aquifers, are isolated from the deeper fractured aquifer. Due to the hydraulic isolation of the perched aquifer/s from the deeper and weathered aquifer/s, the integrity of wetland systems should not be affected by dewatering.
		Undermining is also associated with dewatering and lowering of the water table that can reduce the groundwater contribution to baseflow during the operational phases while subsidence can result in stream capture due to settlement or collapse. However, given the extraction ratios for the proposed extension areas, subsidence is unlikely to occur.
		Water abstracted from underground is likely to be sulphate rich and should be stored in proper engineered storage facilities within the affected water circuit. Any water discharged should comply to relevant legislative or licence conditions. If these management measures and conditions are met, little or no water quality impact is expected on any surface receptor during the operational phase.
	Surface infrastructure	Ineffective erosion control on access roads may lead to siltation of downstream water resources, including adjacent wetland and downstream drainage line. The proposed ventilation shaft will be located upstream of the natural drainage line. The wetland area is situated downstream of the proposed shaft and surface flow is expected to reach the area due to the nature of the contours. Croplands and natural veldt are situated between the proposed ventilation shaft the downstream drainage line/wetland area and will reduce velocity of surface flow and contain a portion of silt carried from the access roads at the proposed shaft.
	(ventilation shaft, downcast shaft, powerline)	Construction of the ventilation shaft may result in seepage from the adjacent wetland due to the gradient created. This seepage should cease to occur during the operational phase due to the shaft being sealed but should nevertheless be monitored to confirm.
		Inadequate clean storm water diversion will prevent clean storm water in the direct upstream catchment of the ventilation shaft from reporting to the surface water resource with subsequent impacts on the availability of water to downstream users and on the ecological reserve of the catchment. The nature of activities at the proposed ventilation shaft do not pose significant risk by preventing surface water



Environmental component (Aspects affected)	Activity	Potential Impact
		reporting to the natural downstream water resource (i.e. no water retention infrastructures are proposed on site).
		Construction and operational activities in close proximity to the wetland area may impact on the sensitive ecological function of the wetlands system.
		Oil leakage at the sub-station and transformer bay may result in surface water pollution.
		Spillages of hazardous chemicals at the contractor's laydown area during construction may result in surface water pollution.
		Incorrect storage of domestic and hazardous waste at the contractor's laydown area during the construction phase may result in surface water pollution.
Groundwater quality	Underground mining (board and pillar)	Coal surfaces exposed to the atmosphere within underground workings can potentially generate acid mine drainage (AMD). Humidity in air and groundwater seepage running down walls can react with coal surfaces. Coal remaining in the pillars of the 2 Seam and walls of these seams, as well as dust on the floor, can be exposed to the atmosphere. The open underground workings will be a source of contaminated water during operation and for a period following closure. Since dewatering occurs up until mine closure, very little water will be allowed to accumulate. Some water will however accumulate but a plume will not develop since the groundwater flow gradients are directed towards the mine workings. Only when the voids have filled will a plume develop in the deeper aquifer.
		The flow in the aquifer will be directed towards the undergrounds during this stage of mining. The exposed coal seams will be above groundwater level, and very little groundwater pollution is thus expected. If water do accumulate in mined out sections, or lowest elevation areas, a deterioration of quality will begin to occur but will be insignificant during the early operational stages. If the quality does deteriorate after long exposure times, a plume will not develop away from the voids as a result of the negative gradient created.
		Elevated sulphate concentrations together with a decrease in pH within source monitoring boreholes and water in mine voids indicate polluted water. These elevated concentrations



Environmental component (Aspects affected)	Activity	Potential Impact
		are however to be expected in the mining area and the important factor is to ensure that water management is such that the affected water is not released into the receiving environment through discharge, decant or even plume movement.
		Due to the workings acting as sinks, a plume will not migrate but will be drawn inwards towards it. This will be caused by the local dewatering strategies and pumping to the EWRP.
Groundwater quantity	Underground mining (board and pillar)	The localised dewatering of the deep aquifer on cannot be prevented. Since mining will be underground, it can be expected that the mining will be below the static groundwater levels. It is expected that the deeper aquifer will be drawn down to the bottom of No. 2 Seam. No boreholes are drilled down to this depth with most boreholes exploiting groundwater from the shallower aquifer mostly less than 60 mbs.
		Groundwater users that extract groundwater from the shallow weathered aquifer are not expected to be significantly impacted on in terms of water levels but this should be confirmed with ongoing and long-term monitoring. If impact is confirmed by monitoring, impacts to the community's and farmers' water supply must be mitigated by the client providing an alternative reliable, clean water supply. Water level impacts are however expected to be restricted to within the deeper fractured rock aquifer, which is currently not being utilised by the surrounding groundwater users.
		The effect of bord-&-pillar on shallow aquifer recharge is expected to be minimal due to the depth of mining and the fact that stooping is not planned for the mining operation. The recharge to the deep, secondary aquifer is expected to be less than 1% especially due to the confined to semi-confined nature of the aquifer/s.
		The underground mine was designed for zero subsidence. With the extraction ratios for the bord-&-pillar mining, subsidence or cracking is not expected; this will also limit drawdown within the shallow/weathered aquifer.
		Reasons for the localisation of the groundwater level impacts are:
		 The depth at which the planned mining will take place. The prevention of subsidence and subsequent fracture formation.



Environmental component (Aspects affected)	Activity	Potential Impact
		The overall low aquifer transmissivity.
Groundwater	Surface infrastructure (ventilation shaft, downcast shaft, powerline)	Site clearing and removal of topsoil, may lead to ponding of surface water in the cleared areas during the wet season and could potentially lead to increased infiltration to aquifers. Groundwater quality impacts during the construction phase are expected to be insignificant if the proposed management measures are implemented. The stripping and stockpiling of topsoil and subsoil from the area is considered negligible since no chemical interaction is envisaged that could have an adverse impact on groundwater quality. The stripping of topsoil may result in a very slight increase in groundwater recharge, which is a slight positive effect on the groundwater environment. The duration of the activity is however so limited that the effect will not be measurable.
		The construction of the above-mentioned infrastructure will cause a very small reduction in recharge to the aquifer due to the compaction of the surface area. This impact is countered by the fact that vegetation clearing may result in ponding and slight increases in recharge. Runoff water will contribute to the catchment yield. Carbonaceous material has the potential to
		generate acidic leachate, which means that any construction undertaken with carbonaceous material may be a potential source of poor quality leachate.
		Oil or fuel spillages from construction machinery may collect in the soils. During rainfall events, hydrocarbon compounds from oils and fuel in the soils may migrate to the subsurface water bodies with water infiltrating through these polluted areas. Due to the short exposure, duration of the activities and small scale of these possible spills, the impacts will be negligible during the construction phase of the shaft.
		A very limited geohydrological impact is expected in terms of site clearing and removal of topsoil given the small surface area involved and the short duration of the construction phase.
		The impacts on groundwater quality are primarily related to the management of materials, wastes and spills from drilling operations. Contamination of groundwater may also arise due to incorrect handling and disposal of waste materials, the physical drilling process



Environmental component (Aspects affected)	Activity	Potential Impact
		(sludge contains oils and greases) and oil leaks from drill rigs. This risk is considered low.
Groundwater quality	Mine Closure	The plume in the deeper aquifer is expected to be limited to the mine boundaries for a considerable time after closure. The plume will not migrate as the mine workings act as a groundwater sink. The water levels are expected to take a considerable time to recover and pollution movement away from the mine will only start to occur once the mine has filled to near surface/pre-mining elevations. This could be between 60- and 100 years. However, the status quo strategy of pumping underground water to the EWRP are also possibly to remain for a time after closure to prevent decant of substandard quality.
		Water accumulating underground will continue to deteriorate until all pyrite has been oxidised. Decanting of water above-ground may result in pollution of receiving surface water resources. If the effects of only the project area are considered, no decant at the shaft will take place. However, when the cumulative effect of the nearby mines and mine hydraulic connectivity are considered decant at the shaft could be possible.
Groundwater quantity	Mine Closure	Once dewatering has ceased, the voids created by mining will be allowed to flood which could be approximately within 60 – 100 years. The hydraulic heads in the shallow weathered aquifer are not expected to have recovered fully at 100 years post decommissioning since it is expected that the water levels in the secondary aquifer will not have recovered at the same time and will, therefore, probably still result in a slight drawdown in the shallow, weathered aquifer. It must be stressed that the slight drawdown of the weathered aquifer is based on worst case scenarios.
		When coal, rock or mineral ore is removed from an underground mine, the overlying earth can sink, i.e. subsidence. The extent of mine subsidence depends on the mining method, local geology, depth of mining and amount of material extracted. Mine subsidence can affect built features, like homes or roads, and environmental features like surface freshwater resources and aquifers.
		No roof collapse and cracking/fracturing of roof strata or subsidence is expected because of the proposed bord-&-pillar mining. The mine plan



