UMSIMBITHI (PTY) LTD

WONDERFONTEIN ENVIRONMENTAL MANAGEMENT PROGRAMME

MP 30/5/1/2/2/359 MR

FINAL

Volume 1 of 2

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEXURES

1 INTRODUCTION

Umsimbithi (Pty) Ltd, a Mbokobo Mining (Pty) Ltd and Anglo Coal joint venture has submitted a mining right application to the Department of Mineral and Energy (DME) to mine coal at various portions of the Farm Wonderfontein 428 JS and also at Portion 14 of Klippan 452 JS between Wonderfontein and Carolina in the Mpumalanga Province. Refer to **Figure 1** showing the locality of the mine. The mine will be developed partly opencast and partly underground. The area has not been mined before, therefore making it a greenfields mining development.

A letter of acceptance was received from the DME on 1 December 2008 (DME Ref No MP 30/5/1/2/2/359 MR). In terms of the acceptance letter dated 1 December 2008 an EMP and the results of public participation have to be compiled and submitted in terms of Section 22 (4) of the Mineral and Petroleum Resources Development Act (MPRDA), 2002 (Act 28 of 2002) and submitted to the DME by 1 June 2009. This document serves and contains the EMP as well as the results of the public participation.

The activity entails the opencast mining of approximately 1320 ha and underground mining on 146 ha. Present information indicate that 90 million ton of 1#, 2#, 4# and 5# seam coal are present within the mining rights application area. This will mean an operational life of 15 to 22 years. Coal will be processed at the approved Wonderfontein processing plant. The development of a coarse coal mine residue deposit facility is also planned to manage coarse coal mine residue generated at the Wonderfontein process plant. The preliminary mining layout is shown in **Figure 2** and the planned time frame of mining in **Figure 3**.

Associated infrastructure will include a crusher, mine residue facilities (discard dump), roads, product coal stockpiles, overburden stockpiles, topsoil stockpiles, diesel storage facilities and pollution control measures. Offices and workshops will also be built.

The planned production rate at Wonderfontein Mine will be approximately 300 000 tons of coal per month and the planned operational mine life is for 15 to 22 years, production volumes may vary due to climatic and geological factors. An assessment indicates that approximately 1320 ha will be mined opencast and a further146 ha underground.

Provision was made for the construction of the initial storage of discard (discard dump with footprint area 8.4 ha) adjacent to the process plant. The future extension of the discard dump however will be placed in a mined out opencast pit (footprint area 78 ha), thereby being a disturbed area by the time of discard placement. Preliminary investigations indicate that a pollution control dam with a capacity of 98 000 m^3 will be adequate to manage the affected water run-off.

Various communities as well as a school are located within and adjacent to the proposed mining area and they will be affected by the proposed mining activities.

1.1 NAME, ADDRESS, TELEPHONE AND FAX NUMBERS OF MINE, MINE OWNER AND MINE MANAGER

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1.2 NAME, ADDRESS AND TELEPHONE NUMBER OF THE MINERAL RIGHTS HOLDER

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1.3 NAME, ADDRESS, TELEPHONE AND FAX NUMBERS OF THE APPLICANT FOR MINING AUTHORISATION

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1.4 NAME AND ADDRESS OF THE OWNER OF THE LAND AND THE TITLE DEED DESCRIPTION

See **Table 1** for the owners and lessees of the farms that will be included in the project. Also see **Annexure 1** for the title deed descriptions.

Table 1: Owners and lessees of farms

FARM NAME	NO	DISTRICT	PORTION	TITLE DEED NO	AREA	REGISTERED OWNER
WONDERFONTEIN	428	JS	RE 12	T1210/1982	195.6362	Umcebo PROP (Pty) Ltd
WONDERFONTEIN	428	JS	RE 13	T115907/1997	195.6362	Corlouis Boerderye Pty Ltd
WONDERFONTEIN	428	JS	17	T24557/1957	1.7131	N.G. Kerk - Belfast
WONDERFONTEIN	428	JS	19	T11209/1979	319.6067	Hoogenoeg Boerdery (Pty) Ltd
WONDERFONTEIN	428	JS	21	T36114/1982	97.8172	Hendrik Francois de Jager
WONDERFONTEIN	428	JS	22	T1279/1993	238.2369	D S van Wyk
WONDERFONTEIN	428	JS	RE 23	T45598/1980	610.7984	Johannes Martinus Stephanus Steele
WONDERFONTEIN	428	JS	15	T3815/2000	163.4563	D S van Wyk
WONDERFONTEIN	428	JS	25	T98933/2000	82.4565	Hendrik Francois de Jager
WONDERFONTEIN	428	JS	26	T29526/1985	147.2373	DS van Wyk
WONDERFONTEIN	428	JS	RE	T39310/1995	152.4898	D S van Wyk
WONDERFONTEIN	428	JS	RE11	T29527/1985	97.8189	Hendrik Francois de Jager
WONDERFONTEIN	428	JS	RE 2	T116467/1997	195.6376	Umcebo PROP (Pty) Ltd
WONDERFONTEIN	428	JS	RE 6	T24559/1957	245.0563	Johannes jacobus Erasmus
WONDERFONTEIN	428	JS	RE 7	T6031/1982	238.2347	Petrus Christiaan van Wyk
WONDERFONTEIN	428	JS	RE 3	T42810/1988	331.2379	Anna Catharina van Vreeden
KLIPPAN	452	JS	14	T98950/1994	1025.48	Corlouis Boerderye Pty Ltd

1.5 NAME AND CONTACT DETAILS OF THE CONSULTANT USED (EAP):

Consultant: Jaco – K Consulting
Contact person: Jaco Kleynhans
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1.6 REGIONAL SETTING

Wonderfontein Mine is situated in the Mpumalanga province, approximately 20 km from Belfast. It bisects the Carolina - Wonderfontein road (R33), 5 km south of the N4 national freeway. The town of Arnot lies approximately 12 km to the south west and Middelburg is approximately 40 km to the west. **Figure 1** indicates the regional setting of the proposed coal mine. The property is represented on the 2529 DD SA 1:50 000 topographical map.

The co-ordinates of the plant site are: Lat: 25°50'44.42" South
Long: 29°52'10.94" East

1.6.1 MAGISTERIAL DISTRICT AND RELEVANT REGIONAL SERVICES COUNCIL AUTHORITY

The proposed mine falls within the Albert Luthuli Local Municipality, in the ward number 21. The geographical area of the ward wherein the proposed mine falls, is 3027.272 square kilometers.

1.6.2 NEIGHBOURING TOWNS

The closest major towns are Belfast, which lies approximately 20 kilometres to the northeast of the proposed mine, and Carolina which lies approximately 35 km southeast of the proposed mine.

1.6.3 SURFACE INFRASTRUCTURE

Figure 4 shows the current infrastructure associated with the site. As indicated, the proposed mine is mainly located between the tarred main road from the N4 to Carolina (the R33) and a secondary tarred road, which goes to Hendrina, but extends beyond the mentioned roads.

A 400kVA Eskom power line traverses in an east-west direction through the centre of the Klippan farm and also traverses the Grootpan-Steelecoal mines. A railway line is situated to the west of the proposed mining area.

The following infrastructure and surface constraints where identified:

- Roads
- Rivers
- Pans
- Plant Position
- Railway and Siding

Rivers will have a 100m boundary (from centre of river) placed on either side and no mining will take place inside these areas. This also applies to the large pan in the South.

The plant will be placed on a portion of the coal, but as the plant position is fixed, approximately 3 million tonnes of ROM is lost.

1.6.4 SERVITUDES

Power line servitude is present in the southern section of the reserve and road reserves are present along the R 33 (Wonderfontein – Carolina) tar road as well as along the D383 road (Wonderfontein Hendrina tar road).

1.6.5 LAND TENURE AND USE OF IMMEDIATELY ADJACENT LAND

The affected and adjacent farms are currently utilised for maize, soy bean, potato and livestock production. As expected, it is historically a strong farming community. However; opencast and underground coal mining activities are currently taking place on the neighbouring farms to the east and south east, being Grootpan, Steelecoal and Klippan mines.

The Morelig School is also located on Portion 17 of the Farm Wonderfontein 428 JS.

See **Figure 5** for a layout map with current land owners.

Table 2: Owners and lessees of farms adjacent to the proposed Wonderfontein Mine

FARM NAME	PORTION	REGISTERED OWNER
Klippan 452 JS	Portion 2, RE	Umcebo Properties (Klippan Mine)
Klippan 452 JS	Portion 6	H.E. Combrink
Klippan 452 JS	Portion 5, RE	F.J.M. Swart
Klippan 452 JS	Portion 10	F.J.M. Swart
Kaalplaats 453 JS	Portion 10	J.M.S. Steele (Steelecoal Mine)
Wonderfontein 428 JS	Portion 26	D.S. van Wyk
Wonderfontein 428 JS	Portion 7	D.S. van Wyk
Wonderfontein 428 JS	Portion 19	Hooggenoeg Boerdery
Wonderfontein 428 JS	Portion 3	A.C. van Vreden
Wonderfontein 428 JS	Portion 20	P.C van Wyk
Wonderfontein 428 JS	Portion 23	J.M.S. Steele
Leeuwfontein 431 JS	Portion 4	J.M.S. Steele
Leeuwfontein 431 JS	Portion 6	J.M.S. Steele
Grootlaagte 449 JS	Portion 14	Corlouis Boerdery

1.6.6 THE RIVER CATCHMENT IN WHICH THE MINE IS SITUATED

The mining area is comprised of various drainage lines in two main catchments areas. The northern part of the Wonderfontein mine drains towards the east forming part of the Blesbokspruit catchment area, whilst the southern half of site drains south towards Wonderfontein itself. The opencast mining area in the northern part does not directly interfere with existing stream or river drainage patterns and hence there will be no river diversions associated with this part of the mining activity.

However, the new proposed opencast area in the southern half which is being applied for will drain to the south, which is to Wonderfontein itself.

1.7 DESCRIPTION OF THE PROPOSED PROJECT

Wonderfontein Mine will be using both opencast (truck and shovel – 1320 ha) and underground mining (146 ha) methods. Present preliminary information indicate that between 90 and 100 million ton of 1#, 2#, 4# and 5# seam coal are present within the mining rights application area. The planned average production rate at Wonderfontein Mine will be approximately 300 000 ton of coal per month which equates to 3 600 000 million ton (3.6 Mt) per year. The planned operational mine life is for 15 to 22 years.

New box-cuts will be developed and the overburden and topsoil will be stockpiled as indicated in **Figure 6**. 2 underground mining areas will be accessed by the existing opencast pits that will be developed adjacent to those areas. The coal will be beneficiated at the approved Wonderfontein Processing plant.

The proposed mining area consists of 7 opencast mining pits and 2 underground mining areas (**Figure 2**). Pit 1 and 2 are the most northern pits, situated east and west of the Wonderfontein-Carolina road respectively. New box cuts will be developed for each of the two pits. Pit 3 and 4 is situated east and west of the Wonderfontein-Hendrina road respectively. Two new boxcuts will have to be developed for each of these two pits. However, the discard dump will be developed on mined out areas in Pit 3. Pit 5 and 6 and one of the underground areas are situated in the centre of the area. Pit 6 will be accessed from Klippan Mine by extending the opencast cut, if opencast mining is approved at Klippan. Pit 5 will be accessed from Pit 6. Pit 6 and 8 and the southern underground mining area are situated south and towards the west of the Klippan pan. Pit 8 will be accessed by extending

the current opencast cut at Steelecoal Mine and Pit 10 underground will be accessed from Pit 6.

A summary of the pits are as follows:

- Pit 1 is bounded by the boundary of the coal seam and the provincial road to the South-East. For drainage considerations it will be mined from the South to the North (The coal seams dips from North to South).
- Pit 2 is bounded by the provincial road and the river. For drainage considerations it will be mined from the South to the North.
- Pit 3 is bounded to the South by a river, to the West by the plant and a secondary tar road, to the North by the coal boundary and to the East by a river. For drainage considerations it will be mined from the South to the North.
- Pit 4 is bounded with the secondary tar road and the coal boundary. For drainage considerations it will be mined from the South to the North.
- Pit 5 starts in the South by a cavity that will be left by mining pit 6. To the East it is bounded by the mineral boundary, to the West it is bounded by the area earmarked for underground mining and to the North by a river. For drainage considerations it will be mined from the South to the North.
- Pit 6 starts in the East with a mining void that will be left by mining which will take place to prior to the Wonderfontein mine starting production. It is bounded to the North and South by pit 5 and 10 and to the West by the boundary of the coal. The pit will be mined from East to West to make use of the mining void that will be left from mining the Klippan area.
- Pit 8 starts in the East with a mining void that was left by mining the adjacent property previously. To the South it is bounded by the mineral boundary, to the North the boundary of the coal and to the West by Pit 5. The pit will be mined from East to West to make use of the mining void that exists.
- Pit 10 underground extends South from Pit 6 and is bounded by a secondary road to the West, a pan to the East and the mineral boundary to the South. It will be mined

underground from North to South to make use of the void that will be left from mining pit 6.

The mine will thus consist of:

- The opencast pit areas, which will progressively be mined and rehabilitated;
- A processing plant will be constructed adjacent to the proposed mining site, on portion 2 of the farm Wonderfontein; - Please note that the processing plant has already been approved as part of an environmental authorisation process and is only considered in terms of the cumulative visual impact;
- Discard dump. Three location alternatives (Options) were considered for the dump. Option 1, which is composed of Option 1B and Option 1 Extension, is situated directly north and east of the processing plant site. Option 2 is situated south of the processing plant site. Option 3, comprises Option 1B and Option 3 Extension, which is situated some distance to the south and away from the main infrastructure complex;
- A stockpile area will be developed on site to store ROM coal at the processing plant;
- A sewerage treatment plant will be developed on site;
- Workshops, administration and other buildings will probably be constructed on site however no accommodation or other recreation facilities are anticipated;
- A mining area pollution control dam will be constructed to which polluted water will be diverted and stored;
- Storm water diversion berms and / or channels will be created to divert and direct storm water around the site;
- Disturbance of wetland areas;
- Additional operational components include trucks that will transport the coal from the mining pit to the ROM stockpile area. Front-end loaders will load the haul trucks that will transport the ROM coal to the processing plant at Wonderfontein; and
- A railway line exists to the west of the proposed mining activity. An additional siding will be constructed on the adjacent Portion 2 of the farm Wonderfontein. Once the coal is processed at the Wonderfontein plant, it will be transported via rail to the various clients. Some coal might be transported by road to other clients. Note that an environmental

authorisation for the construction of the railway line siding was obtained, as part of the Wonderfontein processing plant authorisation.

1.7.1 MINERAL DEPOSIT

The stratigraphy at Wonderfontein consists of 5 coal seams.

- The bottom seam present is the Seam 1 which is represented over approximately 85% of the mining area. The seam varies from 0.5m to 3m with an average seam thickness of 1.42m.
- The parting thickness between Seam 1 and Seam 2 lower varies from 0.1m to 5.5m with the average at 2.79m.
- Seam 1 is overlain by **Seam 2 lower**, which is the major seam represented, covering 100% of the mining area. The seam varies from 0.5m to 5.5m with an average seam thickness of 2.70m.
- The parting thickness between Seam 2 lower and Seam 2 upper varies from 0.1m to 6m with the average at 1m.
- Seam 2 lower is succeeded by **Seam 2 upper** which is only found in the North Western portion of the mining area and covers approximately 30% of the area. The seam varies from 0.8m to 2.47m with an average seam thickness of 1.43m.
- The parting thickness between Seam 2 lower and Seam 4 lower varies from 4m to 28m with the average at 18m.
- **Seam 4 lower** succeeds Seam 2 upper which is only found in the central portion of the mining area and covers approximately 30-35% of the area. The seam varies from 0.8m to 3.3m with an average seam thickness of 1.86m.
- The parting thickness between Seam 4 lower and Seam 5 varies from 0.5m to 14m with the average at 7m.
- The upper seam present is the Seam 5, also found in the same area as Seam 4 lower covering approximately 30% of the mining area. The seam varies from 1m to 3.5m with an average seam thickness of 2.20m.