Environmental component (Aspects affected)	Activity	Potential Impact
		was designed in such a manner as to prevent the destabilisation of the roof.
	Underground mining (board and pillar)	Decreased flow in wetlands due to abstraction of and drawdown of groundwater (shallow weathered aquifer).
		Altered flow characteristics in wetlands and loss of flow due to surface subsidence within or in close proximity to wetlands. Surface subsidence or fracturing of rocks overlying the underground mine could lead to the creation of preferential flow paths as well as alter the surface topography of wetlands.
		Altered flow characteristics in wetlands and loss of flow due to surface subsidence within or in close proximity to wetlands.
Sensitive landscapes (including wetlands)		Water quality deterioration in wetlands due to decant of contaminated mine water. After closure the mined-out voids are likely to fill with water over time, eventually leading to decant of water into surface water resources. Decant water is likely to be acidic, metal rich and of high salinity.
	Surface infrastructure (ventilation shaft, downcast shaft, powerline)	Disturbance of wetland habitat - Wetland habitat falling in close proximity to the proposed surface infrastructure could be disturbed during the construction process. Construction vehicles accessing the sites, turning, offloading materials on site etc. are also likely to contribute to disturbance and destruction of wetland habitat outside the servitude. Disturbance of the wetland vegetation is also likely to provide opportunity for invasion by alien vegetation and increase the risk of erosion.
		Increased risk of erosion within wetlands - The soils within the hillslope seepage wetlands are highly susceptible to erosion once disturbed or cleared of vegetation. The clearing of vegetation, together with the disturbance of the soil and the potential flow concentration of storm water runoff entering wetlands during the construction phase pose a significant erosion risk. Erosion and gully incision within wetlands will lead to loss of habitat and desiccation of habitat.
		Increased sediment transport into wetlands - Sediment washed off the bare soil areas associated with construction areas will be deposited in adjacent wetland areas. Sediment



Environmental component (Aspects Activity affected)

Potential Impact

deposition in wetlands could lead to changes in wetland vegetation and a shift to pioneer and invasive species.

Water quality deterioration - During construction, as activities are taking place adjacent to and within wetlands, there is a possibility that water quality can be impaired. Typically, impairment will occur as a consequence of sediment disturbance resulting in an increase in turbidity. Water quality may also be impaired as a consequence of accidental spillages and the intentional washing and rinsing of equipment within the wetlands. It is likely that hydrocarbons will be stored and used on site, as well as cement and other potential pollutants.

Habitat fragmentation - Construction of infrastructure near wetlands could lead to habitat fragmentation and to provide an obstacle to free movement of faunal species associated with the wetlands. This impact will start in the construction phase but will persist for the duration of the operational phase. The affected wetlands are already heavily fragmented by existing road and linear infrastructure crossings, as well as extensive cultivation and mining impacts.

Establishment and spread of alien species - Areas disturbed during the construction process will be susceptible to invasion by alien vegetation, e.g. Acacia mearnsii, which is already established on site. These alien species could spread to the adjacent wetland areas and result in decreased flows, increased erosion and decreased biodiversity in these systems.

Water quality deterioration – Contaminated runoff from surface infrastructure areas could enter adjacent wetlands via stormwater. Excess water from the underground mine workings is likely to be contaminated and, if discharged, lead to water quality deterioration in adjacent wetlands

Disturbance of wetland habitat - Regular maintenance activities along the powerline and security fences could lead to disturbances of the wetland systems crossed by these linear infrastructures.



Environmental component (Aspects affected)	Activity	Potential Impact
	Underground mining (board and pillar)	All new underground mining areas will be mined using existing or approved shafts, therefore, no new / additional impacts to air quality are expected from the preparation for the underground mining of coal.
		Dust fallout impacts relate to nuisance impacts, i.e. reduced visibility and layers of dust deposited on the surrounding environment during construction.
Air quality	Surface infrastructure (ventilation shaft, downcast shaft, powerline)	PM2.5 and PM10 impacts can in general be of concern due to their direct health impact potentials. Such fine particles are able to be deposited in, and damaging to, the lower airways and gas-exchanging portions of the lung.
		Greenside Colliery is primarily an underground bord and pillar mine, minimising surface dust fallout. However, the inherent air quality of the area is considered poor and is impacted on by the activities of adjacent collieries, industry, and vehicle use and veld fires. Furthermore, dust generation occurs from the existing discard dump on-site.
Noise	Underground mining (board and pillar)	All new underground mining areas will be mined using existing or approved shafts, therefore, no new / additional impacts to the noise environment are expected from the preparation for the underground mining of coal.
	Surface infrastructure (ventilation shaft, downcast shaft, powerline)	Although there are agricultural activities at the proposed site the study area is characterised by the presence of major exiting noise sources. There are major coal mining activities at Kleinkopje in the south, Greenside Colliery in the north and Landau in the East. The N12 highway, which crosses the area immediately to the North of the proposed site, carries a large amount of traffic. This includes a very significant amount of heavy vehicles. Other busy roads crossing the area are the R547, the road connecting the R544 and the R547 past Kleinkopje, and the road leading from Kleinkopje, past Landau village to Clewer. Residential areas consist of villages associated with the mines of the area.
		Noise levels were expected have significant contributions from the N12 Highway and the other coal mines in the area, and in light of the above, the proposed project is not expected to worsen the noise levels of the study area.
		Therefore, with the general high level of mechanisation in the area, relatively high



Environmental component (Aspects affected)	Activity	Potential Impact
		existing ambient noise may be expected. The current ambient noise levels are characterised by the presence of mining and road traffic related noises. Noise levels at the proposed project are expected to be the same as that of the rest of the Greenside Colliery.
	Underground mining (board and pillar)	All new underground mining areas will be mined using existing or approved shafts, therefore, no new / additional impacts to the visual environment is expected from the preparation for the underground mining of coal.
Visual	Surface infrastructure (ventilation shaft, downcast shaft, powerline)	The proposed project will lie in close proximity to the N12 which is a major route for tourists and holiday makers travelling between Johannesburg and the eastern Mpumalanga. Other coal mines in the vicinity surround Greenside Colliery and therefore, the background visual effects are dominated by mining activities. Visual impacts are expected to be low.
	Underground mining (board and pillar)	All new underground mining areas will be mined using existing or approved shafts, therefore, no new / additional impacts to sites of archaeological and cultural importance are expected from the preparation for the underground mining of coal.
	Surface infrastructure (ventilation shaft, downcast shaft, powerline)	The Phase I HIA study for the proposed project area revealed the following types and ranges of heritage resources as outlined in Section 38 of the National Heritage Resources Act (No 25 of 1999), namely:
Sites of Archaeological and		Two graveyards. The two graveyards will not be affected by the
Cultural Importance		proposed project.
		All graveyards and graves can be considered to be of high significance and are protected by various laws Legislation with regard to graves includes Section 36 of the National Heritage Resources Act (Act No 25 of 1999) whenever graves are older than sixty years. It seems as if both graveyards are older than sixty years. Other legislation with regard to graves includes those which apply when graves are exhumed and relocated, namely the Ordinance on Exhumations (No 12 of 1980) and the Human Tissues Act (No 65 of 1983 as amended).



Environmental component (Aspects affected)	Activity	Potential Impact
Socio-economic	Underground mining (board and pillar) and Surface infrastructure (ventilation shaft, downcast shaft, powerline)	Jobs will be retained, providing income and, therefore, having a further impact on the regional socio-economy aspects of the area, along with other benefits arising from the Social and Labour Plan.
	Mine Closure	During mine closure, a loss of jobs will occur which may not only impact on the employees but on the socio-economic status of the local community and economy.