1.7.2 MINE PRODUCT(S) OR PROSPECTING TARGET MINERAL(S)

Three products will be produced at Wonderfontein namely:

- Metallurgical coal with an Ash value of 17%;
- Export steam coal with a calorific value of 27.2MJ/kg; and
- Eskom grade steam coal with a calorific value of 20MJ/kg.

The basic qualities of the coal are contained in the following table:

Table 3: Wonderfontein Coal Qualities

Qualities	5#	Lower 4#	Upper 2#	Lower 2#	1#
Calorific Value: MJ/kg	19.62	19.79	21.71	22.95	23.48
Volatile Matter:	20.27	20.85	22.26	21.91	29.54
Ash Content:	34.24	32.69	26.99	23.61	24.80
Sulphur:	0.86	0.58	0.74	0.89	1.00

1.7.3 ESTIMATED RESERVES OF EXTENT OF TARGET AREA

The estimated measured was determined to be 90 million tons.

1.7.4 PROPOSED MINING METHOD(S)

As mentioned above, both opencast (roll over method) and underground mining (bord and pillar) methods will be used.

1.7.5 PLANNED PRODUCTION RATE

The planned production rate will be 300 000 ton per month for 15 – 22 years.

1.7.6 PLANNED MINE LIFE

15 – 22 years and a further 3 - 5 years post closure will be used for rehabilitation monitoring.

2 COMPLIANCE WITH SECTION 39 (4) (A) (I)

2.1 SECTION 39 (3) (A) – BASELINE INFORMATION

2.1.1 GEOLOGY

This section was abstracted from the Groundwater report in Annexure 5.

2.1.1.1 Regional Geology

The Wonderfontein coal reserve falls within the Springs-Witbank Coalfield, comprising sediments of the coal-bearing Ecca Group of the Karoo Sequence, which was deposited on an undulating pre-Karoo floor. This had a significant influence on the nature, distribution, and thickness of many of the sedimentary formations, including the coal seams.

The sequence typically comprises, from the base upwards a diamictite of probable glacial origin, pro-glacial varved siltstone and pebbly mudstone, and paraglacial gravel and conglomerate, overlain by swamp, fluviodeltaic and shoreline deposits.

Figure 7: Regional geological map (scanned from Council for Geoscience map)

The five classically recognized coal seams of the Witbank Coalfield, numbered from the base up as Seams -1,2,3,4 and 5 respectively, occur in strata comprised of sandstone with subordinate mudstone, siltstone and shale, and are generally contained within a 70m succession:

- Gluaconitic sandstones, which form distinctive markers, occur above the No's 4A and 5 seams. Strata overlying the Seam-5 are mainly arenaceous;
- The entire sequence has been extensively intruded by pre-Karoo dolerites;
- Coal seam topography and distribution are commonly controlled by pre-Karoo topography, with surface topography limiting the distribution of the Seam-3, Seam-4 and Seam-5;
- Parting thicknesses between seams remains remarkably constant.

The non-Karoo geology can be summarised:

- An inlier of rocks belonging to the Upper Zone of the Rustenburg Layered Suite can be seen to sub-outcrop along the central to southern, and western boundary of the Wonderfontein reserve;
- The western half of the northern reserve boundary is underlain by rocks belonging to the Upper Zone of the Rustenburg Layered Suite and by volcanic rocks of the Dullstroom Formation which belongs to the Pretoria Group;
- The south-eastern corner of the reserve is underlain by volcanic rocks of the Dullstroom Formation that belongs to the Pretoria Group which is partially bounded by Dwyka Group sub-outcrops.

2.1.1.2 Local Geology

Geological information obtained through the Umcebo exploration boreholes in the Wonderfontein reserve, was statistically evaluated and modelled (by the mine geologists and mine design engineer) in respect of lithological thickness and structural compartmentalization.

The extents of the different coal seams indicated the Seam-2L being the most prominent. See **Annexure 5** for figures indicating the extent of the mine layout in relation to the proposed mine layout. Cross sections are also included. A map

showing the Wonderfontein reserve in relation to the mapped surface geology and the Seam-2L coal seam elevation contour map can also be viewed in **Annexure 5**, the Groundwater Assessment.

2.1.1.3 Dykes, sills and faults that extend beyond the property boundary

The following regional occurrences of dolerite were noted:

- A large sill outcrop area is indicated some 5.4km to the south of the reserve area;
- A major northeast trending dolerite dyke is indicated some 17km to the west of the reserve.

2.1.2 CLIMATE

2.1.2.1 Regional climate

Reference is made to the Surface Water Resources of South Africa, 1990, Water Research Commission. Climatological data has been recorded at Belfast, which has a similar altitude to the study area.

The proposed mine is situated on the Highveld, and therefore falls within the summer rainfall region. The Highveld is characterised by thunderstorm activities.

The regional climate can be described as falling within the Highveld climatic zone, which is sub-humid, with a summer rainfall and cold winters. Sub-catchment no. X11C is described as having a mean annual precipitation of 755 mm, and a mean annual evaporation of 1975 mm.

2.1.2.2 Mean monthly and annual rainfall

The second nearest weather station to the Wonderfontein Site is the Nooitgedacht Dam station 0517147, with 48 years recorded daily data available up to date.

Rainfall data from the Nooitgedacht Dam Station (0517147) was obtained from the Department of Water Affairs. Measurements of the weather station started in 1961 and the data obtained reflect measurements up to 28 February 2009 (see **Annexure 4** for more detail).

The monthly rainfall, as a percentage of the mean annual precipitation (MAP), is presented in **Table 4**. The monthly distribution shows a relatively long rainfall season for Southern Africa, with six months receiving more than 50 mm.

The period May to August is dry with only 40.8 mm falling during these months. Most of the annual rainfall occurs during the six months from October to March. Based on these statistics, the peak rainfall month is November.

The mean annual precipitation (MAP) for the site is **723.7 mm/a**, Rainfall Zone X1A (Figure 2 in Annexure A in **Annexure 4**).

Table 4: Monthly Average Precipitation (Nooitgedacht Dam Station 0517147)

MONTH	RAINFALL (ADJUSTED %)	RAINFALL (mm / MONTH)
Jan	17.05	123.4
Feb	12.51	90.5
Mar	10.52	76.1
Apr	5.87	42.5
May	2.18	15.8
Jun	1.23	8.9
Jul	1.05	7.6
Aug	1.18	8.5
Sep	4.10	29.7
Oct	10.79	78.1
Nov	17.38	125.8
Dec	16.14	116.8
Total	**100**	**723.7**

2.1.2.3 Maximum rainfall intensities

Table 5 below indicates the maximum 24-hour rainfall intensities per month.

Table 5: Maximum Rainfall intensities

MONTH	24 HOURS
January	71
February	88
March	55
April	64
May	54
June	19
July	25
August	29
September	48
October	61
November	58
December	87

The maximum 24 hour rainfall intensity is in February, namely 88 mm, and the lowest is in June, 19 mm.

2.1.2.4 Mean monthly maximum and minimum temperatures

The area has a relatively warm Highveld temperature regime. **Table 6** below characterizes the temperature regime of this area.

Table 6: Characterisation of temperature

MEAN MONTHLY MAXIMUM AND MINIMUM TEMPERATURES (ºC)				
Month	**Daily Maximum**	**Daily Minimum**	**Highest Temp.**	**Lowest Temp.**
January	27.2	13.7	32.0	9.1
February	26.8	13.4	30.8	9.0
March	26.8	11.4	30.2	6.4
April	23.9	7.4	27.9	1.4
May	21.3	2.2	26.1	-2.9
June	18.5	-1.8	22.4	-6.0
July	18.4	-1.7	23.0	-5.8
August	21.4	0.8	26.0	-4.1
September	24.0	5.3	29.2	-1.3
October	26.0	10.1	31.2	4.4
November	26.2	11.8	31.8	5.9
December	27.1	13.2	31.2	7.8

2.1.2.5 Mean monthly wind direction and speed

The following table, **Table 7**, presents average monthly wind direction and velocity for the Witbank region. The direction (N) is measured relative to north as the frequency per 1000 readings. The wind velocity (V) is measured in metres per second.

Table 7: Wind Direction and Velocity (N/V) (Witbank Region)

Month	N	NE	E	SE	S	SW	W	NW
Jan	161/3.0	287/3.2	109/3.7	48/4.5	44/3.1	92/3.3	122/3.6	96/3.3
Feb	142/2.9	295/3.2	141/3.9	60/4.2	44/3.1	74/3.4	112/3.4	101/2.9
Mar	152/2.8	304/3.3	139/3.4	63/3.5	36/3.1	54/3.1	100/3.4	104/2.9
Apr	170/2.7	211/3.3	87/3.4	39/3.0	47/3.2	95/3.4	149/3.6	146/2.8
May	172/2.6	166/2.9	67/3.0	51/3.3	59/3.4	89/3.7	162/3.9	167/2.9
Jun	146/2.5	149/3.0	86/3.2	43/3.2	54/3.6	117/3.0	157/3.8	166/2.7
Jul	162/2.5	184/2.9	79/3.4	53/4.2	51/3.9	99/3.9	142/3.6	153/2.8
Aug	174/5.4	180/3.4	83/3.2	40/4.4	40/3.5	86/4.1	141/4.1	182/3.0
Sep	197/3.2	223/3.8	84/4.0	41/3.9	27/3.5	70/3.9	131/4.3	171/3.3
Oct	190/3.4	243/3.7	83/4.3	42/3.6	33/3.6	71/3.6	142/4.0	160/3.8
Nov	174/3.2	225/3.6	92/4.1	40/3.9	28/3.1	68/3.1	185/3.8	154/3.5
Dec	180/3.1	254/3.4	95/4.0	40/4.0	34/3.0	69/3.3	154/3.45	135/3.3
Ave	188/2.0	227/3.3	95/3.7	47/3.8	41/3.3	82/3.8	141/3.8	146/3.1

2.1.2.6 Mean monthly evaporation

The proposed mining operation lies within Evaporation Zone 5A of the Surface Water Resources of South Africa 1990. The monthly evaporation figures as measured at the Nooitgedacht Dam Station X1E003 are as follows:

Table 8: Monthly Average Evaporation (mm) for the Nooitgedacht Dam Station X1E003

Month	Evaporation (mm)
January	198.4
February	170.1
March	166.9
April	126.6
May	110.5
June	108.3
July	98.0
August	124.0
September	150.4
October	167.1
November	166.7
December	189.4
TOTAL ANNUAL	**1776.4**

This information was obtained from the Nooitgedacht dam monitoring station. The information indicates that the seven summer months from September to March constitute 68% of the mean annual evaporation.

The mean annual evaporation (MAE) for the site is **1759 mm/a**, Evaporation Zone 5 (Figure 3 in Annexure A in **Annexure 4**) as calculated for 48 years. See **Annexure 4** for more information.

2.1.2.7 Incidence of extreme weather conditions

Frost: The lowest temperature of –12.4 °C was recorded during 1926. An average of between 120 and 150 days of frost occurs between April and September.

Hail: An average of 2.8 days per year is associated with hail, with the most significant hail event being recorded on 26/12/1940.

Drought: The lowest annual rainfall, recorded during the 53-year rainfall record, was 24 mm.

High winds: The highest wind speed recorded from 1962 to 1988 was 5.7 m/sec (SE) during September.

2.1.3 TOPOGRAPHY

The study area is characterised by undulating, rolling hills and is without any prominent topographical landforms. The highest point in this catchment is 1762.8 masl, with the topography generally sloping towards the Blesbok Spruit. The site itself is representative of the local topography and is slightly undulating with its highest point in the eastern corner. A tributary of the Blesbok Spruit traverses the site from west to east, almost bisecting the coal reserve area which is to be mined.

2.1.4 SOILS

A detailed soil assessment was conducted by Rehab_Green and is included as **Annexure 2**.

The soils were classified according to the Taxonomic System for South Africa (Soil Classification, A Taxonomic System for South Africa, 1991).

Very high potential soils occur in the southern parts of the proposed mining area. Three springs which at the origin of 2 tributaries of the Blesbokspruit occurs just outside the proposed mining area and forms wide wetland zones. Four major pans occur just south of the proposed mining area called Rietpan, Klippan, Blinkpan and Grootpan.

The majority of the area (approximately 41%) is utilized for dry land maize production and 33% for grazing purposes.

The majority of the area consists of gently sloping crests (1-2% slopes), mild sloping midslopes (2-5% slopes) and fairly wide, gently sloping valley bottoms.

A total of 19 soil types, based on dominant soil form and effective soil depth were identified during field observations and were named as: **Hu1**, **Hu2**, **Gf1**, **Cv1**, **Cv2**, **Cv3**, **Cv4**, **Av1**, **Av2**, **Gc1**, **Gc2**, **Dr1**, **Ms/R**, **Ct**, **Dr2**, **Wa1**, **Lo1**, **Lo2** and **Ka**. Two non-soil related units **SW** and **Ext** were included in the legend. Unit **SW** represents surface water such as pans and dams and unit **Ext** represent disturbed land which consists mainly of excavated areas. The extent of these soil types are shown in Figures 2a and 2b in **Annexure 2**.

Red and yellow, well- to moderately drained soils with arable land capability and moderate to high agricultural potential comprises 60.06% (765.88 ha) of the surveyed area. These soils consists of soils types **Hu1**, **Hu2**, **Gf1**, **Cv1**, **Cv2**, **Cv3**, **Av1** and **Gc1**.

Shallow, yellow brown soils with grazing land capability and moderate to low agricultural potential comprises 13.07% (166.41 ha) of the surveyed area. These soils consist of soils types **Cv4**, **Av2** and **Gc2**.

Shallow stony soils with grazing land capability and low agricultural potential comprises 1.98% (25.36 ha) of the surveyed area. These soils consist of soil types **Dr1** and **Ms/R**.

Temporary wetland zones dominated by soil types **Ct**, **Dr2**, **Wa1** and **Lo1** comprises 5.81% (73.95 ha) of the surveyed area. Seasonal wetland zones dominated by soil type **Lo2** comprises 17.92% (228.32 ha) and permanent wetland zones dominated by soil type **Ka** comprises 0.61% (7.7 ha) of the surveyed area.

Surface water comprises 0.3% (3.88 ha) and excavations 0.24% (3.02 ha).

The soil types are summarised in the soils legend (**Table 9**) in terms of the dominant and subdominant soil forms and families, average effective soil depth, the clay content of the A and B- or E- or G-horizon, the texture class, a broad description of the dominant soil form, the agricultural potential, the land capability and the area and percentage comprised by each soil type.