Table 24: Preliminary identification of potential cumulative impacts

Environmental component (Aspects affected)	Activity	Potential Impact description
Geology	All mining activities conducted in a regional context.	The proposed and current mining activities as well as the surrounding mining activities may cumulative have an impact on the regional geological strata.
Topography	Mining and agricultural activities.	No contribution to cumulative impacts associated with the project are foreseen.
Soil	Mining and agricultural activities.	No contribution to cumulative impacts associated with the project are foreseen.
Surface and groundwater	Contaminated surface water runoff as a result of the mining and	Surface and groundwater resources may become contaminated in the event that contaminated surface water runoff from the mining areas and agricultural areas enter the receiving environment.
agricultural activities.	The potential for cumulative groundwater impacts within the area as a result of mining activities will be further assessed during the EIA Phase.	
Vegetation and Fauna	Mining and agricultural related activities.	The potential destruction of the natural vegetation as well as habitat loss for fauna species, may occur on a cumulative scale, should other activities in the area have a similar impact on the biodiversity of the area.
Sensitive landscapes (including wetlands)	Mining and agricultural related activities	The proposed and existing mining activities, as well as the agricultural activities conducted on site, may cumulatively have an impact on the wetlands located on the project site.



Environmental component (Aspects affected)	Activity	Potential Impact description
Noise	Noise generation from mining activities	No contribution to cumulative impacts associated with the project are foreseen.
Air Quality	Air pollution from mining activities	Greenside Colliery is primarily an underground bord and pillar mine, minimising surface dust fallout. However, the inherent air quality of the area is considered poor and is impacted on by the activities of adjacent collieries, industry, and vehicle use and veld fires. Furthermore, dust generation occurs from the existing discard dump on-site.
Socio- Economic	Mining and mining related activities	Jobs will be retained, providing income and, therefore, having a further impact on the regional socio-economy aspects of the area, along with other benefits arising from the Social and Labour Plan.
	Mine Closure	During mine closure, a loss of jobs will occur which may not only impact on the employees but on the socio-economic status of the local community and economy.

8.6. Methodology used in determining and ranking potential environmental impacts and risks

8.6.1 Methodology to be applied during the EIA and EMP phase

The environmental risk of any aspect is determined by a combination of parameters associated with the impact. Each parameter connects the physical characteristics of an impact to a quantifiable value to rate the environmental risk.

Impact assessments should be conducted based on a methodology that includes the following:

- Clear processes for impact identification, predication and evaluation;
- Specification of the impact identification techniques;
- Criteria to evaluate the significance of impacts;
- Design of mitigation measures to lessen impacts;
- Definition of the different types of impacts (indirect, direct or cumulative); and
- Specification of uncertainties.

After all impacts have been identified, the nature and scale of each impact can be predicted. The impact prediction will take into account physical, biological, socio-economic and cultural information and will then estimate the likely parameters and characteristics of the impacts. The impact prediction will aim to provide a basis from which the significance of each impact can be determined and appropriate mitigation measures can be developed.

The risk assessment methodology is based on defining and understanding the three basic components of the risk, i.e. the source of the risk, the pathway and the target that experiences the risk (receptor).



Refer to Figure 58 below for a model representing the above principle (as contained in the DWA's Best Practice Guideline: G4 – Impact Prediction).

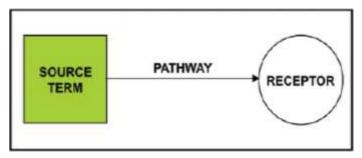


Figure 58: Impact prediction model

Table 25 and

Table 26 below indicate the methodology to be used in order to assess the Probability and Magnitude of the impact, respectively, and Table 27 provides the Risk Matrix that will be used to plot the Probability against the Magnitude in order to determine the Severity of the impact.

Table 25: Determination of Probability of impact

Score	Frequency of Aspect / Unwanted Event	Availability of Pathway from the source to the receptor	Availability of Receptor		
1	Never known to have happened, but may happen	A pathway to allow for the impact to occur is never available	The receptor is never available		
2	Known to happen in industry	A pathway to allow for the impact to occur is almost never available	1		
3	< once a year	A pathway to allow for the impact to occur is sometimes available	The receptor is sometimes available		
4	Once per year to up to once per month	A pathway to allow for the impact to occur is almost always available	'		
5	Once a month - Continuous	A pathway to allow for the impact to occur is always available	The receptor is always available		

<u>Step 1</u>: Determine the PROBABILITY of the impact by calculating the average between the Frequency of the Aspect, the Availability of a pathway to the receptor and the availability of the receptor.

Table 26: Determination of Magnitude of impact

Score		Source			Receptor	
	Duration of impact	Extent	Volume / Quantity / Intensity	Toxicity / Destruction Effect	Reversibility	Sensitivity of environmental component



Score		Source			Receptor	
1	Lasting days to a month	Effect limited to the site. (metres);	Very small quantities / volumes / intensity (e.g. < 50L or < 1Ha)	Non-toxic (e.g. water) / Very low potential to create damage or destruction to the environment	Bio-physical and/or social functions and/or processes will remain unaltered.	Current environmental component(s) are largely disturbed from the natural state.
2	Lasting 1 month to 1 year	Effect limited to the activity and its immediate surroundings. (tens of metres)	Small quantities / volumes / intensity (e.g. 50L to 210L or 1Ha to 5Ha)	Slightly toxic / Harmful (e.g. diluted brine) / Low potential to create damage or destruction to the environment	Bio-physical and/or social functions and/or processes might be negligibly altered or enhanced / Still reversible	Receptor of low significance / sensitivity
3	Lasting 1 – 5 years	Impacts on extended area beyond site boundary (hundreds of metres)	Moderate quantities / volumes / intensity (e.g. > 210 L < 5000L or 5 – 8Ha)	Moderately toxic (e.g. slimes) Potential to create damage or destruction to the environment	Bio-physical and/or social functions and/or processes might be notably altered or enhanced / Partially reversible	Current environmental component(s) are moderately disturbed from the natural state.
4	Lasting 5 years to Life of Organisation	Impact on local scale / adjacent sites (km's)	Very large quantities / volumes / intensity (e.g. 5000 L - 10 000L or 8Ha-12Ha)	Toxic (e.g. diesel & Sodium Hydroxide)	Bio-physical and/or social functions and/or processes might be considerably altered or enhanced / potentially irreversible	No environmentally sensitive components.
5	Beyond life of Organisation / Permanent impacts	Extends widely (nationally or globally)	Very large quantities / volumes / intensity (e.g. > 10 000 L or > 12Ha)	Highly toxic (e.g. arsenic or TCE)	Bio-physical and/or social functions and/or processes might be severely/substantially altered or enhanced / Irreversible	Current environmental component(s) are a mix of disturbed and undisturbed areas.

Step 2: Determine the MAGNITUDE of the impact by calculating the average of the factors above.



Table 27: Determination of Severity of impact

Environmental I	Environmental Impact Rating / Priority					
			MAGNITUDE			
Probability	1	2	3	4	5	
	Minor	Low	Medium	High	Major	
5	Low	Medium	High	High	High	
Almost Certain						
4	Low	Medium	High	High	High	
Likely						
3	Low	Medium	Medium	High	High	
Possible						
2	Low	Low	Medium	Medium	High	
Unlikely						
1	Low	Low	Low	Medium	Medium	
Rare						

<u>Step 3:</u> Determine the SEVERITY of the impact by plotting the averages that were obtained above for Probability and Magnitude.

8.6.2 Knowledge gaps, assumptions and limitations

The information contained in this report, have been informed by:

- The approved Environmental Management Programme (EMPr) titled: Aligned Environmental Management Programme Report for Anglo American Thermal Coal: Greenside Colliery, DMR Reference: MP30/5/1/2/2/304MR, dated April 2014 compiled by WSP Environmenetal (Pty) Ltd;
- Geohydrological investigation as part of undermining of Waterpan and wetlands at 3A North and East Block, compiled by Shangoni Management Services (Pty) Ltd. dated 2018.
- Wetland Assessment Report for the East Bock Underground Mining Project, compiled by Wetland Consulting Services (Pty) Ltd. dated 2018.