Table 9: Soil legend based on soil types and effective depth

SOIL LEGEND										
Soil Type Code	**Dominant Soil Form and Family**	**Subdominant Soil Form and Family**	**Effective Depth (mm)**	**Clay % A-horizon B/E/G-horizon**	**Texture Class**	**Summarized Description of Dominant Soil Form**	**Agricultural Potential**	**Land Capability**	**Area (ha)**	**Area (%)**
Hu1	Hutton 2100	Bainsvlei 2100, Griffin 2100	1400-1600	A: 15-20 B: 15-30	Sandy loam - sandy clay loam	Very deep, red, structureless, well drained, sandy loam to sandy clay loam soils.	Very high	Arable	246.46	19.338
Hu2	Hutton 2100	Bainsvlei 2100, Griffin 2100, Bloemdal 2100	900-1200	A: 12-18 B: 15-25	Sandy loam - sandy clay loam	Deep, red, structureless, well drained, sandy loam to sandy clay loam soils.	Very high	Arable	27.84	2.185
Gf1	Griffin 2100	Hutton 2100, Clovelly 2100	1400-1600	A: 12-16 B: 15-25	Sandy loam - sandy clay loam	Very deep, yellowish red, structureless, well drained, sandy loam soils.	High	Arable	5.86	0.460
Cv1	Clovelly 2100	Griffiin 2100, Avalon 2100	1200-1500	A: 10-15 B: 12-18	Sandy loam	Very deep, yellow brown, structureless, well drained, sandy loam soils.	High	Arable	27.69	2.172
Cv2	Clovelly 2100	Avalon 2100, Glencoe 2100	900-1200	A: 10-15 B: 12-18	Sandy loam	Deep, yellow brown, structureless, well drained, sandy loam soils.	High	Arable	135.81	10.656
Cv3	Clovelly 2100	Avalon 2100, Glencoe 2100	600-1000	A: 10-15 B: 12-18	Sandy loam	Moderately deep, yellow brown, structureless, well drained, sandy loam soils.	Moderate	Arable	78.44	6.155
Cv4	Clovelly 2100	Mispah 1100, Glencoe 2100, Avalon 2100	300-600	A: 9-12 B: 9-15	Sandy loam	Shallow, yellow brown, structureless, well drained, loamy sand soils underlain by hard or weathered rock.	Moderate-Low	Grazing	39.97	3.136
Av1	Avalon 2100	Clovelly 2100, Glencoe 2100	700-1000	A: 10-14 B: 12-18	Loamy sand - sandy loam	Moderately deep to deep, yellow brown, structureless, moderately drained, sandy loam soils underlain by soft plinthite.	Moderate-high	Arable	205.92	16.157
Av2	Avalon 2100	Dresden, Longlands, Kroonstad, Wasbank	500-800	A: 9-12 B: 9-12	Loamy sand	Temporary seepage zone. Moderately deep, greyish yellow, imperfectly drained, sandy loam soils underlain by soft plinthite.	Moderate-Low	Grazing	8.49	0.667
Gc1	Glencoe 2100	Clovelly 2100, Avalon 2100	600-900	A: 10-14 B: 12-15	Loamy sand	Moderately deep, yellow brown, structureless, moderately drained, sandy loam soils underlain by hard plinthite.	Moderate	Arable	37.84	2.969
Gc2	Glencoe 2100	Clovelly 2100, Avalon 2100, Dresden 1000	400-700	A: 9-12 B: 10-14	Loamy sand	Shallow to moderately deep, yellow brown, structureless, moderately drained, sandy loam soils underlain by hard plinthite.	Moderate-Low	Grazing	117.95	9.254
Dr1	Dresden 2000	Wasbank 1000, Glencoe 2100, Westleigh 2000	50-300	A: 8-10	Loamy sand	Relict seepage zone: Very shallow, greyish yellow, structureless, loamy sand soils underlain by hard plinthite.	Low	Grazing	23.13	1.815

Ms/R	Mispah 1100	Clovelly, Glenrosa, Glencoe	0-400	A: 10-15	Loamy sand	Very shallow, yellow brown, loamy sand soils underlain by hard rock. 5-20 % exposed surface rock.	Low	Grazing	2.23	0.175
Ct	Constantia 1100	Fernwood, Clovelly, Avalon	800-1200	A: 2-8 E: 2-80 B: 5-10	Sandy	Deep, grey and greyish yellow, leached, sandy soils showing signs of wetness in the upper part of the soil profiles.	Low	Wetland-Temporary	7.55	0.593
Dr2	Dresden 2000	Wasbank, Glencoe, Longlands	50-300	A: 5-10	Sandy	Temporary seepage zone: Very shallow, greyish yellow, structureless, loamy sand soils underlain by hard plinthite.	Low	Wetland-Temporary	9.93	0.779
Wa1	Wasbank 1000	Longlands, Dresden, Avalon, Kroonstad	400-800	A: 7-10 E: 2-8	Sand - loamy sand	Moderately deep, grey, imperfectly drained soils underlain by hard plinthite, with signs of wetness and lateral movement of water in the soil profile.	Low	Wetland-Temporary	18.55	1.456
Lo1	Longlands 1000	Wasbank, Dresden, Fernwood, Kroonstad	500-900	A: 7-10 E: 2-8	Sand - loamy sand	Moderately deep, grey, imperfectly drained soils underlain by soft plinthite, with signs of wetness and lateral movement of water in the soil profile.	Low	Wetland-Temporary	37.93	2.976
Lo2	Longlands 1000	Wasbank, Dresden, Fernwood, Kroonstad	500-900	A: 7-10 E: 2-8	Sand - loamy sand	Moderately deep, grey, imperfectly drained soils underlain by soft plinthite, with signs of wetness and lateral movement of water in the soil profile.	Low	Wetland-Seasonal	228.33	17.915
Ka	Katspruit 1000	Kroonstad, Longlands, Fernwood, Wasbank	200-400	A: 20-30 G: 30-40	Loam - clay loam	Shallow, grey, poorly drained soils underlain by gleyed clay, with signs of long term wetness or permanent saturated conditions.	Low	Wetland-Permanent	7.69	0.604
SW	-	-	0	-	-	Open water sources - dams and pans	None	Wetland-Temporary/ Seasonal/ Permanent	3.88	0.305
Exc	-	-	0	-	-	Excavated areas - no topsoil	None	Wilderness	3.02	0.237
								Total	**1274.51**	**100.00**

Derived soil properties of each soil type, e.g. fertility, erodibility, dry land production potential and irrigation potential are given in **Table 10**. Properties were evaluated in terms of three classes: high, moderate, and low with classification in-between these.

Table 10: Other derived soil properties

Soil Type Code	Natural Fertility	Erodibility	Dry land crop production potential	Soil potential for Irrigation
Hu1	Moderate-low	Low	Very high	Very high
Hu2	Moderate-low	Low	Very high	Very high
Gf1	Moderate-low	Low	High	High
Cv1	Moderate-low	Low	High	High
Cv2	Moderate-low	Low	High	High
Cv3	Moderate-low	Low	Moderate	Moderate
Cv4	Moderate-low	Low	Moderate-low	Low
Av1	Moderate-low	Low	Moderate-high	Moderate
Av2	Moderate-low	Low	Moderate-low	Low
Gc1	Moderate-low	Low	Moderate	Moderate
Gc2	Moderate-low	Low	Moderate-low	Low
Dr1	Moderate-low	Low	Low	Low
Ms/R	Moderate-low	Low	Low	Low
Ct	Low	Low	Low	Low
Dr2	Low	Low-moderate	Low	Low
Wa1	Low	Low-moderate	Low	Low
Lo1	Low	Low-moderate	Low	Low
Lo2	Low	Low-moderate	Low	Low
Ka	Moderate	Low-moderate	Low	Low
SW	-	-	None	None
Exc	-	High	Low-none	Low-none

A sample of the A- and B-horizon of the dominant soil types were taken at 15 localities (30 samples). The localities of the sampling points are shown on the detailed soil maps (Figure 2a and 2b) and the soil chemical results are shown in Table 3 of **Annexure 2**.

2.1.5 PRE-MINING LAND CAPABILITY

The pre-mining land capability was determined by the soil specialist and results are shown in **Annexure 2**.

Land capability was assessed according to the definitions of the Chamber of Mines of South Africa and Coaltech Research Association (2007: Guidelines for the Rehabilitation of Mined land. Johannesburg).

The soil characteristics of each soil type are described in the soils legend **Table 9**. The soil types are grouped into land capability classes and shown on the land capability maps, Figures 3a and 3b in **Annexure 2**. **Table 11** shows the soil types grouped into each land capability class, a broad description of the soil group, the number of units per land capability class, and the area and percentage comprised by each land capability class.

Table 11: Areas and percentages of land capability classes

Areas and Percentages Comprised by Land Capability Classes						
Land Capability Code	**Land Capability Class**	***Soil Types**	**Broad Soil Description**	**Unit Count**	**Area (ha)**	**Area (%)**
A	**Arable**	Hu1, Hu2, Gf1, Cv1, Cv2, Cv3, Av1, Gc1	Moderate to very deep red and yellow soils with moderate to very high agricultural potential.	13	765.86	60.090
G	**Grazing**	Cv4, Av2, Gc2, Dr1 and Ms/R	Shallow yellow brown soils and shallow stony soils within soil-rock complexes with moderate-low and low agricultural potential.	11	191.78	15.040
W-T	**Temporary Wetland**	Ct, Dr2, Wa1, Lo1	Predominantly temporary seepage zones. Shallow, greyish, imperfectly drained, sandy soils underlain by hard or soft plinthite.	22	74.22	5.830
W-S	**Seasonal Wetland**	Lo2	Predominantly seasonal wetland zones. Grey, leached, imperfectly drained sandy soils underlain by soft plinthite.	9	228.95	17.970
W-P	**Permanent Wetland**	Ka	Pan. Grey, mottled soils underlain by gleyed clay showing signs of prolonged wetness.	2	10.68	0.840
W	**Wilderness**	Exc	Excavations – no topsoil	6	3.02	0.240
*See soil map, Figure 2 in **Annexure 2**			**Total**	**63**	**1274.51**	**100.0**

The outer edge of the wetlands was accurately located by means of systematic auger observations towards the wetlands. The temporary, seasonal and permanent wetland zones within each wetland were not mapped. The total wetland was classified in one of these zones based on the dominant zone covering the largest area of the wetland.

Small seepage zones, wet spots and pans were mostly classified as temporary wetland zones. Wider drainage lines and seepage zones were mostly classified as seasonal wetland zones although parts of it might consist of permanent zones. The edges of big perennial pans were classified as permanent zones.

2.1.6 LAND USE

The localities and extent of land use practices were surveyed during the time of the soil assessment. See **Annexure 2** for more detail.

The majority of the surveyed area is utilized for dry land maize production which comprises 40.95% (521.9 ha) of the proposed mining area. Portions of irrigated maize fields within the proposed mining area comprises 6.88% (87.69 ha). Soybeans, sugar beans and potatoes are produced in crop rotating systems. Areas permanently used for grazing purposes (mainly cattle farming) comprises 32.91% (419.48 ha) of the surveyed area.

The extent of land use practices were surveyed during the time of the soil assessment and are shown on the land use maps, Figure 4a and 4b of the soil specialist report in **Annexure 2**. **Table 12** shows the current land use, the number of units per land use and the area and percentage comprised by each land use within the proposed mining area.

Table 12: Areas and percentages of current land uses

LEGEND – CURRENT LAND USE				
Land Use Code	**Current Land Use**	**Unit Count**	**Area (ha)**	**Area (%)**
M-Irr	Maize – Irrigated with centre pivots	3	87.69	6.879
M-D	Maize - Dry land	21	521.90	40.950
S-D	Soybeans - dry land	2	54.30	4.260
P	Pasture	6	83.02	6.515
SG	Sugar graze	4	21.04	1.651
G	Grazing –Mainly commercial cattle farming.	17	419.48	32.913
V-G	Vacant /Grazing – Patches with no specific land use which consists mainly of shallow and wet patches within maize fields - grazed only in winter together with maize rest.	30	53.50	4.200
DF	Dairy farm – Area occupied by related buildings and handling facilities	1	6.50	0.510
FS	Farmstead and related farming structures and buildings.	5	8.87	0.697

LEGEND – CURRENT LAND USE				
Land Use Code	**Current Land Use**	**Unit Count**	**Area (ha)**	**Area (%)**
S	Local school	1	2.35	0.185
GY	Graveyard	5	0.50	0.040
LV	Labourer village	6	6.67	0.524
BT	Bluegum trees	1	3.17	0.249
SW	Surface water – Dams and pans	3	3.88	0.305
OC	Mining opencast - box cut	1	1.61	0.127
	TOTAL		**1274.48**	**100.00**

2.1.6.1 Historical agricultural production

Crop yields vary from farm to farm and even between different fields on the same farm due to varying characteristics of soil types such as effective soil depth, soil texture, soil water holding capacity, annual precipitation and farm management and therefore crop yields are strongly correlated with soil properties. Long term average crop yields were obtained from the current farmers as show in **Table 13**. The yields are mostly determined by a combine harvester with a global positioning system.

Table 13: Historical agricultural production

Product	*Soil Types)	Derived soil potential	Potential Yield (tons/ha/annum)
Klippan ptn 14, Wonderfontein Ptn 13 – L and P Bezuidenhoudt (5 years)			
Maize (Supported by irrigation)	Hu1, Hu2	Very high	8-10
Maize (Dry land)	Hu1, Hu2,	Very high	7-8
Maize (Dry land)	Cv1, Av1, Gc1	Moderate to high	5-7
Soybeans (Dry land)	Hu1, Hu2	Very high	2
Potatoes (Supported by irrigation)	Hu1, Hu2	Very high	55 (5500 sachets)
Pasture - *Eragrostis curvila*	Cv2, Cv4	Moderate to low	16x1.5m bales Or 16x280 kg = 4.48 tons
Grazing - Including maize rests	Av1, Cv4, Lo1, Lo2	Moderate to low	3ha/LSU

Product	*Soil Types)	Derived soil potential	Potential Yield (tons/ha/annum)
(Livestock - Cattle)			
Portion 15 and 22 Wonderfontein 428 JS – D van Wyk (10 years)			
Maize (Dry land)	Av1, Cv2	Moderate to high	7
Soybeans	Av1, Cv2		2.5-3 (2 years)
Portion 11, 21 and 25 Wonderfontein 428 JS – H de Jager (10 years)			
Maize (Dry land)	Hu2, Av1	Moderate – very high	5-6.5
Dairy farm (Milk - 150 cows)	Gc2, Dr1, Dr2, Lo2	Moderate to low	90 000 liter/month Or 1.1 million liter per annum
Portion 23 Wonderfontein 428 JS – J Steel			
Maize (Dry land)	Hu2, Cv3	Moderate – very high	5-7

2.1.6.2 Evidence of misuse

No evidence of misuse was observed.

2.1.6.3 Existing structures

Existing structures are 5 farmsteads, a dairy farm with related facilities, a local school, 5 local graveyards, 6 labourer villages, 3 farm dams, 3 centre pivots, 2 power lines and numerous farm fences as indicated on the Land use maps Figures 4a and 4b in **Annexure 2**.

2.1.7 NATURAL VEGETATION

A detailed ecological assessment was conducted by Scientific Aquatic Services and is attached in Annexure 3.

The assessment site falls within the Grassland biome and the Mesic Highveld Grassland bioregion. Recent vegetation classifications describe the vegetation of the area as that belonging to the Rand and Eastern Highveld Grassland vegetation types (Mucina & Rutherford, 2006).

Regarding the vegetation type occurring at the site, it is evident that the site falls within the Eastern Highveld Grassland and the Eastern Temperate Freshwater Wetland vegetation types.

During the field visits it was noted that the majority of the assessment site has been transformed for the farming of maize. Some other areas within the assessment site that would have historically been home to terrestrial grasslands have not been cultivated due to a very stony substrate. However, these areas have been used as grazing lands for livestock and as such have become dominated by *Hyparrhenia dissoluta*, *Eragrostis rotifer*, *E. gummiflua*, *E. curvula*, *Pogonarthria squarrosa*, *Aristida*

congesta and *Stoebe vulgaris*, species that are common in sandy, disturbed veld.

Three wetland systems were found within the assessment site. Two of these systems (Klippan and Pan 2) have been broadly described as belonging to the Eastern Temperate Freshwater Wetlands, a habitat type that is associated with large pans and adjacent wetlands. In addition, another system, referred to in this report as the Wonderfontein Wetland System, was found in the interior of the assessment site. This wetland is formed around a series of small, interconnected streams. While some portions of the permanent and seasonal zones of these systems have been degraded by the construction of farm dams, the majority are still in relatively good condition are dominated by such species as *Typha capensis*, *Phragmites australis*, *Imperata cylindrica*, *Andropogon sp*., *Cyperus sp.* and *Agrostis lachnantha* and as such should be regarded as ecologically sensitive. The temporary zones have been degraded by the presence of livestock; encroachment of maize farming, invasion by exotic species, resulting in a homogenous vegetation pattern, being almost completely dominated by

Eragrostis plana. Care should be taken during the construction phase to minimise the impact to the wetland habitats found within the proposed development site.

2.1.7.1 Dominant species

As mentioned the site falls within the Eastern Highveld Grassland vegetation type, and one can expect the species associated with this vegetation type to occur here. Eastern Temperate Freshwater Wetland vegetation types also occur.

For descriptive purposes the assessment site has been broken down into several habitats, based on the dominant floral species. See Figure 4 in **Annexure 3** for the divisions of the different habitat types.

Farmland

A large portion of the assessment site is agricultural land. The most abundant crop is maize (*Zea mays*) but *Sorghum bicolor* is also cultivated. While most of the farmland is currently being used as growing fields, a few fields have been abandoned, resulting in them being invaded by exotic species, especially *Tagetes minuta*, *Bidens formosa*, *Bidens pilosa* and *Datura sp*.

Scattered throughout the assessment site were the residences of the farmers who manage these agricultural lands. Within the residences, the dominant grass species was the exotic *Pennisetum clandestinum*. These areas also had a woody species component; however, the vast majority of these species are exotic, e.g. *Pinus sp*., *Eucalyptus camaldulensis* and *Acacia mearnsii*.

These areas have been extensively transformed and are no longer representative of the Eastern Highveld Grassland vegetation type.

Transformed grasslands

Certain portions of the assessment site have not been used for the cultivation of crops. In these areas, the top soil is sand but underneath this layer it becomes fairly rocky and stony. This would make ploughing, planting and harvesting crops more difficult and as such these areas have rather been used as grazing lands for livestock. Here, the vegetation is dominated by grass and forb species that are common in sandy, disturbed and overgrazed areas, such as: *Hyparrhenia dissoluta*, *Eragrostis rotifer*, E*. gummiflua*, *E. curvula*, *Pogonarthria squarrosa*, *Aristida congesta* and *Stoebe vulgaris*.

Wetlands

Wetlands were observed within the assessment site. The dominant vegetation found within the different zones of the wetlands is presented in the following table.

Table 14: Wetland vegetation types

Terrestrial species	Temporary zone species	Seasonal zone species	Permanent zone species
Hyperthelia dissoluta	*Hyparrhenia tamba*	*Imperata cylindrica*	*Imperata cylindrica*
Themeda triandra	*Eragrostis plana*	*Pennisetum thunbergii*	*Limosella maior*
Zea mays	*Pennisetum clandestinum*	*Eragrostis inamoena*	*Typha capensis*
Tagetes minuta	*Cyperus sp.*	*Agrostis lachnantha*	*Phragmites australis*
Bidens formosa	*Berkeya radula*	*Cyperus sp.*	
Helichrysum nudifolium	***Verbena bonariensis***	*Andropogon eucomus*	
Asclepias burchellii	*Eragrostis gummiflua*	*Andropogon huillensis*	
Eragrostis gummiflua			

Note: Exotic species are shown in bold, blue text

Not all the wetlands within the assessment site are in the same condition and so will be described separately:

- Wonderfontein wetland

This wetland system is formed around a series of small interconnected streams that flow within the property of the proposed development. The streams themselves and the adjacent seasonal zones of the wetland are dominated by such species as *Agrostis lachnantha*, *Andropogon huillensis*, *A. eucomus*, *Imperata cylindrica* and *Cyperus sp*. In contrast, the large temporary zones of the wetland are almost completely dominated by *Eragrostis plana*. This grass species is common in damp and trampled veld, and therefore the presence of cattle has facilitated the proliferation of this species.Almost all the zones of the wetland have been degraded in some way or another. In the permanent and seasonal zones, this is due to the construction of farm dams. However, despite this degradation these areas still provide habitat for a variety of plants and animals and as such contribute to the overall biodiversity of the assessment site. With regards to the temporary zone, certain portions have been transformed into agricultural land and the rest has been used as grazing lands for cattle, resulting in the dominance of *Eragrostis plana*. In addition, the exotic invasive *Eucalyptus camaldulensis* is seen in some of this area. The homogenous nature of the temporary zone lowers its ecological value from the perspective of how many plant and animal species it supports; however, from a

functional point of view, it still retains some value as it helps sustain the overall wetland system.

- Klippan wetland system

This system is found in the south of the assessment site. This wetland system takes the form of a series of small streams that flow almost parallel to one another down one large hill before terminating in the Klippan. Adjacent to the small streams are seasonal wetlands that are dominated by *Agrostis lachnantha*, *Andropogon huillensis*, *A. eucomus*, *Hyparrhenia tamba*, *Imperata cylindrical* and *Cyperus sp.* These seasonal zones then transition into temporary zones, which are largely dominated by *Eragrostis plana*, which has come to dominate due to the presence of grazing livestock. In addition, these sections of the wetland have been degraded by the encroachment of farming and invasion by exotic species, particularly *Pennisetum clandestinum* and *Tagetes minuta*.

While the temporary zones have been degraded the seasonal zones are still in relatively good condition and home to a variety of plant species. In addition, these wetlands are important as they help sustain the Klippan. Klippan itself was investigated by Natural Scientific Services (2006) and was found be ecologically valuable in the sense that it provided habitat to a variety of plant and animal species, particularly large flocks of migratory birds, e.g. the Lesser Flamingo (*Phoenicopterus rubber*) which is categorised as Near Threatened and which have been recorded at the site.

- Pan 2

This pan is located in the north western section of the assessment site. Within the pan itself, aquatic species such as *Phragmites australis*, *Typha capensis* and *Schoenoplectus sp.* were found. Moving out of the pan and into the surrounding wetland, *Cyperus sp*. become more prevalent before giving way to such graminoid species as *Aristida congesta*, *Hyparrhenia hirta*, *Eragrostis plana*, *Pogonarthria squarrosa* and *Themeda triandra* (Scientific aquatic Services; 2006).

The ecological integrity of this pan has been altered by the construction of a railway, which not only bisects the pan itself but it also acts as a recruitment centre for exotic species, e.g. the exotic trees *Acacia mearnsii* and *Eucalyptus camaldulensis*.

In addition to these, other exotic species such as *Tagetes minuta*, *Bidens formosa* and *B. pilosa* are commonly encountered (Scientific aquatic Services 2006).

Despite some level of degradation, the pan and associated wetland still provide an aquatic microhabitat for aquatic-dependent floral and faunal species within an area that has almost been completely transformed for agricultural purposes (Scientific Aquatic Services).

2.1.7.2 Endangered or rare species

No red data floral species were found during the assessment.

By conserving the wetland areas of the habitat for the RDL species with a high POC of occurring on the site will be afforded which in turn will allow for ongoing sustainability of the populations should they in fact occur in the area.

2.1.7.3 Intruder or exotic species

Numerous exotic species were found throughout the site. *Tagetes minuta* and *Bidens formosa* have infested abandoned agricultural fields. Where these abandoned fields have encroached into a wetland, exotic species such as *Bidens formosa* and *Pennisetum clandestinum* have invaded and degraded the wetland.

Other exotic species encountered were *Pinus sp. Acacia mearnsii* and *Eucalyptus camaldulensis*. This species were generally encountered close to human residences and wetlands. It is recommended that alien vegetation and invasive species be removed as part of the landscaping activities to be completed once the civil works have drawn to a conclusion.

2.1.8 ANIMAL LIFE

A detailed ecological assessment was conducted by Scientific Aquatic Services and is attached in **Annexure 3**.

2.1.8.1 Mammals

During the field visit, a yellow mongoose (*Cynictus penicillata*), scrub hare (*Lepus saxatalis*), Grey Duiker (*Sylvicapra grimmia*), Steenbok (*Raphicerus campestris*) and Blue Wildebeest (*Connochaetes taurinus*) were directly observed, while evidence of porcupine (*Hystrix africaeaustralis*) was indirectly observed. Under the

IUCN, these species are designated as least concern, a category that is made up off widespread and abundant taxa.

Portions of the assessment site are still in relatively good condition and therefore are likely to support a diversity of mammal species.

2.1.8.2 Birds

In general, the majority of the birds observed within the assessment site were in the maize fields and wetlands. The maize lands were dominated by Helmeted Guineafowl, Swainson's Francolin and Redbilled Quelea, while the wetlands were home to such species as Orangethroated Longclaw, Marsh Owl, Egyptian Goose, Spurwinged Goose, Blackheaded Heron, Blacksmith Plover and Redknobbed Coot. The majority of the birds observed during the field visits were all common species, the exception being a Southern Bald Ibis, which is a Red Data species, falling into the vulnerable category. This bird was seen within the Wonderfontein Wetland system.

2.1.8.3 Reptiles

No reptile species were observed during the assessment but this is probably more due to their cryptic nature than the lack of available habitat. The majority of the assessment took place during cooler periods when these species are less active.

This is also likely to have played a role in the absence of species observed during the assessment.

2.1.8.4 Amphibians

No amphibian species were directly observed but species were heard calling. Given the presence of the wetlands the assessment site is likely to support an abundance of frog species. However, the majority of listed frog species in the 2003 Mpumalanga State of Environment Report are not likely to be found at the assessment site because the site falls out of the boundaries of their historical distribution. The exception is the Giant Bullfrog, whose distribution just extends to include the assessment site. By conserving the wetland habitats on the propos subject property, adequate protection of the habitat for these species will be afforded.

2.1.8.5 Invertebratas

During the field study it was found that the subject property had an abundance of insects but a low diversity of families were represented The most prevalent species were members of the Grasshopper family, *Acrididae*, and the Foam/lubber grasshopper family, *Pyrgomorphidae*, which is to be expected given the presence of grasslands and agricultural lands on the property. Other common insects that were observed included a variety of butterflies form the *Nymphalide* and *Pieridae* families; Ants, Honey bees, Ladybirds and Houseflies. In addition, the presence of the wetlands means that insects with aquatic stages in their life history were common, particularly the dragonfly family *Libellulidae*, the damselfly family *Coenagrionidae*, and the Hemipteran family *Gerridae*.

2.1.8.6 Endangered or rare species

One red data fauna species were found during the assessment. The RDSIS for the site showed 31 (12 mammals, 16 birds, one invertebrate, one amphibian and one reptile) red and orange listed species to have a 60% or greater probability of occurrence of the site. The overall RDSIS value for the site was 51%. This is a medium value, indicating that the assessment site is fairly important for RDL species conservation within the region.

The southern bald ibis, which falls into the vulnerable category of the red data list, was observed within the Wonderfontein Wetland System.

2.1.9 SURFACE WATER

A detailed surface water assessment was conducted by InterCiv and is attached in **Annexure 4**.

The Wonderfontein Site is located in the X11C Quaternary Sub-catchment in the upper reaches of the Komati River Primary Catchment area (refer Figure 2 in Annexure A in **Annexure 4**).

Refer Figure 5 in Annexure A in **Annexure 4** for the layout of all rivers and streams located from the 1:50 000 topographical maps of the area between the Wonderfontein Mine and the Nooitgedacht Dam.

The X11C Quaternary Sub-catchment drains directly into the Nooitgedacht Dam. The following formal rivers have been identified in the X11C Quaternary Sub-catchment area:

Table 15: Formal rivers downstream from Wonderfontein Site

Item	River Name	River Length
1	Leeubankspruit	10.6 km
2	Blesbokspruit	5 km
3	Witkloofspruit	15.5 km

The Wonderfontein Site drains towards five tributaries (labelled in the surface water study as Stream 1 to Stream 5) of the Blesbokspruit River. The Blesbokspruit River discharges into the Witkloofspruit River, a tributary of the Nooitgedacht Dam.

The following pans have been identified on the 1:50 000 topographical maps (refer Figures 5 and 7 in Annexure A in **Annexure 4**) that will receive runoff water from the Wonderfontein Site:

Table 16: Pans affected by the Wonderfontein Site

Pan Name	Surface Area	Catchment Area
Klippan	2.63 km^2	21.74km^2
Pan 1	0.25 km^2	1.69km^2

Refer to Figures 5 & 7 in Annexure A in **Annexure 4**.The streams flowing across/near the Wonderfontein Mining Site are labelled as “Stream 1, Stream 2, Stream 3, Stream 4 and Stream 5” with their catchments indicated.

All five these streams discharge into the Blesbokspruit River, which ultimately discharges into the Nooitgedacht Dam.

The following table summarizes the characteristics of these five streams:

Table 17: Receiving streams from the Wonderfontein Site

River Name	Length	Slope (average)	Catchment Area
Stream 1	6.1 km	1: 80	14.55 km^2
Stream 2	3.6 km	1: 92	16.16 km^2
Stream 3	1.6 km	1: 170	6.5 km^2
Stream 4	2.5 km	1: 185	5.51 km^2
Stream 5	0.7 km	1: 101	0.7 km^2

2.1.9.1 Surface Water Quantity

Mean Annual Runoff

The Wonderfontein Site is located in the Hydro Zone P (refer Figure 4 in Annexure A in **Annexure 2**). There are no river gauge stations in the rivers/stream located on the Wonderfontein Site property (in the quaternary sub-catchment X11C). The only registered river stream gauge station is located approximately 28km downstream at the Nooitgedacht Dam. Readings from this station is not only limited to discharge from the Wonderfontein Site quaternary sub-catchment area X11C but also inflows from the Komati river and other rivers in the quaternary sub-catchment areas X11A and X11B, with the most inflows originating from the X11A (Komati river) catchment area.

The following information was obtained from the Surface Water Resources of South Africa (Volume VI, Water Research Commission, 1990) regarding the Quaternary Sub-catchment X11C:

Table 18: Quaternary Sub-catchment X11C:

Catchment Area	Forest Area	MAP (mm/a)	MAE (mm/a)	MAR (mm/a)	MAR ($10^6 m^3/a$)
319 km^2	5 km^2	716	1450	**45**	14.2

The catchment MAR (mm) for the X11C Quaternary sub-catchment area provided by the WRC is **45 mm/a** relating to a total annual volume of **14.2 mil m^3/a**.

The size of the Wonderfontein Mining area (including the opencast area, plant, dumps and siding area) is 16.43km^2. The natural pre-mining catchment area of the Wonderfontein Mining area is 27.1km^2.

Utilizing the rainfall/runoff response mentioned above, the expected mean annual runoff for the natural catchment areas of the Wonderfontein Mine area on the site is shown in the following table:

Table 19: Natural MAR for Wonderfontein Mine Site

Entity	Natural Catchment (km^2)	Mine Size (km^2)	% of catchment	MAR (Mine Natural catchment) (mil m^3)	MAR (Mining Area) (mil m^3)
Wonderfontein Mine	24.707	16.43	66%	1.112	0.739

The pre-mining natural surface water runoff from the natural catchment area of the Wonderfontein Mining site is **1.112 mil m^3/a**. The proportion of runoff originating on the Wonderfontein Mine boundary area is **0.739mil m^3**, constituting 66% of the mine's natural catchment.

As mentioned the total runoff from the Quaternary Catchment area X11C is 14.2 mil m^3 /a (source: Surface Water Resources of South Africa, Volume VI).

Therefore, the total natural pre-mining mean annual runoff originating on the Wonderfontein Mine site constitutes 5.21% of the Quaternary Sub-Catchment X11C's mean annual runoff.

The MAR of the natural streams is reflected in the following table:

Table 20: Wonderfontein Mine Natural Stream MAR (mil m^3/a)

Stream Nr	Catchment Area	MAR (million m3)	% of Quaternary Catchment X11C
Stream 1	14.55 km^2	0.655	4.61%
Stream 2	16.16 km^2	0.727	5.12%
Stream 3	6.5 km^2	0.293	2.06%
Stream 4	5.51 km^2	0.248	1.73%
Stream 5	0.7 km^2	0.032	0.23%

The above table reflects the proportional runoff from each stream within the Quaternary Sub-Catchment X11C which has a catchment area of 319km^2 and MAR of 14.2 mil m^3.

Flood peaks and volumes

The calculated 24hr maximum storm precipitation for various recurrence intervals for the chosen weather station (Nooitgedacht Dam Station) is reflected in the table below:

Table 21: Flood peaks

1:2	1:10	*1:20*	*1:50*	*1:100*	1:200	1:500	1:1000	1:10000
43mm	79mm	93mm	111mm	124mm	137mm	155mm	168mm	212mm

The following table reflects a summary of the flood peak discharge for various recurrence intervals for all the streams within the Wonderfontein Mine property:

Table 22: Results of Flood Peak Runoff (m^3/s) for streams inside Wonderfontein Property

Stream Name	1:2	1:5	1:10	1:20	1:50	1:100
Stream 1	24	41	57	69	93	119
Stream 2	33	56	79	96	128	163
Stream 3	16	28	39	48	64	82
Stream 4	62	108	152	184	247	314
Stream 5	2	4	6	7	10	12

The following table reflects a summary of the flood discharge volumes for various recurrence intervals for all the streams within the Wonderfontein Mine property:

Table 23: Results of Flood Volumes (mil m^3) for streams inside Wonderfontein Property

Stream Name	1:2	1:5	1:10	1:20	1:50	1:100
Stream 1	0.19	0.32	0.44	0.53	0.72	0.92

Stream Name	1:2	1:5	1:10	1:20	1:50	1:100
Stream 2	0.18	0.31	0.43	0.52	0.70	0.90
Stream 3	0.06	0.10	0.13	0.16	0.22	0.28
Stream 4	0.30	0.52	0.72	0.87	1.18	1.51
Stream 5	0.004	0.007	0.009	0.011	0.015	0.019

The positions of the 100m offset lines are indicated on Figure 6 in Annexure A of **Annexure 4**.