The following assumptions and limitation were made by the Wetland specialist in the 2018 report:

- Wetland systems reflect the ecological boundary where there is a close relation and interaction between water content and soil particles in the first 50 centimetres of the soil profile. The soil-water interaction in response influences the plant communities and soil properties, i.e. causing mottling and gleying in the soil. The wetland boundary, based on vegetation species compositions and soil properties, can vary depending on historical rainfall conditions and introduce a degree of variability in the wetland boundary between years as well as sampling period.
- The scale of the remote imagery used (1:10 000 aerial photographs and Google Earth Imagery), as well as the accuracy of the handheld GPS unit used to delineated wetlands in the field, result in the delineated wetland boundaries being accurate to about 10-20m on the ground. Should greater



mapping accuracy be required, the wetlands would need to be pegged in the field and surveyed using conventional survey techniques.

- Groundtruthing and field verification of wetland boundaries was limited to the study area. Wetlands
 falling outside the study area boundary were not delineated in the field as part of the current study,
 and are based on existing information from previous studies and desktop mapping where necessary
 to fill gaps.
- This impact assessment was based on the project description and proposed development and activity descriptions as detailed and illustrated in this report.
- Reference conditions are unknown. This limits the confidence with which the present ecological category (PES) is assigned.
- No formal hydrological flow modelling or hydro-pedological assessments of the wetlands were undertaken as part of this study, though consideration of hydrological flow drivers at a conceptual level informed the impact assessment.

The following assumptions and limitation were made by the Geohydrological specialist in the 2018 report:

- The model was developed on the assumption that the fractured rock aquifer will behave as an equivalent homogeneous porous medium. This is not accurate as aquifer conditions and parameters vary in the natural system even over very short distances. However, on a large enough scale this assumption should be acceptable and REV should suffice well enough.
- The complexities of fractured rock aquifers imply that the model can only be used as a guide to
 estimate the aquifer hydraulic properties that will in turn be used in the model to predict contaminant
 transport.
- If there are preferential flow paths due to faults or fractures that have not been identified, it can be
 expected that the contaminant plume will move faster in these structures and could therefore have
 a greater extent.
- Conservative approaches were followed with regards to assigning hydraulic and physical parameters to the steady state calibration and the transient transport model.
- Due to various model limitations and lack of data, the model should be regarded as qualitative rather than quantitative.

8.7. Positive and negatives that the proposed activity and alternatives will have on the environment and community affected

The positive and negative implication of the proposed activity and the alternative identified have been provided below and assessed in terms of the following four categories:

- Environmental.
- Technical/Engineering.
- Economical.
- Social.



The positive and negative impacts of both the proposed activities and the preliminary identified alternatives will be further assessed as part of the EIAR and EMPr.

Table 28: Advantage and disadvantages of the proposed activities and preliminary identified alternatives

Alternative		Advantages	Disadvantages
Activity alternatives (mining method alternatives)			Environmental: Opencast mining would pose a significant higher impact on environmental aspects, such as air quality, flora, fauna, soil, land use and land capability, sensitive landscapes, surface water and visual (including sense of place).
	Alternative MM1: Opencast (surface)	Technical/Engineering: May have less safety related issues then with underground mining. Economical: No advantages identified. Social: Job opportunities will be retained. Benefits arising from the SLP such as LED projects, learnerships etc.will continue.	Technical/Engineering: Larger affected water containment facilities and storm water diversion measures would be needed for the safe continuation of mining activities and will entail higher cost implications than the underground mining method.
	mining methods		Economical: The 4 Seam Select is too deep to mine economically by surface (opencast) mining methods. The post closure impact on land use will result in higher capital expenditure required for rehabilitation.
			Social: More significant surface disturbance than underground mining. Opencast mining would pose a higher impact on social aspects (such as air quality, sense of place, blasting and vibration and community health).
	Alternative MM2: Undergorund mining method (board and pillar)	Environmental: Minimal surface disturbance. The post closure impact on land use will not be as significant as with opencast mining. No loss of landscape character, sense of place and visual absorption capacity. Technical/Engineering: Continuation of existing underground mining activities, method and equipment already in place a part of Greenside's existing operations. Economical: Maximize the utilization of mineral resources and optimise capital income.	Environmental: Risk of subsidence, with impacts on surface such as sensitive landscapes (e.g. wetland areas) Technical/Engineering: Greater subsidence risk relative to opencast mining potentially impacting on the production rate. Economical: Additional operating costs required for the expansion of the existing underground mining. Social: May have more safety related issues than with opencast mining (subsidence areas).



Alternative		Advantages	Disadvantages
		Social: Less particulate emissions than opencast mining methods. Minimal surface disturbance. Fewer sensitive visual receptors impacted and exposed to mining activities. Lowered visual intrusion. Job opportunities will be retained. Benefits arising from the SLP such as LED projects, learnerships etc.will continue.	
Site alternatives for the ventilation shaft	Altenative A, B, C and D	Environmental: Alternative C falls completely outside delineated wetland habitat within a cultivated field and is considered the preferred alternative from a wetland perspective, though it has been indicated that it may be unsuitable from a mining perspective. Alternative D is located outside delineated wetland habitat and is also considered suitable from a wetland perspective. Technical/Engineering: None. Economical: None.	Environmental: Alternatives A and B fall predominantly within delineated Seep wetland habitat and are considered unsuitable from a wetland perspective. Technical/Engineering: None. Economical: None. Social: None.
Site alternatives for the downcast shaft	Alternative 1 and 2	Environmental: Alternative 2 located outside wetland habitat, is considered the preferred location. Technical/Engineering: None. Economical: None Social: None	Environmental: Alternative 1 is located within the delineated wetland habitat and is considered an unsuitable location from a wetland perspective. Technical/Engineering: None Economical: None Social: None
Development versus no-go alternative	Alternative NG1: Mining and related activities (development)	Environmental: None identified Technical/Engineering: Equipment already available. Economical: Capital income from mining additional mineral reserves. Social: Job opportunities will be retained. Benefits arising from the SLP such as LED projects, learnerships etc.will continue.	Environmental: None identified other than the existing environmental risks associated with Greenside Colliery Technical/Engineering: Will impact on the existing operating costs and resources. Economical: Additional capital cost required. Social: None identified other that the existing impacts from Greenside Colliery.



Alternative	Advantages	Disadvantages
Alternative NG2: No go option	Environmental: Status quo of the site will remain as is (no additional environmental impacts will occur as a result of the mining and related activities) Technical/Engineering: No additional machinery and resources required. Economical: None identified Social: No additional environmental impacts will occur as a result of the mining and related activities.	Environmental: None identified, as the cumulative impacts from the project to the existing impacts arising from Greenside Colliery is considered low, but will be further confirmed and provided in the EIAR Technical/Engineering: Not optimally applying existing infrastructure for further mining of resources. Economical: Loss of income from not mining the mineral reserve. Social: Opportunity lost in expanding the LOM and workforce.

8.8. Possible mitigation measures that could be applied and the level of risk

Table 29 below provides for a summary of the issues and concerns as raised by affected parties and an assessment of the mitigations or site layout alternatives available to accommodate or address their concerns, together with an assessment of the impacts or risks associated with the mitigation or alternatives considered.

After this Scoping Report has been made available for public review for a period of thirty (30) days, any comments received will be included into the below table, where after the report will be finalised and submitted to the DMR.

Table 29: Summary of issues and concerns raised by I&Aps (This table will be completed once the initial Public Participation Process has ended, prior to the Scoping Report being submitted to the DMR.)

Concerns as raised by affected parties	Mitigation measures or site alternative

9. Plan of study for the Environmental Impact Assessment Process

9.1. Description of alternatives

Refer to Sections 8.1 and 8.7 above for a description of the alternatives that have been identified.



9.2. Description of the aspects to be assessed as part of the environmental impact assessment process

As part of the proposed project, all aspects of the environment are considered and include (but are not limited to):

- Geology.
- Topography.
- · Soil, Land use and land capability.
- Fauna and Flora.
- Surface water.
- Groundwater.
- Sensitive landscapes (including wetlands).
- Air quality.
- Noise.
- Visual aspects.
- Sites of cultural and archaeological importance.
- Socio-economic aspects.