2.1.9.2 Surface Water Quality

Water samples have been collected on and around the site at four different points the past two years. The purpose of water sampling is to gather some baseline information prior to the proposed operations. Results can be viewed in **Table 24**, refer to **Figure 25** showing the locality of the monitoring points. Please note that only a summary of the 4 points are given in the table below. The water qualities can be viewed in **Annexure 1**.

Table 24: Surface water qualities (SANS 241 (2005))

	WS1		WS2		WS3		SW4	
Analysis Results mg/l	**Avg**	**P75**	**Avg**	**P75**	**Avg**	**P75**	**Avg**	**P75**
Total Dissolved Solids	4533.85	4177.00	2819.73	2490.00	102.60	106.50	111.52	114.00
Suspended Solids	384.92	571.75	468.95	591.25	84.77	38.60	32.54	40.00
Nitrate & Nitrite as N	0.49	0.63	0.46	0.39	0.15	0.19	0.41	0.30
Chlorides as Cl	1479.96	1446.25	767.14	754.00	18.40	20.00	16.36	18.00
Total Alkalinity as $CaCO_3$	743.62	764.50	832.73	983.00	45.20	44.75	35.32	48.00
Fluoride as F	2.05	2.77	1.30	1.40	0.33	0.39	0.26	0.27
Sulphate as SO_4	600.50	437.25	276.92	315.75	11.72	14.10	28.51	30.70
Total Hardness as $CaCO_3$	87.85	92.81	78.79	90.85	47.66	46.50	51.32	47.00
Calcium Hardness as $CaCO_3$	50.14	56.61	73.01	71.25	28.40	25.00	26.23	23.00
Magnesium Hardness as $CaCO_3$	37.64	39.72	23.96	27.92	19.23	21.00	25.20	26.42
Calcium as Ca	20.08	22.65	21.96	27.00	11.37	10.12	10.60	9.37
Magnesium as Mg	9.17	9.63	5.82	6.75	4.65	5.05	5.80	5.82

	WS1		WS2		WS3		SW4	
Analysis Results mg/l	**Avg**	**P75**	**Avg**	**P75**	**Avg**	**P75**	**Avg**	**P75**
Sodium as Na	1445.87	1405.00	911.14	758.75	11.25	11.78	11.36	12.90
Potassium as K	53.48	48.28	59.55	65.65	5.37	6.26	3.62	4.80
Iron as Fe	3.05	3.78	5.76	7.49	1.27	1.62	2.24	2.99
Manganese as Mn	0.11	0.14	0.33	0.38	0.13	0.04	0.14	0.07
Conductivity at 25° C in mS/m	685.52	714.50	425.69	399.00	16.04	16.76	17.05	18.39
pH-Value at 25 ° C	9.00	9.63	8.27	8.92	7.73	8.10	7.23	7.42
pHs by 21° Celsius	7.81	7.67	7.43	7.62	11.14	8.58	8.64	8.92
Langelier Saturation Index	-0.51	-0.27	-0.27	-0.27	-0.90	-0.65	-1.85	-1.41
Turbidity as N.T.U.	393.80	432.00	497.55	476.50	39.47	21.50	42.17	47.00
Free Residual Chlorine Cl_2	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Boron as B	0.01	0.01	0.01	0.01	0.01	0.01	0.36	0.53
Aluminium as Al	3.19	3.84	3.97	4.47	0.08		0.66	0.77

Yellow: Exceeding Class 1 Lower limit (Recommended Operational Limit)

Orange: Exceeding Class 1 Recommended Operational Upper Limit

Red: Exceeding Class 2 Maximum allowable for limited duration

WS 1 and WS 2 are both pans in the Wonderfontein Area. High levels of TDS, conductivity, chlorides, fluoride, sulphates, sodium, and potassium are present here, as well as elevated metal concentrations (Fe, Al and Mn). This forms part of the baseline information, since no mining has been conducted in the areas close to the pans. See Annexure 1 for the surface water qualities as measured over the period starting in September 2006 until February 2009.

WS 3 is the clean water dam located at Portion 2 of the farm Wonderfontein, within close proximity where the process plant is going to be constructed. This is the farmer, Petie Bezuidenhout's dam. The water quality of this dam is very good although slightly elevated metal concentrations are present. It is therefore clear that this area has elevated metal concentrations in the water.

SW4 is a downstream point in the Blesbokspruit River. The sample is taken at the bridge on the R33 road to Carolina. It is also clear that the water quality is very good, except for elevated metal concentrations (Fe, Mn and Al). This could be due to the natural geology of the area causing elevated metal concentrations in the water.

The Nooitgedacht Dam was recently included in the surface water monitoring programme. The water quality as tested in April 2009 was as follow:

Table 25: Nooitgedacht Dam Water Quality

pH value at 25°C	7.88
Conductivity in mS/m	17.5
Total Dissolved Solids	122
Total Acidity as CaCO3 to pH 8.3	<2
Calcium as Ca	12.8
Magnesium as Mg	7.56
Sodium as Na	10.3
Potassium as K	2.53
Sulphate as SO4	23.5
Chloride as Cl	10
Fluoride as F	<0.20
Iron as Fe	<0.01
Manganese as Mn	<0.01
Aluminium as Al	0.04
Nitrate & Nitrite as N	<0.1
Total Alkalinity as CaCO3	56

2.1.9.3 Drainage density

The drainage density is the total length of all the streams and rivers in the study area divided by the total area of each catchment. The following table reflects the catchment areas of all the above mentioned river and streams, with their stream lengths as well as the drainage density of each:

Table 26: Wonderfontein Mine Natural Stream Drainage Densities (km/km^2)

River Name	Catchment Area	Stream Length	Drainage Density
Stream 1	14.55 km^2	6.1 km	0.4192
Stream 2	16.16 km^2	3.6 km	0.2228
Stream 3	6.5 km^2	1.6 km	0.246
Stream 4	5.51 km^2	2.5 km	0.45
Stream 5	0.7 km^2	0.7 km	1

2.1.9.4 *Dry Weather Flows*

Dry Weather Flows (also known as "Normal Flows") is often estimated as the flow available 70% of the time during the critical season (i.e. period of maximum demand and minimum streamflow). In the summer rainfall region this occurs usually from the beginning of August to October or November, in the winter rainfall season from January to April, viz a period of about 3 to 4 months (Surface Water Resources of South Africa, 1990, User's Manual, WRC).

See **Annexure 4** for more detailed information.

Table 27: Natural Dry Weather Flow originating from the Wonderfontein Mine Site

Catchment	MAR (million m3)	Annual Dry Weather Flow (mil m3/annum)	Monthly Dry Weather Flow (mil m3/month)	Dry weather flow (l/s)
Wonderfontein property	0.740	0.0252	0.0084	3.19

The dry weather flows for the following streams can be determined:

Table 28: Wonderfontein Mine Natural Stream Dry Weather Flows

Stream Nr	MAR (million m^3)	Annual Dry Weather Flow (mil m^3/annum)	Monthly Dry Weather Flow (mil m^3/month)	Dry weather flow (l/s)
Stream 1	0.655	0.0222	0.0074	2.83
Stream 2	0.727	0.0247	0.0082	3.13
Stream 3	0.293	0.0100	0.00332	1.26
Stream 4	0.248	0.0084	0.00281	1.07
Stream 5	0.032	0.0011	0.0004	0.14

2.1.9.5 *Surface water use*

Surface water is used by live-stock, irrigation and domestic use.

2.1.9.6 Water authority

Department of Water Affairs and Forestry: Mpumalanga Regional Office, Nelspruit.

2.1.9.7 Wetlands

As mentioned above in **sections 2.1.4** and **2.1.7.1**. Wetland systems occur on site. See those sections for more detailed descriptions regarding the wetlands as well as **Annexure 2** and **Annexure 3**.

2.1.9.8 River Diversions

No river diversion is considered.

2.1.10 GROUNDWATER

A detailed groundwater assessment was conducted for the site my Groundwater Square and the results of the assessment is shown in **Annexure 5**.

2.1.10.1 Hydrocencus

Hydrocensus information of external groundwater users within a 1km to 2km radius (>3km to the north) of the Wonderfontein mine layout was gathered during the period of 16/04/2008 to 28/05/2008. All hydrocensus information are summarised in **Tables 29** to **31**. A total of 101 hydrocensus borehole were included in the study. The position of the hydrocensus boreholes and springs are depicted in **Figure 8** below.

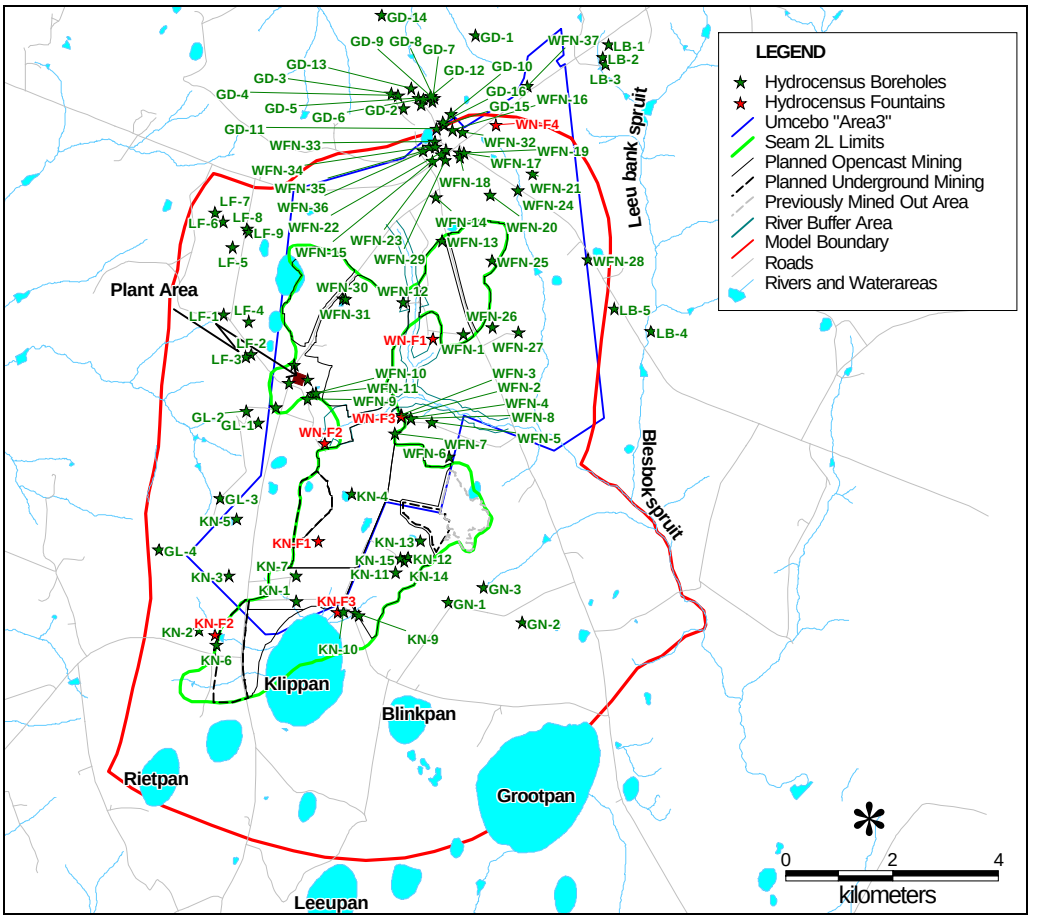

Figure 8: Positions of boreholes and springs at Wonderfontein mining area.

Table 29: Hydrocensus Owner Information

Map Nr	Name of Owner	Address	Contact Person	Phone Numbers	Farm Name	Farm Number	Portion Number
WFN-1	Morelig Combined School	PO Box 15, Wonderfontein	Principal S Maseko	O72 158 5540	Wonderfontein	428 JS	
WFN-2	HF de Jager	PO Box 28, Wonderfontein	Hennie de Jager	082 926 4546	Wonderfontein	428 JS	2
WFN-3	HF de Jager	PO Box 28, Wonderfontein	Hennie de Jager	082 926 4546	Wonderfontein	428 JS	2
WFN-4	HF de Jager	PO Box 28, Wonderfontein	Hennie de Jager	082 926 4546	Wonderfontein	428 JS	11
WFN-5	HF de Jager	PO Box 28, Wonderfontein	Hennie de Jager	082 926 4546	Wonderfontein	428 JS	11
WFN-6	HF de Jager	PO Box 28, Wonderfontein	Hennie de Jager	082 926 4546	Wonderfontein	428 JS	11
WFN-7	HF de Jager	PO Box 28, Wonderfontein	Hennie de Jager	082 926 4546	Wonderfontein	428 JS	2
WFN-8	HF de Jager	PO Box 28, Wonderfontein	Hennie de Jager	082 926 4546	Wonderfontein	428 JS	11
WFN-9	Mcebo		Kobus Mulder	082 894 1637	Wonderfontein	428 JS	
WFN-10	Mcebo		Kobus Mulder	082 894 1637	Wonderfontein	428 JS	
WFN-11	Mcebo		Kobus Mulder	082 894 1637	Wonderfontein	428 JS	
WFN-12	DS van Wyk (jr)	PO Box 3, Wonderfontein	Danie van Wyk	082 702 4724	Wonderfontein	428 JS	
WFN-13	DS van Wyk (jr)	PO Box 3, Wonderfontein	Danie van Wyk	082 702 4724	Wonderfontein	428 JS	
WFN-14	DS van Wyk (jr)	PO Box 3, Wonderfontein	Danie van Wyk	082 702 4724	Wonderfontein	428 JS	
WFN-15	DS van Wyk (jr)	PO Box 3, Wonderfontein	Danie van Wyk	082 702 4724	Wonderfontein	428 JS	
WFN-16	AC van Vreden	PO Box 3, Wonderfontein	Danie van Wyk	082 702 4724	Wonderfontein	428 JS	
WFN-17	AC van Vreden	PO Box 3, Wonderfontein	Danie van Wyk	082 702 4724	Wonderfontein	428 JS	
WFN-18	AC van Vreden	PO Box 3, Wonderfontein	Danie van Wyk	082 702 4724	Wonderfontein	428 JS	
WFN-19	AC van Vreden	PO Box 3, Wonderfontein	Danie van Wyk	082 702 4724	Wonderfontein	428 JS	
WFN-20	AC van Vreden	PO Box 3, Wonderfontein	Danie van Wyk	082 702 4724	Wonderfontein	428 JS	
WFN-21	AC van Vreden	PO Box 3, Wonderfontein	Danie van Wyk	082 702 4724	Wonderfontein	428 JS	
WFN-22	AC van Vreden	PO Box 3, Wonderfontein	Danie van Wyk	082 702 4724	Wonderfontein	428 JS	
WFN-23	AC van Vreden	PO Box 3, Wonderfontein	Danie van Wyk	082 702 4724	Wonderfontein	428 JS	
WFN-24	AC van Vreden	PO Box 3, Wonderfontein	Danie van Wyk	082 702 4724	Wonderfontein	428 JS	
WFN-25	AC van Vreden	PO Box 3, Wonderfontein	Danie van Wyk	082 702 4724	Wonderfontein	428 JS	
WFN-26	AC van Vreden	PO Box 3, Wonderfontein	Danie van Wyk	082 702 4724	Wonderfontein	428 JS	
WFN-27	AC van Vreden	PO Box 3, Wonderfontein	Danie van Wyk	082 702 4724	Wonderfontein	428 JS	
WFN-28	Hoogenoeg Boerdery		Christo Botha	083 251 3087	Wonderfontein	428 JS	
WFN-29	DS van Wyk (jr)	PO Box 3, Wonderfontein	Danie van Wyk	082 702 4724 013-246 1432	Wonderfontein	428 JS	
WFN-30	JMS Steele		Johan Steele	083 654 6076	Wonderfontein	428 JS	
WFN-31	JMS Steele		Johan Steele	083 654 6076	Wonderfontein	428 JS	
WFN-32	Spoornet		?		Wonderfontein	428 JS	
WFN-33	Wonderfontein Clinic	P/Bag 604, Belfast	Sister Mickey Debeile		Wonderfontein	428 JS	
WFN-34	Wonderfontein Meule	PO Box 6, Wonderfontein	Chris Brocklebank	013-246 7400	Wonderfontein	428 JS	
WFN-35	Wonderfontein Meule	PO Box 6, Wonderfontein	Chris Brocklebank	013-246 7400	Wonderfontein	428 JS	
WFN-36	Wonderfontein Meule	PO Box 6, Wonderfontein	Chris Brocklebank	013-246 7400	Wonderfontein	428 JS	
WFN-37	AFGRI (O.T.K.)	PO Box 40, Wonderfontein	G de Wit	013-246 7300	Wonderfontein	428 JS	
WN-F1	W Erasmus	Hendrina	Wynand Erasmus	072 389 2553	Wonderfontein	428 JS	
WN-F2	Corlouis Boerdery		Petie Bezuidenhout	083 962 1783	Wonderfontein	428 JS	
WN-F3	HF de Jager	PO Box 28, Wonderfontein	Hennie de Jager	082 926 4546	Wonderfontein	428 JS	2
WN-F4	PC van Wyk	PO Box 42, Wonderfontein	Pieter van Wyk	082 377 8990	Wonderfontein	428 JS	
WF-1	Mcebo		Kobus Mulder	082 894 1637	Wonderfontein	428 JS	
WF-2	Mcebo		Kobus Mulder	082 894 1637	Wonderfontein	428 JS	
WF-3	Mcebo		Kobus Mulder	082 894 1637	Wonderfontein	428 JS	
WF-4	Mcebo		Kobus Mulder	082 894 1637	Wonderfontein	428 JS	
GD-1	DS van Wyk (sr)	PO Box 75, Wonderfontein	Danie van Wyk	072 596 3855	Generaalsdraai	423 JS	
GD-2	PC van Wyk	PO Box 42, Wonderfontein	Pieter van Wyk	082 377 8990	Generaalsdraai	423 JS	
GD-3	PC van Wyk	PO Box 42, Wonderfontein	Pieter van Wyk	082 377 8990	Generaalsdraai	423 JS	