9.3. Description of aspects to be assessed by specialists

Section 8.4.1 provides both a summary of the baseline environment as applicable to the existing mining and related activities, informed by:

- The approved Environmental Management Programme (EMPr) titled: Aligned Environmental Management Programme Report for Anglo American Thermal Coal: Greenside Colliery, DMR Reference: MP30/5/1/2/2/304MR, dated April 2014 compiled by WSP Environmenetal (Pty) Ltd;
- Geohydrological investigation as part of undermining of Waterpan and wetlands at 3A North and East Block, compiled by Shangoni Management Services (Pty) Ltd., dated 2018.
- Wetland Assessment Report for the East Bock Underground Mining Project, compiled by Wetland Consulting Services (Pty) Ltd., dated 2018.
- A Fauna and Flora Report for Greenside Mineral Residue Discard Facility, compiled by Digby Wells Environmental, dated October 2013.
- A Phase 1 Heritage Impact assessment (HIA) study for Anglo Operations Limited Greenside Colliery's new Discard Facility near eMahlahleni on the Eastern Highveld in the Mpumalanga Province, dated November 2014, and compiled by Dr. Julius Pistorius.
- Greenside Colliery New Discard Facility, eMalahleni Local Municipality, Mpumalanga Province, Farm: Portion 0, 2 and 3 Groenfontein 331JS, Palaeontological Impact Assessment: Phase 1 Field study, compiled by Dr. Fourie, dated November 2014.



9.4. Proposed method of assessing the environmental aspects including the proposed method of assessing alternatives

9.4.1 Proposed method of assessing environmental aspects

The method for assessing the environmental aspects have been described in Part 8.6.2 above.

9.4.2 Proposed method of assessing alternatives

Refer to Parts 8.1 and 8.7 above for the description of alternatives identified and for the advantages and disadvantages of the identified alternatives.

9.5. The proposed method of assessing duration and significance

The method used in determining the significance and the duration of the impact is described above in Table 30. Duration is divided into five (5) periods. A score of between 1 and 5 is assigned to the impact based on the characteristics of the impact and the period for which the impact will occur and have an impact on the socio-economic, cultural and biophysical environment. The score assigned to the specific impact for duration is then used in determining the magnitude of the impact.

Table 30: Determination of the duration of the impact

Duration of impact	Score
Lasting days to a month	1
Lasting 1 month to 1 year	2
Lasting 1 – 5 years	3
Lasting 5 years to Life of Organisation	4
Beyond life of Organisation / Permanent impacts	5

9.6. The stages at which the Competent Authority will be consulted

The Competent Authority, in this case the Mpumalanga Department of Mineral Resources (DMR) will be consulted throughout the application process.

This Scoping Report is compiled and will be made available for public and stakeholder review for a period of thirty (30) days. This Scoping Report will be submitted to the DMR, where after the DMR will have 44 days to either refuse environmental authorisation or accept the Scoping Report and inform the applicant to proceed with the tasks contemplated in the plan of study for the EIA.

The Competent Authority (the DMR) will further be involved during the EIA phase of the project. The EIAR and EMPr will also be made available for a public and stakeholder review period of thirty (30) days. Upon completion of the review period, the EIAR and EMPr will be finalised and submitted to the DMR, where after the DMR will have a period of 107 days to consider the application and, in writing, notify the applicant of the decision to grant or refuse environmental authorisation.



9.7. Particulars of the public participation process with regard to the Impact Assessment process that will be conducted

9.7.1 Steps to be taken to notify interested and affected parties

A detailed public participation process was undertaken as part of the initial application- and scoping phase for the proposed project. The following has been conducted as part of the Environmental Authorisation Application (proof hereof will be included in the final Public Participation Report to be submitted to the DMR along with the Final Scoping Report) (will be attached as Annexure E to this report):

- Advertisements.
 - A Newspaper advertisement was placed in the Witbanknews on the 16th of November 2018.
- Site notices.
 - Five (5) site notices were placed around the proposed project site as well as at the existing
 Mine.
- Written notices.
 - o Written notices (including BIDs) were distributed to Interested and Affected Parties (I&APs).
- Availability of Scoping Report for public review
 - This Scoping Report will be made available for public and stakeholder review for a period of 30 days (from 20 November 2018 to 14 January 2019). Notices providing the detail of the public viewing station and review period, were sent to registered I&APs via e-mail. This notification also formed part of the above-mentioned advertisement and site notices.

9.8. Description of the tasks that will be undertaken as part of the environmental impact assessment process

The Draft Environmental Impact Assessment Report (EIAR) and Environmental Management Programme Report (EMPr) will be submitted, once the Scoping Report has been accepted by the Competent Authority. The EIAR will be compiled in accordance to Appendix 3 of the EIA Regulations 2014, as amended and the Draft Environmental Management Programme Report (EMPr) will be compiled in accordance to Appendix 4 of the EIA Regulations 2014, as amended.

Required content of Environmental Impact Assessment Report

An environmental impact assessment report must contain the information that is necessary for the competent authority to consider and come to a decision on the application, and must include-

- (a) Details of-
 - (i) The EAP who prepared the report; and
 - (ii) The expertise of the EAP, including a curriculum vitae;



- (b) The location of the activity, including:
 - (i) The 21-digit Surveyor General code of each cadastral land parcel;
 - (ii) Where available, the physical address and farm name; and
 - (iii) Where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties.
- (c) A plan which locates the proposed activity or activities applied for as well as the associated structures and infrastructure at an appropriate scale, or, if it is-
 - (i) A linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; and
 - (ii) On land where the property has not been defined, the coordinates within which the activity is to be undertaken.
- (d) A description of the scope of the proposed activity, including-
 - (i) All listed and specified activities triggered and being applied for; and
 - (ii) A description of the associated structures and infrastructure related to the development.
- (e) A description of the policy and legislative context within which the development is located and an explanation of how the proposed development complies with and responds to the legislation and policy context;
- (f) A motivation for the need and desirability for the proposed development, including the need and desirability of the activity in the context of the preferred location;
- (g) A motivation for the preferred development footprint within the approved site;
- (h) A full description of the process followed to reach the proposed development footprint within the approved site, including:
 - (i) Details of the development footprint alternatives considered;
 - (ii) Details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs;
 - (iii) A summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them;
 - (iv) The environmental attributes associated with the development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;



- (v) The impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts-
 - (aa) Can be reversed;
 - (bb) May cause irreplaceable loss of resources; and
 - (cc) Can be avoided, managed or mitigated;
- (vi) The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks;
- (vii) Positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community, that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;
- (viii) The possible mitigation measures that could be applied and level of residual risk;
- (ix) If no alternative development locations for the activity were investigated, the motivation for not considering such; and
- (x) A concluding statement indicating the preferred alternative development location within the approved site;
- (i) A full description of the process undertaken to identify, assess and rank the impacts the activity and associated structures and infrastructure will impose on the preferred location through the life of the activity, including-
 - (i) A description of all environmental issues and risks that were identified during the environmental impact assessment process; and
 - (ii) An assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures;
- (j) An assessment of each identified potentially significant impact and risk, including-
 - (i) Cumulative impacts;
 - (ii) The nature, significance and consequences of the impact and risk;
 - (iii) The extent and duration of the impact and risk;
 - (iv) The probability of the impact and risk occurring;
 - (v) The degree to which the impact and risk can be reversed;
 - (vi) The degree to which the impact and risk may cause irreplaceable loss of resources;
 - (vii) The degree to which the impact and risk can be mitigated;



- (k) Where applicable, a summary of the findings and recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final assessment report;
- (I) An environmental impact statement which contains-
 - (i) a summary of the key findings of the environmental impact assessment:
 - (ii) a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers; and
 - (iii) a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives; based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation;
- (m) Based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation;
- (n) The final proposed alternatives which respond to the impact management measures, avoidance, and mitigation measures identified through the assessment;
- (o) Any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation
- (p) A description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed;
- (q) A reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;
- (r) Where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded, and the post construction monitoring requirements finalised;
- (s) An undertaking under oath or affirmation by the EAP in relation to:
 - (i) The correctness of the information provided in the reports;
 - (ii) The inclusion of comments and inputs from stakeholders and I&APs;
 - (iii) The inclusion of inputs and recommendations from the specialist reports where relevant; and



- (iv) Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties;
- (t) Where applicable, details of any financial provisions for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts;
- (u) An indication of any deviation from the approved scoping report, including the plan of study, including-
 - (i) Any deviation from the methodology used in determining the significance of potential environmental impacts and risks; and
 - (ii) A motivation for the deviation;
- (v) Any specific information that may be required by the competent authority; and
- (w) Any other matters required in terms of section 24(4) (a) and (b) of the Act.

Required content of EMPr

An EMPr must comply with section 24N of the Act and include-

- (a) Details of
 - (i) The EAP who prepared the EMPR; and
 - (ii) The expertise of that EAP to prepare an EMPR, including a curriculum vitae;
- (b) A detailed description of the aspects of the activity that are covered by the EMPR as identified by the project description;
- (c) A map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that any areas that should be avoided, including buffers;
- (d) A description of the impact management objectives, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the development including-
 - (i) Planning and design;
 - (ii) Pre-construction activities;
 - (iii) Construction activities;
 - (iv) Rehabilitation of the environment after construction and where applicable post closure;
 - (v) Where relevant, operation activities;
- (e) A description and identification of impact management outcomes required for the aspects contemplated in paragraph (d);



- (f) A description of proposed impact management actions, identifying the manner in which the impact management objectives and outcomes contemplated in paragraphs (d) and (e) will be achieved, and must, where applicable, include actions to
 - (i) Avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;
 - (ii) Comply with any prescribed environmental management standards or practices;
 - (iii) Comply with any applicable provisions of the Act regarding closure, where applicable;
 - (iv) Comply with any provisions of the Act regarding financial provisions for rehabilitation;
- (g) The method of monitoring the implementation of the impact management actions contemplated in paragraph (f);
- (h) The frequency of monitoring the implementation of the impact management actions contemplated in paragraph (f);
- (i) An indication of the persons who will be responsible for the implementation of the impact management actions;
- (j) The time periods within which the impact management actions contemplated in paragraph (f) must be implemented;
- (k) The mechanism for monitoring compliance with the impact management actions contemplated in paragraph (f);
- A program for reporting on compliance, taking into account the requirements as prescribed by the Regulations;
- (m) An environmental awareness plan describing the manner in which-
 - (i) The applicant intends to inform his or her employees of any environmental risk which may result from their work; and
 - (ii) Risks must be dealt with in order to avoid pollution or the degradation of the environment;
- (n) Any specific information that may be required by the competent authority.

9.9. Measures to avoid, reverse, mitigate, or manage identified impacts

Table 31 below is the Risk assessment table in which preliminarily identified impacts have been identified. Mitigations measures (to avoid, reverse, mitigate, or manage identified impacts) as well as the extent to which these impacts are anticipated to result in residual risks are also provided in Table 31 below.



Table 31: Risk assessment table

Environmental component (Aspects affected)	Activity	Potential Impact	Mitigation type Modify/Remedy/ Control/Stop	Potential for residual risk
	Underground mining (board and pillar)	The coal seams will be removed by underground mining methods, permanently altering the geological sequence.	N/A	Low potential for residual risk, however the impact is of a permanent nature.
Geology	Surface infrastructure (ventilation shaft, downcast shaft, powerline)	There are no impacts identified to Geology as a result of the surface infrastructure.	N/A	N/A
Topography, Soils Land use	Underground mining (board and pillar) and undermining of wetland.	Subsidence and / or fracturing of rocks may impact on overlying geological strata, alter topography and/or reduce land capability, as well as cause an increased risk of erosion within wetlands.	Remedy	Low to medium potential for residual risk, if not mitigated appropriately
and land capability	Surface infrastructure (ventilation shaft, downcast shaft, powerline)	There are no impacts identified to topography as a result of the surface infrastructure.	N/A	N/A
Fauna and Flora	Underground mining (board and pillar) and undermining of wetland.	Loss of a portion of high sensitivity vegetation that is representative of an endangered vegetation type and reduction of wetland and untransformed grassland habitat for fauna through subsidence of soil.	Control	Low to medium potential for residual risk, if not mitigated appropriately
Flora	Surface infrastructure (ventilation shaft,	No significant biodiversity impacts of more than Low significance (with the possible exception of bird mortalities caused by collision with, or electrocution by, power lines) are expected as a result of shaft or power line construction assuming standard construction	Control	Low potential for residual risk, if not mitigated appropriately



Environmental component (Aspects affected)	Activity	Potential Impact	Mitigation type Modify/Remedy/ Control/Stop	Potential for residual risk
	downcast shaft, powerline)	management best practice, and the mitigation measures are adhered to.		
Surface water	Underground mining (board and pillar)	During the operational phase, the mining will be active that will require dewatering of the deep aquifer(s). Dewatering of the water table may also result in moisture loss from overlying wetlands and pans while decant of poor water quality may jeopardise the ecological integrity of these systems. Historic monitoring records have confirmed that the perched, and source water for wetland aquifers, are isolated from the deeper fractured aquifer. Due to the hydraulic isolation of the perched aquifer/s from the deeper and weathered aquifer/s, the integrity of wetland systems should not be affected by dewatering. Undermining is also associated with dewatering and lowering of the water table that can reduce the groundwater contribution to baseflow during the operational phases while subsidence can result in stream capture due to settlement or collapse. However, given the extraction ratios for the proposed extension areas, subsidence is unlikely to occur. Water abstracted from underground is likely to be sulphate rich and should be stored in proper engineered storage facilities within the affected water circuit. Any water discharged should comply to relevant legislative or licence conditions. If these management measures and conditions are met, little or no water quality impact is expected on any surface receptor during the operational phase.	Control	Low to medium potential for residual risk, if not mitigated appropriately
	Surface infrastructure (ventilation shaft, downcast shaft, powerline)	Ineffective erosion control on access roads may lead to siltation of downstream water resources, including adjacent wetland and downstream drainage line. The proposed ventilation shaft will be located upstream of the natural drainage line. The wetland area is situated downstream of the proposed shaft and surface flow is expected to reach the area due to the nature of the contours.	Control	Low potential for residual risk, if not mitigated appropriately



Environmental component (Aspects affected)	Activity	Potential Impact	Mitigation type Modify/Remedy/ Control/Stop	Potential for residual risk
		Croplands and natural veldt are situated between the proposed ventilation shaft the downstream drainage line/wetland area and will reduce velocity of surface flow and contain a portion of silt carried from the access roads at the proposed shaft.		
		Construction of the ventilation shaft may result in seepage from the adjacent wetland due to the gradient created. This seepage should cease to occur during the operational phase due to the shaft being sealed but should nevertheless be monitored to confirm.		
		Inadequate clean storm water diversion will prevent clean storm water in the direct upstream catchment of the ventilation shaft from reporting to the surface water resource with subsequent impacts on the availability of water to downstream users and on the ecological reserve of the catchment. The nature of activities at the proposed ventilation shaft do not pose significant risk by preventing surface water reporting to the natural downstream water resource (i.e. no water retention infrastructures are proposed on site).		
		Construction and operational activities in close proximity to the wetland area may impact on the sensitive ecological function of the wetlands system.		
		Oil leakage at the sub-station and transformer bay may result in surface water pollution.		
		Spillages of hazardous chemicals at the contractor's laydown area during construction may result in surface water pollution.		
		Incorrect storage of domestic and hazardous waste at the contractor's laydown area during the construction phase may result in surface water pollution.		



Environmental component (Aspects affected)	Activity	Potential Impact	Mitigation type Modify/Remedy/ Control/Stop	Potential for residual risk
Groundwater quality	Underground mining (board and pillar)	Coal surfaces exposed to the atmosphere within underground workings can potentially generate acid mine drainage (AMD). Humidity in air and groundwater seepage running down walls can react with coal surfaces. Coal remaining in the pillars of the 2 Seam and walls of these seams, as well as dust on the floor, can be exposed to the atmosphere. The open underground workings will be a source of contaminated water during operation and for a period following closure. Since dewatering occurs up until mine closure, very little water will be allowed to accumulate. Some water will however accumulate but a plume will not develop since the groundwater flow gradients are directed towards the mine workings. Only when the voids have filled will a plume develop in the deeper aquifer. The flow in the aquifer will be directed towards the undergrounds during this stage of mining. The exposed coal seams will be above groundwater level, and very little groundwater pollution is thus expected. If water do accumulate in mined out sections, or lowest elevation areas, a deterioration of quality will begin to occur but will be insignificant during the early operational stages. If the quality does deteriorate after long exposure times, a plume will not develop away from the voids as a result of the negative gradient created. Elevated sulphate concentrations together with a decrease in pH within source monitoring boreholes and water in mine voids indicate polluted water. These elevated concentrations are however to be expected in the mining area and the important factor is to ensure that water management is such that the affected water is not released into the receiving environment	Control	Low to medium potential for residual risk, if not mitigated appropriately
		through discharge, decant or even plume movement.		