Map Nr	Name of Owner	Address	Contact Person	Phone Numbers	Farm Name	Farm Number	Portion Number
GD-4	PC van Wyk	PO Box 42, Wonderfontein	Pieter van Wyk	082 377 8990	Generaalsdraai	423 JS	
GD-5	WJ Prinsloo	PO Box 10, Wonderfontein	Kobus Prinsloo	082 378 3626	Generaalsdraai	429 JS	
GD-6	WJ Prinsloo	PO Box 10, Wonderfontein	Kobus Prinsloo	082 378 3626	Generaalsdraai	429 JS	
GD-7	WJ Prinsloo	PO Box 10, Wonderfontein	Kobus Prinsloo	082 378 3626	Generaalsdraai	429 JS	
GD-8	WJ Prinsloo	PO Box 10, Wonderfontein	Kobus Prinsloo	082 378 3626	Generaalsdraai	429 JS	
GD-9	WJ Prinsloo	PO Box 10, Wonderfontein	Kobus Prinsloo	082 378 3626	Generaalsdraai	429 JS	
GD-10	WJ Prinsloo	PO Box 10, Wonderfontein	Kobus Prinsloo	082 378 3626	Generaalsdraai	429 JS	
GD-11	WJ Prinsloo	PO Box 10, Wonderfontein	Kobus Prinsloo	082 378 3626	Generaalsdraai	429 JS	
GD-12	WJ Prinsloo	PO Box 10, Wonderfontein	Kobus Prinsloo	082 378 3626	Generaalsdraai	429 JS	
GD-13	WJ Prinsloo	PO Box 10, Wonderfontein	Kobus Prinsloo	082 378 3626	Generaalsdraai	429 JS	
GD-14	WJ Prinsloo	PO Box 10, Wonderfontein	Kobus Prinsloo	082 378 3626	Generaalsdraai	429 JS	
GD-15	Biominerale	PO Box 21, Wonderfontein	RE Benson	083 265 9269	Generaalsdraai	429 JS	
GD-16	Biominerale	PO Box 21, Wonderfontein	RE Benson	083 265 9269	Generaalsdraai	429 JS	
LB-1	PC van Wyk	PO Box 42, Wonderfontein	Pieter van Wyk	082 377 8990	Leeuwbank	427 JS	
LB-2	PC van Wyk	PO Box 42, Wonderfontein	Pieter van Wyk	082 377 8990	Leeuwbank	427 JS	
LB-3	PC van Wyk	PO Box 42, Wonderfontein	Pieter van Wyk	082 377 8990	Leeuwbank	427 JS	
LB-4	J Botha	PO Box 687, Ellisras	Isrent Tlou (Beestepan Boerdery)	082 388 3501 014-763 1050	Leeuwbank	427 JS	
LB-5	J Botha	PO Box 687, Ellisras	Isrent Tlou (Beestepan Boerdery)	082 388 3501 014-763 1050	Leeuwbank	427 JS	
LF-1	JMS Steele		Skepa Mahlango	083 654 6076	Leeufontein	428 JS	
LF-2	JMS Steele		Skepa Mahlango	083 654 6076	Leeufontein	428 JS	
LF-3	JMS Steele		Skepa Mahlango	083 654 6076	Leeufontein	428 JS	
LF-4	JMS Steele		Skepa Mahlango	083 654 6076	Leeufontein	428 JS	
LF-5	JMS Steele		Skepa Mahlango	083 654 6076	Leeufontein	428 JS	
LF-6	JMS Steele		Skepa Mahlango	083 654 6076	Leeufontein	428 JS	
LF-7	JMS Steele		Skepa Mahlango	083 654 6076	Leeufontein	428 JS	
LF-8	JMS Steele		Skepa Mahlango	083 654 6076	Leeufontein	428 JS	
LF-9	JMS Steele		Skepa Mahlango	083 654 6076	Leeufontein	428 JS	
KN-1	Corlouis Boerdery	PO Box 19, Wonderfontein	Louis Bezuidenhout	073 305 8574	Klippan	452 JS	
KN-2	Corlouis Boerdery	PO Box 19, Wonderfontein	Louis Bezuidenhout	073 305 8574	Klippan	452 JS	
KN-3	Corlouis Boerdery	PO Box 19, Wonderfontein	Louis Bezuidenhout	073 305 8574	Klippan	452 JS	
KN-4	Corlouis Boerdery	PO Box 19, Wonderfontein	Louis Bezuidenhout	073 305 8574	Klippan	452 JS	
KN-5	Corlouis Boerdery	PO Box 19, Wonderfontein	Louis Bezuidenhout	073 305 8574	Klippan	452 JS	
KN-6	Corlouis Boerdery	PO Box 19, Wonderfontein	Louis Bezuidenhout	073 305 8574	Klippan	452 JS	
KN-7	Corlouis Boerdery	PO Box 19, Wonderfontein	Louis Bezuidenhout	073 305 8574	Klippan	452 JS	
KN-8	Corlouis Boerdery	PO Box 19, Wonderfontein	Louis Bezuidenhout	073 305 8574	Klippan	452 JS	
KN-9	EH Combrinck	PO Box 34, Wonderfontein	Stephan Combrinck	083 663 7513 013-297 1556	Klippan	452 JS	
KN-10	EH Combrinck	PO Box 34, Wonderfontein	Stephan Combrinck	083 663 7513 013-297 1556	Klippan	452 JS	
KN-11	GJ van Rooyen		Deon van Rooyen	082 578 7278	Klippan	452 JS	
KN-12	GJ van Rooyen		Deon van Rooyen	082 578 7278	Klippan	452 JS	
KN-13	GJ van Rooyen		Deon van Rooyen	082 578 7278	Klippan	452 JS	
KN-14	GJ van Rooyen		Deon van Rooyen	082 578 7278	Klippan	452 JS	
KN-15	GJ van Rooyen		Deon van Rooyen	082 578 7278	Klippan	452 JS	
KN-F1	Corlouis Boerdery	PO Box 19, Wonderfontein	Louis Bezuidenhout	073 305 8574	Klippan	452 JS	
KN-F2	Corlouis Boerdery	PO Box 19, Wonderfontein	Louis Bezuidenhout	073 305 8574	Klippan	452 JS	
KN-F3	EH Combrinck	PO Box 34, Wonderfontein	Stephan Combrinck	083 663 7513 013-297 1556	Klippan	452 JS	
GN-1	GJ van Rooyen		Deon van Rooyen	082 578 7278	Grootpan	456 JS	
GN-2	GJ van Rooyen		Deon van Rooyen	082 578 7278	Grootpan	456 JS	
GN-3	GJ van Rooyen		Deon van Rooyen	082 578 7278	Grootpan	456 JS	
KLIPBH-1	Mcebo		Kobus Mulder	082 894 1637	Klippan	452 JS	
GL-1	GPJ van Rensburg		Gawie van Rensburg	082 806 4825	Grootlaagte	449 JS	
GL-2	GPJ van Rensburg		Gawie van Rensburg	082 806 4825	Grootlaagte	449 JS	

Map Nr	Name of Owner	Address	Contact Person	Phone Numbers	Farm Name	Farm Number	Portion Number
GL-3	GPJ van Rensburg		Gawie van Rensburg	082 806 4825	Grootlaagte	449 JS	
GL-4	GPJ van Rensburg		Gawie van Rensburg	082 806 4825	Grootlaagte	449 JS	

Table 30: Hydrocensus – Location information

Map Nr	Map ID	GPS Long (WGS 84)	GPS Lat (WGS 84)	Elevation (m)	Topography	Site Type	Information Source	Site Status	Site Purpose	User Consumer	User Application	Equipment
WFN-1	2529 DD	29.89946	25.83822	1743.00	F	B	G	G	P	N	DA	S
WFN-2	2529 DD	29.88803	25.85229	1726.00	S	B	G	G	P	N	DA	S
WFN-3	2529 DD	29.88806	25.85201	1728.00	S	B	G	G	P	N	AS	S
WFN-4	2529 DD	29.88980	25.85253	1716.00	R	B	G	G	P	N		N
WFN-5	2529 DD	29.89372	25.85320	1721.00	F	B	G	G	P	N		N
WFN-6	2529 DD	29.89704	25.85905	1732.00	F	B	G	G	P	N		N
WFN-7	2529 DD	29.88685	25.85516	1728.00	F	B	G	G	P	N		N
WFN-8	2529 DD	29.88980	25.85257	1717.00	R	B	G	G	P	N		N
WFN-9	2529 DD	29.87045	25.84935	1756.00	S	B	G	G	P	N	DA	S
WFN-10	2529 DD	29.87139	25.84854	1746.00	S	B	G	U				N
WFN-11	2529 DD	29.87204	25.84839	1745.00	L	B	G	U	P	N		N
WFN-12	2529 DD	29.88822	25.83290	1732.00	S	B	G	G	P	N	AD	S
WFN-13	2529 DD	29.89538	25.82240	1761.00	S	B	G	G	P	N	DA	H
WFN-14	2529 DD	29.89419	25.81504	1785.00	F	B	G	U	P	N		WP
WFN-15	2529 DD	29.89348	25.80891	1800.00	F	B	G	U	P	N		S
WFN-16	2529 DD	29.89718	25.80358	1816.00	F	B	G	G	P	N	AS	M
WFN-17	2529 DD	29.89849	25.80736	1795.00	S	B	G	U	P	N		P
WFN-18	2529 DD	29.89858	25.80822	1786.00	S	B	G	D	P	N		N
WFN-19	2529 DD	29.89936	25.80749	1794.00	S	B	G	G	P	N	DA	S
WFN-20	2529 DD	29.90427	25.81463	1762.00	S	B	G	U	P	N		WP
WFN-21	2529 DD	29.91223	25.81094	1765.00	F	B	G	G	P	N	AS	WP
WFN-22	2529 DD	29.89601	25.80700	1803.00	F	B	G	G	P	N	DA	S
WFN-23	2529 DD	29.89518	25.80781	1803.00	F	B	G	U	P	N		N
WFN-24	2529 DD	29.90954	25.81382	1754.00	R	B	G	U	P	N		N
WFN-25	2529 DD	29.90485	25.82568	1750.00	S	B	G	U	P	N		N
WFN-26	2529 DD	29.90489	25.83696	1738.00	F	B	G	G	P	N	DA	H
WFN-27	2529 DD	29.90980	25.83779	1721.00	S	B	G	G	P	N	AD	WP
WFN-28	2529 DD	29.92269	25.82545	1747.00	S	B	G	U	P	N		WP
WFN-29	2529 DD	29.89591	25.80870	1800.00	F	B	G	U	P	N		H
WFN-30	2529 DD	29.87691	25.83227	1767.00	S	B	G	G	P	N	DA	WP
WFN-31	2529 DD	29.87739	25.83236	1766.00	S	B	G	U	P	N		WP
WFN-32	2529 DD	29.89910	25.80399	1801.00	S	B	G	G	P	N	AD	S
WFN-33	2529 DD	29.89386	25.80559	1810.00	S	B	G	G	P	N	DA	S
WFN-34	2529 DD	29.89288	25.80647	1805.00	F	B	G	G	P	N	DA	S
WFN-35	2529 DD	29.89171	25.80716	1805.00	F	B	G	G	P	N	DA	S
WFN-36	2529 DD	29.89401	25.80654	1800.00	F	B	G	G	P	N	DA	S
WFN-37	2529 DD	29.91114	25.79612	1810.00	F	B	G	G	P	N	DA	S
WN-F1	2529 DD	29.89380	25.83898	1729.00	S	F	G	G	P	N	AS	N