Environmental component (Aspects affected)	Activity	Potential Impact	Mitigation type Modify/Remedy/ Control/Stop	Potential for residual risk
		Due to the workings acting as sinks, a plume will not migrate but will be drawn inwards towards it. This will be caused by the local dewatering strategies and pumping to the EWRP.		
		The localised dewatering of the deep aquifer on cannot be prevented. Since mining will be underground, it can be expected that the mining will be below the static groundwater levels. It is expected that the deeper aquifer will be drawn down to the bottom of No. 2 Seam. No boreholes are drilled down to this depth with most boreholes exploiting groundwater from the shallower aquifer mostly less than 60 mbs.		
Groundwater quantity	Underground mining (board and pillar)	Groundwater users that extract groundwater from the shallow weathered aquifer are not expected to be significantly impacted on in terms of water levels but this should be confirmed with ongoing and long-term monitoring. If impact is confirmed by monitoring, impacts to the community's and farmers' water supply must be mitigated by the client providing an alternative reliable, clean water supply. Water level impacts are however expected to be restricted to within the deeper fractured rock aquifer, which is currently not being utilised by the surrounding groundwater users.	Control	Low to medium potential for residual risk, if not mitigated appropriately
		The effect of bord-&-pillar on shallow aquifer recharge is expected to be minimal due to the depth of mining and the fact that stooping is not planned for the mining operation. The recharge to the deep, secondary aquifer is expected to be less than 1% especially due to the confined to semi-confined nature of the aquifer/s.		
		The underground mine was designed for zero subsidence. With the extraction ratios for the bord-&-pillar mining, subsidence or cracking is not expected; this will also limit drawdown within the shallow/weathered aquifer.		
		Reasons for the localisation of the groundwater level impacts are:		



Environmental component (Aspects affected)	Activity	Potential Impact	Mitigation type Modify/Remedy/ Control/Stop	Potential for residual risk
		 The depth at which the planned mining will take place. The prevention of subsidence and subsequent fracture formation. The overall low aquifer transmissivity. 		
Groundwater	Surface infrastructure (ventilation shaft downcast shaft powerline)	THE PACCONSTRUCTION OF THE ANOVA-MANTIONAG INTRASTRUCTURA WILL CALLSA	Control	Low to medium potential for residual risk, if not mitigated appropriately



Environmental component (Aspects affected)	Activity	Potential Impact	Mitigation type Modify/Remedy/ Control/Stop	Potential for residual risk
		bodies with water infiltrating through these polluted areas. Due to the short exposure, duration of the activities and small scale of these possible spills, the impacts will be negligible during the construction phase of the shaft.		
		A very limited geohydrological impact is expected in terms of site clearing and removal of topsoil given the small surface area involved and the short duration of the construction phase.		
		The impacts on groundwater quality are primarily related to the management of materials, wastes and spills from drilling operations. Contamination of groundwater may also arise due to incorrect handling and disposal of waste materials, the physical drilling process (sludge contains oils and greases) and oil leaks from drill rigs. This risk is considered low.		
Groundwater quality	Mine Closure	The plume in the deeper aquifer is expected to be limited to the mine boundaries for a considerable time after closure. The plume will not migrate as the mine workings act as a groundwater sink. The water levels are expected to take a considerable time to recover and pollution movement away from the mine will only start to occur once the mine has filled to near surface/pre-mining elevations. This could be between 60- and 100 years. However, the status quo strategy of pumping underground water to the EWRP are also possibly to remain for a time after closure to prevent decant of substandard quality.	Control	Low to medium potential for residual risk, if not mitigated appropriately
		Water accumulating underground will continue to deteriorate until all pyrite has been oxidised. Decanting of water above-ground may result in pollution of receiving surface water resources. If the effects of only the project area are considered, no decant at the shaft will take place. However, when the cumulative effect of the nearby mines and mine hydraulic connectivity are considered decant at the shaft could be possible.		



Environmental component (Aspects affected)	Activity	Potential Impact	Mitigation type Modify/Remedy/ Control/Stop	Potential for residual risk
Groundwater quantity	Mine Closure	Once dewatering has ceased, the voids created by mining will be allowed to flood which could be approximately within 60 – 100 years. The hydraulic heads in the shallow weathered aquifer are not expected to have recovered fully at 100 years post decommissioning since it is expected that the water levels in the secondary aquifer will not have recovered at the same time and will, therefore, probably still result in a slight drawdown in the shallow, weathered aquifer. It must be stressed that the slight drawdown of the weathered aquifer is based on worst case scenarios. When coal, rock or mineral ore is removed from an underground mine, the overlying earth can sink, i.e. subsidence. The extent of mine subsidence depends on the mining method, local geology, depth of mining and amount of material extracted. Mine subsidence can affect built features, like homes or roads, and environmental features like surface freshwater resources and aquifers. No roof collapse and cracking/fracturing of roof strata or subsidence is expected because of the proposed bord-&-pillar mining. The mine plan was designed in such a manner as to prevent the destabilisation of the roof.	Control	Low to medium potential for residual risk, if not mitigated appropriately
Sensitive		Decreased flow in wetlands due to abstraction of and drawdown of groundwater (shallow weathered aquifer).	Stop/ Control;	
Sensitive landscapes (including wetlands)	Underground mining (board and pillar)	Altered flow characteristics in wetlands and loss of flow due to surface subsidence within or in close proximity to wetlands. Surface subsidence or fracturing of rocks overlying the underground mine could lead to the creation of preferential flow paths as well as alter the surface topography of wetlands.	Stop and Control	Medium potential for residual risk, if not mitigated appropriately



Environmental component (Aspects affected)	Activity	Potential Impact	Mitigation type Modify/Remedy/ Control/Stop	Potential for residual risk
		Altered flow characteristics in wetlands and loss of flow due to surface subsidence within or in close proximity to wetlands.	Control	
		Water quality deterioration in wetlands due to decant of contaminated mine water. After closure the mined-out voids are likely to fill with water over time, eventually leading to decant of water into surface water resources. Decant water is likely to be acidic, metal rich and of high salinity.	Control	
		Disturbance of wetland habitat - Wetland habitat falling in close proximity to the proposed surface infrastructure could be disturbed during the construction process. Construction vehicles accessing the sites, turning, offloading materials on site etc. are also likely to contribute to disturbance and destruction of wetland habitat outside the servitude. Disturbance of the wetland vegetation is also likely to provide opportunity for invasion by alien vegetation and increase the risk of erosion.	Control	Medium potential for residual risk, if not mitigated appropriately
	Surface infrastructure (ventilation shaft, downcast shaft, powerline)	Increased risk of erosion within wetlands - The soils within the hillslope seepage wetlands are highly susceptible to erosion once disturbed or cleared of vegetation. The clearing of vegetation, together with the disturbance of the soil and the potential flow concentration of storm water runoff entering wetlands during the construction phase pose a significant erosion risk. Erosion and gully incision within wetlands will lead to loss of habitat and desiccation of habitat.	Control and Remedy	Medium potential for residual risk, if not mitigated appropriately
		Increased sediment transport into wetlands - Sediment washed off the bare soil areas associated with construction areas will be deposited in adjacent wetland areas. Sediment deposition in wetlands could lead to changes in wetland vegetation and a shift to pioneer and invasive species.	Control and Remedy	Medium potential for residual risk, if not mitigated appropriately