Map Nr	Map ID	GPS Long (WGS 84)	GPS Lat (WGS 84)	Elevation (m)	Topography	Site Type	Information Source	Site Status	Site Purpose	User Consumer	User Application	Equipment
WN-F2	2529 DD	29.87366	25.85689	1733.00	S	F	G	G	P	N	AD	S
WN-F3	2529 DD	29.88803	25.85230	1731.00	R	F	G	G		N	AS	N
WN-F4	2529 DD	29.90535	25.80272	1784.00	S	F	G	G	P	N	AS	N
WF-1	2529 DD	29.86448	25.85092	1765.00	F	B	G	G	O	N	TM	N
WF-2	2529 DD	29.86690	25.84675	1766.00	F	B	G	G	O	N	TM	N
WF-3	2529 DD	29.86795	25.84362	1761.00	S	B	G	G	O	N	TM	N
WF-4	2529 DD	29.87038	25.84608	1757.00	F	B	G	G	O	N	TM	N
GD-1	2529 DD	29.90139	25.78750	1792.00		B	G	G	P	N	AS	WP
GD-2	2529 DD	29.88797	25.80001	1798.00	F	B	G	G	P	N	AD	WP
GD-3	2529 DD	29.88573	25.79747	1772.00	S	B	G	G	P	N	AD	S
GD-4	2529 DD	29.88698	25.79784	1780.00	S	B	G	U	P	N		N
GD-5	2529 DD	29.89085	25.79816	1796.00	S	B	G	G	P	N		S
GD-6	2529 DD	29.89169	25.79838	1808.00	S	B	G	G	P	N		S
GD-7	2529 DD	29.89344	25.79884	1802.00	F	B	G	U	P	N		WP
GD-8	2529 DD	29.89375	25.79822	1802.00	S	B	G	G	P	N		S
GD-9	2529 DD	29.89307	25.79787	1800.00	S	B	G	G	P	N		S
GD-10	2529 DD	29.89693	25.80095	1800.00	F	B	G	G	P	N		HP
GD-11	2529 DD	29.89422	25.80339	1803.00	F	B	G	G	P	N		S
GD-12	2529 DD	29.89132	25.79929	1804.00	S	B	G	U	P	N		N
GD-13	2529 DD	29.88941	25.79666	1785.00	S	B	G	G	P	N		WP
GD-14	2529 DD	29.88385	25.78420	1740.00	S	B	G	G	P	N		WP
GD-15	2529 DD	29.89558	25.80277	1805.00	F	B	G	D	P	N		N
GD-16	2529 DD	29.89544	25.80230	1801.00	F	B	G	G	P	N	DA	S
LB-1	2529 DD	29.92635	25.78888	1821.00	S	B	G	G	P	N	DA	Q
LB-2	2529 DD	29.92520	25.79110	1819.00	S	B	G	U	P	N		N
LB-3	2529 DD	29.92566	25.79228	1810.00	S	B	G	G	P	N	DA	S
LB-4	2529 DD	29.93457	25.83754	1723.00	S	B	G	G	P	N	AD	HP
LB-5	2529 DD	29.92774	25.83371	1747.00	S	B	G	U	P	N		N
LF-1	2529 DD	29.85466	25.83512	1760.00	S	B	G	G	P	N	AD	S
LF-2	2529 DD	29.85985	25.84188	1770.00	F	B	G	G	P	N	AD	WP
LF-3	2529 DD	29.85883	25.84231	1771.00	F	B	G	G	P	N	AD	WP
LF-4	2529 DD	29.85931	25.83626	1767.00	F	B	G	G	P	N	AD	S
LF-5	2529 DD	29.85619	25.82367	1770.00	F	B	G	G	P	N	AD	S
LF-6	2529 DD	29.85439	25.81939	1763.00	S	B	G	G	P	N	DA	WP
LF-7	2529 DD	29.85292	25.81787	1753.00	S	B	G	G	P	N	DA	H
LF-8	2529 DD	29.85893	25.82062	1767.00	F	B	G	D	P	N		S
LF-9	2529 DD	29.85919	25.82115	1768.00	F	B	G	U	P	N		S
KN-1	2529 DD	29.86861	25.88374	1712.00	S	B	G	G	P	N	DA	H
KN-2	2529 DD	29.85045	25.88875	1717.00	S	B	G	G	P	N	DA	WP
KN-3	2529 DD	29.85589	25.87939	1743.00	S	B	G	G	P	N	AS	WP
KN-4	2529 DD	29.87885	25.86537	1758.00	S	B	G	G	P	N	AS	WP
KN-5	2529 DD	29.85732	25.86978	1772.00	F	B	G	U	P	N		N
KN-6	2529 DD	29.85370	25.89120	1718.00	S	B	G	G	P	N	DA	S
KN-7	2529 DD	29.86846	25.87941	1723.00	S	B	G	G	P	N	DA	S
KN-8	2529 DD				S	B	G	D				
KN-9	2529 DD	29.87959	25.88557	1707.00	S	B	G	G	P	N	AD	WP
KN-10	2529 DD	29.87738	25.88537	1710.00	S	B	G	G	P	N	AD	S
KN-11	2529 DD	29.88714	25.87867	1739.00	S	B	G	G	P	N	AD	S
KN-12	2529 DD	29.88936	25.87612	1753.00	S	B	G	G	P	N	AD	S
KN-13	2529 DD	29.89172	25.87330	1757.00	S	B	G	G	P	N	AD	S
KN-14	2529 DD	29.88867	25.87683	1751.00	F	B	G	G	P	N	AD	S

Map Nr	Map ID	GPS Long (WGS 84)	GPS Lat (WGS 84)	Elevation (m)	Topography	Site Type	Information Source	Site Status	Site Purpose	User Consumer	User Application	Equipment
KN-15	2529 DD	29.88798	25.87630	1751.00	F	B	G	G	P	N	AD	S
KN-F1	2529 DD	29.87262	25.87346	1745.00	S	F	G	G	P	N	DA	N
KN-F2	2529 DD	29.85345	25.88952	1721.00	S	F	G	G	P	N	AS	N
KN-F3	2529 DD	29.87631	25.88554		S	F	G	G	P	N	DA	N
GN-1	2529 DD	29.89697	25.88373	1748.00	F	B	G	G	P	N	AD	S
GN-2	2529 DD	29.91094	25.88700	1725.00	F	B	G	G	P	N	AD	WP
GN-3	2529 DD	29.90363	25.88108		S	B	G	G	P	N	AD	S
KLIPBH-1	2529 DD	29.88031	25.88607	1708.00	L	B	G	G	O	N	TM	N
GL-1	2529 DD	29.86124	25.85353	1768.00	F	B	G	G	P	N	AD	S
GL-2	2529 DD	29.85900	25.85151	1763.00	S	B	G	G	P	N	AD	S
GL-3	2529 DD	29.85422	25.86629	1750.00	S	B	G	G	P	N	AD	WP
GL-4	2529 DD	29.84276	25.87507	1749.00	F	B	G	G	P	N	AS	M

Table 31: Hydrocensus – Water related information

Map Nr	BH Diameter (m)	Collar Height (m)	Depth (m)	Yield (L/s)	Abstract Yield (L/s)	Date	Time	Water level (m)	Sampled (Y/N)	Casing Type	Casing Diameter	Water Strike	Date Drilled	Comments: P=People; LSU=Large Stock; SSU=Small Stock; D=Dairy; G=Garden; N=Nursery
WFN-1	165	0.00	?	?	?	20080416	09:10	Closed	Y	S				P=590. Position approx. BH covered with soil.
WFN-2	165	0.49	33.0		0.67	20080416	11:00	2.15	Y	S				P=28, G=1
WFN-3	165	0.25	30.0		0.67	20080416	11:09	Closed	N	S				LSU=440, D=1
WFN-4	165	0.10	11.0	2.50		20080416	11:55	0.58	N	S				Being used for cattle LSU=440
WFN-5	165	0.49	65.0	0.83		20080416	12:07	3.42	N	S	165	62		Standby borehole
WFN-6	165	0.16	30.0	0.22		20080416	11:11	1.05	N	S				Near SE boundary near mine
WFN-7	165	0.11	30.0	0.14		20080416	11:30	9.60	N	S				Was used
WFN-8	165	0.28	?	2.50		20080416	12:00	0.83	N	S				2m From WFN-4
WFN-9	165	0.20	?			20080508	10:00	Closed	Y					
WFN-10	50		?	?		20080508	10:10	Closed	N					Old WP stand
WFN-11	165	0.10	?			20080508	09:50	0.65	N	S				
WFN-12	165	0.10	40.0	?		20080507	11:37	4.06	Y					P=10, LSU=400. Not for drinking, bad taste
WFN-13	165	0.15	?	?		20080507	11:50	7.25	N					
WFN-14	165	0.20	?	?		20080507	12:03	2.58	N					To be used
WFN-15	165	0.05	55.0	?		20080507	12:11	3.66	N					To be used
WFN-16	165		?	0.22		20080507	12:21	Closed	N					
WFN-17	165		20.0	0.14		20080507	12:50	Closed	N					
WFN-18	165		20.0	0.11		20080507	13:02	Blocked	N	S				
WFN-19	165		20.0	0.11		20080507	13:13	Closed	Y	S				P=4
WFN-20	165		30.0	?		20080507	13:25	Closed	N	S				
WFN-21	165	0.00	15.0	0.30		20080507	14:00	0.25	N	S				LSU=400
WFN-22	165	0.00	20.0	0.14		20080507	12:42	Closed	N	S				P=?. Standby borehole for garage
WFN-23	165		88.0	0.17		20080507	12:30	Blocked	N	S				
WFN-24	165		?	?		20080507	13:41	0.00	N	S				Artesian water @ 0.01 l/s

Map Nr	BH Diameter (m)	Collar Height (m)	Depth (m)	Yield (L/s)	Abstract Yield (L/s)	Date	Time	Water level (m)	Sampled (Y/N)	Casing Type	Casing Diameter	Water Strike	Date Drilled	Comments: P=People; LSU=Large Stock; SSU=Small Stock; D=Dairy; G=Garden; N=Nursery
WFN-25	165		?	?		20080507	10:18	Closed	N	S				To be used
WFN-26	165		?	?		20080507	10:05	Closed	N	S				
WFN-27	165	0.15	40.0	0.14		20080507	09:45	Closed	Y					P=20. LSU=400
WFN-28	165		?	?		20080415	12:35	Closed	N					Was used
WFN-29	165	0.35	?	?		20080507	12:58	Closed	N	S				Full of bees
WFN-30	165		?	0.30		20080507	12:45	Closed	N					P=50
WFN-31	165		?	0.30		20080507	12:50	Closed	N					
WFN-32	165		?	?		20080507	15:50	Closed	N					In pumphouse. Supply garage/restaurant also
WFN-33	165		?	?	0.50	20080528	10:35	Closed	N					P=70
WFN-34	165		?		0.30	20080528	11:00	Closed	N					P=20. Only for washing. Water "tastes like coal"
WFN-35	165		?		0.55	20080528	11:15	Closed	N					P=50
WFN-36	165		?		0.30	20080528	11:40	Closed	N					
WFN-37	165		?		3.70	20080526	10:06	Closed	N					P=11
WN-F1		0.00	1.0	5.00		20080416	09:51	0.00	Y					Also sampled for isotope studies (Ithemba Labs)
				7.5		20090225								
WN-F2		0.00	0.0	5.00		20080506	12:15	0.00	Y					Sampled 8/5/08 1630
				7.5		20090225								
WN-F3		0.00	0.0	2.00		20080416	12:15	0.00	N					Feeding 2 dams downstream
WN-F4		0.00	0.0	1.50		20080526	10:40	0.00	N					
WF-1	165	0.65	50.0	?		20080506	14:00	10.93	N	S	165		2006/02/13	Drilled by EDRS
WF-2	165	0.55	50.0	?		20080506	14:10	17.38	N	S	165		2006/02/20	Drilled by EDRS
WF-3	165	0.63	50.0	?		20080506	14:20	2.96	N	S	165		2006/02/20	Drilled by EDRS
WF-4	165	0.72	50.0	?		20080508	09:05	3.63	N	S	165		2006/02/20	Drilled by EDRS
GD-1	165		40.0	0.28		20080507	09:10	Closed	N	S				LSU=230
GD-2	165		40.0	0.28		20080507	15:40	Closed	Y	S				P=5, LSU=80
GD-3	165		40.0	0.69		20080507	15:32	Closed	N	S				P=5, LSU=80
GD-4	165		15.0	?		20080507	15:40	Blocked	N	S				Was used
GD-5	165					20080526	10:50	Closed	N					
GD-6	165					20080526	11:00	Closed	N					
GD-7	165					20080526	11:15	Closed	N					Bees, Was used
GD-8	165					20080526	11:25	Closed	N					
GD-9	165					20080526	11:36	Closed	N					
GD-10	165					20080526	11:45	Closed	N					
GD-11	165					20080526	11:53	Closed	N					
GD-12	165					20080526	12:05	Blocked	N					
GD-13	165					20080526	12:15	Closed	N					
GD-14	165					20080526	12:27	Closed	N					
GD-15	165		40.0	?		20080528	10:35	Closed	N					
GD-16	165		40.0		0.55	20080528	10:48	Closed	N					P=40
LB-1	165		?	0.70		20080507	16:29	Closed	N	S				P=20
LB-2	165		?	?		20080507	16:40		N	S				
LB-3	165	0.25	?		0.52	20080507	16:15	4.64	Y	S				P=50
LB-4	165		?		0.20	20080526	08:05	Closed	N					Drilled by government

Map Nr	BH Diameter (m)	Collar Height (m)	Depth (m)	Yield (L/s)	Abstract Yield (L/s)	Date	Time	Water level (m)	Sampled (Y/N)	Casing Type	Casing Diameter	Water Strike	Date Drilled	Comments: P=People; LSU=Large Stock; SSU=Small Stock; D=Dairy; G=Garden; N=Nursery
LB-5	165		?	?		20080526	08:26	Closed	N					Was used. Pipes still in borehole.
LF-1	165	0.15	87.0	1.10		20080508	13:18	Closed	N	S				P=30, LSU=200
LF-2	165	0.20	?	0.30		20080508	13:26	9.11	N	S				P=300 (See also LF-3, LF-4)
LF-3	165	0.25	?	0.30		20080508	13:35	Closed	N	S				
LF-4	165	0.00	80.0	0.30		20080508	13:40	Closed	N					Borehole and pump covered with soil
LF-5	165		120.0	3.60		20080508	13:50	Closed	Y	S				P=40, LSU=200
LF-6	165	0.45	38.0	0.42		20080508	14:05	Closed	N	S				P=30
LF-7	165		?	0.20		20080508	14:00	Closed	N	S				Drilled by government
LF-8	165		?	?		20080508	14:25	Closed	N	S				Was used, caved in
LF-9	165		90.0	0.55		20080508	14:35	Closed	N	S				Being used periodically
KN-1	165		50.0		0.30	20080506	10:50	Closed	N	S				P=90
KN-2	165		30.0	0.50		20080506	11:10	Closed	N	S				P=10
KN-3	165		30.0	0.50		20080506	11:25	Closed	N	S				LSU=500
KN-4	165		55.0	0.30		20080506	11:43	Closed	N	S				
KN-5	165	0.16	60.0	?		20080506	12:03	2.45	N	S				To be used
KN-6	165		40.0		1.00	20080506	13:12	Closed	N	S				
KN-7	165		50.0		1.00	20080506	13:42	Closed	N	S				
KN-8						20080506				S				Destroyed
KN-9	165	0.62	40.0	0.60		20080508	16:01	0.65	N	S				P=24, LSU=150, D=1
KN-10	165		?	0.17		20080508	16:15	Closed	N	S				P=24, LSU=150, D=1, Poultry = 500
KN-11	165		65.0	0.42		20080509	08:00	Closed	N	S				P=8, LSU=200, SSU=500
KN-12	165	0.35	65.0	1.25		20080509	08:17	2.64	N	S				P=50, LSU=30
KN-13	165	0.65	70.0	1.67		20080509	08:24	5.63	N	S				P=8, LSU=200, SSU=500
KN-14	165		70.0	1.67		20080509	09:13	Closed	N	S				P=8, LSU=200, SSU=500
KN-15	165		70.0	1.67		20080509	09:20	Closed	N	S				Bees
KN-F1		0.00	0.0	0.28		20080506	12:33	0.00	N	S				P=100, LSU=500
KN-F2		0.00	0.0	0.20		20080506	12:54	0.00	N	S				LSU=500
KN-F3		0.00	0.0	1.30		20080508	16:13	0.00	N	S				P=24. SANDSTONE OUTCROP
GN-1	165	0.15	70.0	1.94		20080509	08:30	Closed	N	S				P=8, LSU=200, SSU=500
GN-2	165		65.0	1.39		20080509	08:45	Closed	N	S				P=40, LSU=30
GN-3	165		30.0	2.78		20080509	09:00	Closed	N	S				P=10, LSU=300. Washing potatoes
KLIPBH-1	165	0.47	50.0	?		20080508	17:00	0.17	N	S				Water flowing out of hole in casing 0.17m from top
GL-1	165	0.10	55.0	1.39		20080508	12:05	32.67	N	S				P=5, LSU=120, SSU=300
GL-2	165	0.10	46.0	1.94		20080508	12:15	Closed	Y	S				P=8, LSU=30, SSU=300, Poultry=120, G=1
GL-3	165	0.10	36.0	1.25		20080508	11:50	Closed	Y	S				P=16, LSU=80, SSU=85
GL-4	165	0.10	42.0	1.67		20080508	11:57	Closed	N	S				LSU=300

2.1.10.2 Boreholes and springs and estimated yield

17 new hydrogeological boreholes were drilled in order to obtain site specific groundwater parameters and baseline information. The following data was gathered and can be viewed in detail in **Annexure 5**:

- Hydrogeological borehole logs;
- Pertinent hydrogeological information;
- Groundwater level depths are thematically depicted in Figure 3.6 in **Annexure 5**;
- The major cations and anions are thematically depicted in Figures[1] 3.7. and 3.8 respectively, and hydro-chemically summarised as Piper- Durov- and Expanded Durov plots in Figures 4.5A-C in **Annexure 5**.

An isotope assessment was initiated to determine the origin of the two major springs in the area. It was important to determine whether the water in the two springs was locally derived or representative of a larger regional aquifer, which straddles the quaternary catchment boundaries of the project area. See **Annexure 5** for more information.

2.1.10.3 Groundwater quality

The Wonderfontein groundwater quality database (consisting of recently drilled hydrogeological boreholes and hydrocensus information) was scrutinised to compile a background groundwater quality profile; see **Table 32**.