Environmental component (Aspects affected)	Activity	Potential Impact	Mitigation type Modify/Remedy/ Control/Stop	Potential for residual risk
		Water quality deterioration - During construction, as activities are taking place adjacent to and within wetlands, there is a possibility that water quality can be impaired. Typically, impairment will occur as a consequence of sediment disturbance resulting in an increase in turbidity. Water quality may also be impaired as a consequence of accidental spillages and the intentional washing and rinsing of equipment within the wetlands. It is likely that hydrocarbons will be stored and used on site, as well as cement and other potential pollutants.	Control, Remedy and Stop	Medium potential for residual risk, if not mitigated appropriately
		Habitat fragmentation - Construction of infrastructure near wetlands could lead to habitat fragmentation and to provide an obstacle to free movement of faunal species associated with the wetlands. This impact will start in the construction phase but will persist for the duration of the operational phase. The affected wetlands are already heavily fragmented by existing road and linear infrastructure crossings, as well as extensive cultivation and mining impacts.	Control and Remedy	Medium potential for residual risk, if not mitigated appropriately
		Establishment and spread of alien species - Areas disturbed during the construction process will be susceptible to invasion by alien vegetation, e.g. Acacia mearnsii, which is already established on site. These alien species could spread to the adjacent wetland areas and result in decreased flows, increased erosion and decreased biodiversity in these systems.	Control and Remedy	Medium potential for residual risk, if not mitigated appropriately
		Water quality deterioration – Contaminated runoff from surface infrastructure areas could enter adjacent wetlands via stormwater. Excess water from the underground mine workings is likely to be contaminated and, if discharged, lead to water quality deterioration in adjacent wetlands	Control and Remedy	Medium potential for residual risk, if not mitigated appropriately



Environmental component (Aspects affected)	Activity	Potential Impact	Mitigation type Modify/Remedy/ Control/Stop	Potential for residual risk
		Disturbance of wetland habitat - Regular maintenance activities along the powerline and security fences could lead to disturbances of the wetland systems crossed by these linear infrastructures.	Control and Remedy	Medium potential for residual risk, if not mitigated appropriately
	Underground mining (board and pillar)	All new underground mining areas will be mined using existing or approved shafts, therefore, no new / additional impacts to air quality are expected from the preparation for the underground mining of coal.	Control	Low potential for residual risk
Air quality	Surface infrastructure (ventilation shaft, downcast shaft, powerline)	Dust fallout impacts relate to nuisance impacts, i.e. reduced visibility and layers of dust deposited on the surrounding environment during construction. PM2.5 and PM10 impacts can in general be of concern due to their direct health impact potentials. Such fine particles are able to be deposited in, and damaging to, the lower airways and gasexchanging portions of the lung. Greenside Colliery is primarily an underground bord and pillar mine, minimising surface dust fallout. However, the inherent air quality of the area is considered poor and is impacted on by the activities of adjacent collieries, industry, and vehicle use and veld fires. Furthermore, dust generation occurs from the existing discard dump on-site.	Monitor and Control	Low potential for residual risk
Noise	Underground mining (board and pillar)	All new underground mining areas will be mined using existing or approved shafts, therefore, no new / additional impacts to the noise environment are expected from the preparation for the underground mining of coal.	Control	Low potential for residual risk
	Surface infrastructure (ventilation shaft,	Although there are agricultural activities at the proposed site the study area is characterised by the presence of major exiting noise sources. There are major coal mining activities at Kleinkopje in	Control	Low potential for residual risk



Environmental component (Aspects affected)	Activity	Potential Impact	Mitigation type Modify/Remedy/ Control/Stop	Potential for residual risk
	downcast shaft, powerline)	the south, Greenside Colliery in the north and Landau in the East. The N12 highway, which crosses the area immediately to the North of the proposed site, carries a large amount of traffic. This includes a very significant amount of heavy vehicles. Other busy roads crossing the area are the R547, the road connecting the R544 and the R547 past Kleinkopje, and the road leading from Kleinkopje, past Landau village to Clewer. Residential areas consist of villages associated with the mines of the area.		
		Noise levels were expected have significant contributions from the N12 Highway and the other coal mines in the area, and in light of the above, the proposed project is not expected to worsen the noise levels of the study area.		
		Therefore, with the general high level of mechanisation in the area, relatively high existing ambient noise may be expected. The current ambient noise levels are characterised by the presence of mining and road traffic related noises. Noise levels at the proposed project are expected to be the same as that of the rest of the Greenside Colliery.		
	Underground mining (board and pillar)	All new underground mining areas will be mined using existing or approved shafts, therefore, no new / additional impacts to the visual environment is expected from the preparation for the underground mining of coal.	Control	Low potential for residual risk
Visual	Surface infrastructure (ventilation shaft, downcast shaft, powerline)	The proposed project will lie in close proximity to the N12 which is a major route for tourists and holiday makers travelling between Johannesburg and the eastern Mpumalanga. Other coal mines in the vicinity surround Greenside Colliery and therefore, the background visual effects are dominated by mining activities. Visual impacts are expected to be low.	Modify	Low potential for residual risk



Environmental component (Aspects affected)	Activity	Potential Impact	Mitigation type Modify/Remedy/ Control/Stop	Potential for residual risk
	Underground mining (board and pillar)	All new underground mining areas will be mined using existing or approved shafts, therefore, no new / additional impacts to sites of archaeological and cultural importance are expected from the preparation for the underground mining of coal.	Stop	Low potential for residual risk
Sites of Archaeological and Cultural Importance	Surface infrastructure (ventilation shaft, downcast shaft, powerline)	The Phase I HIA study for the proposed project area revealed the following types and ranges of heritage resources as outlined in Section 38 of the National Heritage Resources Act (No 25 of 1999), namely: Two graveyards. The two graveyards will not be affected by the proposed project. All graveyards and graves can be considered to be of high significance and are protected by various laws Legislation with regard to graves includes Section 36 of the National Heritage Resources Act (Act No 25 of 1999) whenever graves are older than sixty years. It seems as if both graveyards are older than sixty years. Other legislation with regard to graves includes those which apply when graves are exhumed and relocated, namely the Ordinance on Exhumations (No 12 of 1980) and the Human Tissues Act (No 65 of 1983 as amended).	Control	Low potential for residual risk
Socio- economic	Underground mining (board and pillar) and Surface infrastructure (ventilation shaft, downcast shaft, powerline)	Jobs will be retained, providing income and, therefore, having a further impact on the regional socio-economy aspects of the area, along with other benefits arising from the Social and Labour Plan.	Control and remedy	Low. Job security will not continue after the mine has closed.



Environmental component (Aspects affected)	Activity	Potential Impact	Mitigation type Modify/Remedy/ Control/Stop	Potential for residual risk
	Mine Closure	During mine closure, a loss of jobs will occur which may not only impact on the employees but on the socio-economic status of the local community and economy.	Control and remedy	High. Jobs will be lost upon mine Closure.



Other information required by the Competent Authority

10.1. Compliance with the provisions of section 24(4)(a) and (b):read with section 24(3)(a) and (7) of the National Environmental Management Act 107 of 1998. The EIA report must include the:

10.1.1 Impact on the socio-economic conditions of any directly affected person

Table 32: Impact on the socio-economic conditions of any directly affected person

Results of investigation, assessment and evaluation of impact on any directly affected person	Reference to where mitigation is reflected
As per the Social and Labour Plan, during the Life of Mine, Greenside Colliery aims:	Section 8.6.2.
 To promote employment and advance the social and economic welfare of all employees and uplift all stakeholders within the communities in which we operate; To contribute to the transformation of our industry; and To ensure that the holders of mining rights contribute to the socio-economic development of the communities in which they operate, including major labour sending areas. 	

10.1.2 Impact on any national estate referred to in section 3(2) of the National Heritage Resources Act 25 of 1999.

Table 33: Impact on any national estate referred to in section 3(2) of the National Heritage Resources Act 25 of 1999.

Results of investigation, assessment and evaluation of impact on any national estate	Reference to where mitigation is reflected
No impact on national estate (heritage resources) in terms of the Heritage Resources Act (Act 25 of 1999), are identified as part of the project, as the application relates to underground mining.	

11. Other matters required in terms of section 24(4)(a) and (b) of the Act

Section 24(4)(b) of the NEMA (1998), as amended, states that the following:

- "24(4) Procedures for the investigation, assessment and communication of the potential consequences or impacts of activities on the environment -
- (b) must include, with respect to every application for an environmental authorisation and where applicable-



(i) investigation of the potential consequences or impacts of the alternatives to the activity on the environment and assessment of the significance of those potential consequences or impacts, including the option of not implementing the activity;"

The positive and negative implication of the proposed activity and the alternative identified have been provided above under Section 8.7. The positive and negative implications of both the proposed activities and the preliminary identified alternatives will be further assessed as part of the EIAR and EMPr.