Table 32: Background inorganic groundwater quality and SAWQG-DU

	Background Water Quality Range	SA Water Quality Guidelines for Domestic Use, 1996 [effect at higher concentration]	
		Target Water Quality Range	Critical Values
pH	6.0-8.5	(<5.5&>9.5) & (<6.0&>9.0)	<4 & >11
EC (mS/m)	3.5-39	70 [salty taste – no effect]	450
TDS (mg/l)	16-193	450 (= EC x 6.5)	3000
Ca (mg/l)	<24	32 [slight scaling problems]	80
Mg (mg/l)	<11	30 [slight scaling problems]	200
Na (mg/l)	<47	100 [slightly salty]	600
K (mg/l)	<10	50 [undesirable for infants or renal disease]	400
Total Alkalinity (mg/l)	6-100	No standard	No Standard
Cl (mg/l)	<12	100 [corrosion increase]	600 [objectionable salty taste, corrosion]
SO_4 (mg/l)	<22	200 [slight taste, tendency for diarrhoea]	600 [pronounced salty/bitter taste, diarrhoea
NO_3-N (mg/l)	<6	6 [rare instances of methaemoglobinaemia]	20
Fe (mg/l)	<1	0.1 [slight taste, slight plumbing deposits]	10
Mn (mg/l)	<0.5	0.05 [slight staining]	20
Al (mg/l)	<0.05	0.15 [slight colour effect in assoc. with iron or manganese]	0.5
F (mg/l)	<0.77	1 [slight mottling of dental enamel in sensitive individuals]	8

See **Annexure 5** for more detailed descriptions regarding the Wonderfontein Water Quality as well as the Piper and Durov plots of the groundwater quality.

The Klippan pan water quality, is of much higher salinity than the Wonderfontein groundwater. See **Table 33.**

Table 33: Klippan Water quality

Site Name	Date	pH	EC (mS/m)	TDS (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)	Cl (mg/l)	SO_4 (mg/l)	NO3-N (mg/l)	TALK (mg/l)
KPAN	2008/05/08	8.4	141	788	8	3	281	9	322	59	0.22	187

2.1.10.4 Groundwater use

Refer to Hydrocensus **Tables 29 - 31** for more detail on groundwater use in the area.

Groundwater in the area is mostly used for domestic purposes and livestock watering.

2.1.10.5 Groundwater zone

Aquifer parameters

Three aquifer layers of importance were identified in the Karoo setting above the Dwyka Tillite unit; see **Table 34**.

Table 34: Aquifer layers - Karoo

Aquifer	Average depth	Description	Comment
Aquifer-1	0m to 25m (25m thick)	Shallow weathered zone aquifer, which includes the overburden material of average 5m thick (max 10m) in hydrogeological boreholes (additional information provided by soil specialist study)	Unconfined to semi-confined conditions. Groundwater levels are shallower after wet rainfall periods or in close proximity to drainage/rivers/streams. Deepest water strikes and depth of hydrogeological weathering used as indicator of zone bottom.
Aquifer-2	25m to 70m (45m thick)	Deep fractured aquifer	Observations have shown that the potential for the Karoo aquifer to transmit water is largely restricted at depths exceeding 60m to 80m below surface.
Aquifer-3		Dwyka (including Ferricrete)	Most fractures are believed closed. A very low permeable aquifer. Some fracturing may occur on stratigraphical contacts at shallow depths (<25m).

Additional aquifers were incorporated in the groundwater model:

- Predominantly “lava” (Dullstroom Volcanic, belonging to the Pretoria Group) aquifers to the east, taking cognisance of the change in hydraulic characteristics with depth;
- The Karoo aquifers are predominantly underlain by “basement” rock consisting of older members of the Karoo sequence (Dwyka Formation, including Tillite).

Table 35: Aquifer layer parameters - Karoo

Aquifer Layer	Thickness (m)	Permeability (m/d) [m/s]	Storativity	Porosity	Rainfall Recharge (m/d) {mm/a} [%of MAP]
Aquifer-1	25m	(0.06) [$7x10^{-7}$]	0.04	0.07	($4.8x10^{-5}$) {17.5} [2.5]
Aquifer-2	45m	(0.006) [$7x10^{-8}$]	0.02	0.07	
Aquifer -3		($1x10^{-4}$) [$1.2x10^{-9}$]	0.01	0.03	

Table 36: Aquifer layer parameters – "Lavas"

Aquifer Layer	Thickness (m)	Permeability (m/d) [m/s]	Storativity	Porosity	Rainfall Recharge (m/d) {mm/a} [%of MAP]
Aquifer-1	25m	(0.1) [$1.2x10^{-6}$]	0.04	0.07	($4.8x10^{-5}$) {17.5} [2.5]
Aquifer-2	45m	(0.0065) [$7.6x10^{-8}$]	0.04	0.07	

See **Annexure 5** for more detail on aquifer tests performed during this study which played a vital role in determining the ranges of permeability associated with the different aquifers and aquifer layers. Generally speaking, permeability decreases with depth.

The following representative permeability values were determined for the Karoo aquifers:

Table 37: Representative permeability

Aquifer Layer	Average depth	Permeability
All data		0.052m/d
Shallow overburden	< 5m (2.4m to 4.2m saturation)	0.1m/d
Shallow weathered zone aquifer (below overburden)	Below 10m, max weathered depth of 18m to 25m	0.1m/d (**0.06m/d** if outlier value ignored)
Deep non weathered, but fractured aquifer (below shallow weathered zone aquifer)	Below 25m	0.007m/d

The study for Klippan (Usher 2008, IGS Report), quoted a permeability of 0.0034 m/d for the deeper aquifer, with higher values possible.

The Karoo aquifers are believed to be substantially reduced/thinner outside of the area where hydrogeological drilling was performed, due to the undulating pre-Karoo floor. The fresh Dwyka and Dwyka Tillites are believed to be of very low permeability.

The Dullstroom Volcanic Rock formation (belonging to the Pretoria Group), referred to elsewhere as “lava” is known to have relatively higher yielding boreholes.

Felsites (part of granites) on top of the pre-Karoo are non-porous and of low permeability.

The ratio between horizontal and vertical permeability in the deeper Karoo aquifer layer (>25m deep) may be as high as 20.

Aquifer boundaries

Rivers/spruits and pans serve as hydraulic boundaries to the local groundwater flow system. Aquifers discharge into these non-perennial streams (i.e. baseflow), especially during the rainy season when groundwater levels rise due to rainfall recharge.

Boundary conditions as employed in the numerical groundwater flow and transport model are summarised in **Table 38**. A two-dimensional view (top-view) of the model grid, which consists of six layers, is depicted in Figure 4.1 in **Annexure 5**.

Table 38: Numerical model boundaries

Boundary	Boundary type	Comment
North	No-flow	Along topographical high
East - northern half		
West – where rivers are absent		
East - southern half	Seepage face	Seepage to surface if groundwater should rise above the stream/riverbed elevation/surface
West – small portion of central boundary		
Internal streams and wetlands, non-perennial pans, and the boundaries of perennial pans		
South in low lying areas		
West – northern half of model boundary	Outflow	As determined by groundwater gradient across this boundary with fixed hydraulic head as per measured groundwater level elevation.
Pans containing water throughout the year (central zones of pans)	Constant head	This allows recharge to the groundwater system in the event that the groundwater table drops to below the pan bottom. However, groundwater will discharge to these pan areas in the event that the groundwater table rises to above the pan flooding status.

Groundwater levels and groundwater flow

Natural regional groundwater level elevations emulate the topography. Groundwater levels typically vary between 1m and 12m below surface. In low-lying areas such as rivers and streams, groundwater levels are <2m deep. In high-lying areas,

groundwater levels may be >10m deep. Deeper groundwater levels were also observed.

Evidence of perched aquifer conditions were specifically noted at steep topographical gradients. This is explained as follows:

- Groundwater flow is mostly laminar;
- Localised less-permeable rock layers cause the horizontal permeabilities to exceed vertical permeabilities;
- Deeper groundwater flow also discharge to the local streams at lower elevations;
- Evidence of such conditions were found in borehole sets BH-5S/M/D and BH-8S/M/D, which are situated in close proximity to steeper topographical gradients.

Seasonal groundwater level variations can be summarised from standard Umcebo monitoring in the Wonderfontein-Klippan-Steelecoal-area since October 2006:

- Shallow groundwater levels (<5m) typically varies with 2m to 3m;
- Medium depth groundwater levels (5m to 12m) typically varies with 3m to 4m;
- Deep groundwater levels (>15m) typically varies with 4m to 5m.

It is further noted that shallow groundwater levels typically remain at their highest elevation for 1month to 2months. This may be longer for deeper groundwater levels.

With regard to the occurrence of springs, the following is important:

- Wet-patches and groundwater seepage zones exist immediately after significant precipitation events. These areas are typically confined to rivers/streams, non perennial streams, wetlands, natural pans and rocky outcrop areas; small springs typically stop flowing within weeks of these rainfall events;

- Perched aquifer conditions away from streams, and the major springs, are therefore believed to exist only for relatively short periods after rainfall events. Evidence of such areas can be observed as horizontal lines on satellite images;
- The relatively low concentrations (e.g. Cl) observed for major springs, may be due to a certain component of recently recharged rainfall.

2.1.11 AIR QUALITY

A detailed Air Quality Assessment has been conducted by Airshed Planning Professionals and can be viewed in **Annexure 6**.

The Mpumalanga Highveld (formerly known as the Eastern Transvaal Highveld) has frequently been the focus of air pollution studies for two reasons. Firstly, elevated air pollution concentrations have been noted to occur in the region itself. Secondly, various elevated sources of emission located in this region have been associated with long-range transportation of pollutants and with the potential for impacting on the air quality of adjacent and more distant regions (Piketh, 1994).

The Belfast region mainly includes power generation sources, mines, vehicle tailpipe emissions, household fuel combustion, biomass burning and various miscellaneous fugitive dust sources. This section will only focus on the power generation and mining sources.

Highveld Airshed Priority Area Air Quality Management Plan – the Highveld Airshed was declared the second priority area by the minister on 23rd November 2007 (Government Gazette Number 30518). This requires that an Air Quality Management Plan for the area be developed. The plan includes the establishment of an emissions reduction strategies and intervention programmes based on the findings of a baseline characterisation of the area. The implication of this is that all contributing sources in the area will be assessed to determine the emission reduction targets to be achieved over the following few years. The AQMP for the Highveld Priority Area has to be completed by November 2009 with a one year implementation phase.

The baseline study includes the review of site-specific atmospheric dispersion potentials, and existing ambient air quality in the region. The neighbouring Klippan

Colliery has an on-site meteorological station measuring hourly average wind speed, wind direction and temperature data. The station had been implemented on 31 July 2007 but only 3 months of data from this station were available. The dispersion model requires at least one year of meteorological data as input. A wind field was therefore simulated for the region using the CALMET meteorological pre-processor for the CALPUFF dispersion model. Mixing heights were estimated for each hour, based on prognostic equations, while night-time boundary layers were calculated from various diagnostic approaches. The prevailing wind direction on-site was found to be from the north to northeast. The high velocity winds were also recorded from the north and northeast.

Air quality data typically include dust fallout and particulate air concentrations. No existing air quality data exists for the region, thus the Klippan Colliery was included into the Wonderfontein Mine dispersion model to provide a representative baseline. Dust fallout data for Klippan Colliery and Wonderfontein were provided and included in the report. In addition, sensitive receptor areas such as houses, schools and clinics, which are located within close proximity to the mine, were cited. Measured dust fallout measured at Wonderfontein Mine were on average in the MODERATE (250 to 500 mg/m²/day) dust fallout range and below the SANS residential limit of 600 mg/m²/day. A number of exceedances have been recorded since beginning of 2007 but no consecutive months. Dust fallout around the current Klippan Mine indicated also average dust fallout with 3 non-consecutive exceedances of the SANS residential limit.

Legal requirements and human health criteria should be taken into consideration for air quality management practices. Refer to **Annexure 6** for a review of the current air quality pollution legislation context.

Regarding ambient air quality criteria air quality guidelines and standards are fundamental to effective air quality management, providing the link between the source of atmospheric emissions and the user of that air at the downstream receptor site. The ambient air quality guideline values indicate safe daily exposure levels for the majority of the population, including the very young and the elderly, throughout an individual's lifetime. Air quality guidelines and standards are normally given for specific averaging periods. These averaging periods refer to the time-span over which the air concentration of the pollutant was monitored at a location. Generally, five averaging periods are applicable, namely an instantaneous peak, 1-

hour average, 24-hour average, 1-month average, and annual average. The application of these standards varies, with some countries allowing a certain number of exceedances of each of the standards per year. **Table 39** provides the list of the revised standards and the current standards as developed by the South African Bureau of Standards.

Table 39: Air quality standards for inhalable particulates (PM10).

Averaging Period	**Status**	**Standard (µg/m^3)**	**Frequency of Permitted Exceedence (FOE)**	**Compliance Date**
24 hour	Current Standard[(a)]	180	3	Current
	Revised Limit Value[(b)]	75	4	Immediate[(0)]
Annual	Current Standard[(a)]	60	0	Current
	Revised Limit Value[(b)]	40	0	Immediate[(0)]
Notes: [(a)]As per Schedule 2 of the NEM Air Quality Act (Act No 39) 2004. [(b)]As per Government Notice 263 in Government Gazette 31987 published 13 March 2009. [(c)]Once the revised standards have been published as the new SA national standards.				

See **Annexure 6** for more information on World Health Organization guidelines and limits for PM 10 and PM 2.5.

Dust deposition may be gauged according to the criteria published by the South African Department of Environmental Affairs and Tourism (DEAT). In terms of these criteria dust deposition is classified as follows:

SLIGHT - less than 250 mg/m^2/day
MODERATE - 250 to 500 mg/m^2/day
HEAVY - 500 to 1200 mg/m^2/day
VERY HEAVY - more than 1200 mg/m^2/day

However, dust fallout is evaluated against a four-band scale as presented in **Table 40** and **Table 41**.

Table 40: Dust fall out scale (SANS 1929:2005)

Band Number	Band Description	Dustfall rate (D) (mg/m^2/day, 30day average)	Comment
1	Residential	D < 600	Permissible for residential and light commercial
2	Industrial	600 < D < 1200	Permissible for heavy commercial and industrial
3	Action	1200 < D < 2400	Requires investigation and remediation if two sequential months lie in this band, or more than three occur in a year.
4	Alert	D > 2400	Immediate action and remediation required following the first incidence of Dustfall rate being exceeded. Incident report to be submitted to relevant authority.

Table 41: Target, action and alert thresholds for ambient dustfall

Level	Dust-Fall Rate (D) (mg/m2/day, 30-day average)	Averaging period	Permitted Frequency of exceedances
Target	300	Annual	
Action Residential	600	30 days	Three within any year, no two sequential months.
Action Industrial	1200	30 days	Three within any year, not sequential months.
Alert Threshold	2400	30 days	None. First exceedance requires remediation and compulsory report to authorities.

A dust fallout network has been established at the proposed Wonderfontein Mine in January 2007 comprising of 4 single dust fallout buckets. In addition, reference is also made to the dust fallout network at Klippan Mine which comprises of 6 single dust buckets and commenced in August 2007.

Figure 9 provides the dust fallout data for Wonderfontein Mine. From this graph it is clear that the SANS Residential Limit of 600 mg/m²/day was exceeded for a number of time during the monitoring period. WD1, WD2 and WD3 exceeded the SANS Residential Limit in March 2007. Increased dust fallout levels are noted for the period August to October 2007 with WD2, WD3 and WD4 exceeding the Residential Limit and WD3 equalling the SANS Industrial Limit (1 200 mg/m²/day). Dust fallout levels decreased significantly for the remainder of 2007 and beginning 2008 but increased again between July and November 2008. During this period however only

WD1 exceeded the SANS Residential Limit. Dust fallout levels decreased again afterwards with a increase during February 2009, again resulting in WD1 to exceed the limit.

The dust fallout data at Klippan Mine as depicted in **Figure 10**, indicates fairly high dust fallout levels during the first few months of monitoring (August to October 2009). Low dust fallout levels were recorded for the remainder of 2007 and beginning of 2008. Similar to Wonderfontein Mine, dust fallout levels increased during the months of August to November 2008. During this period both Klippan Dust 2 and Klippan Dust 3 exceeded the SANS Residential Limit. No exceedances of the SANS Industrial Limit have been recorded at Klippan to date.

2.1.12 NOISE

Refer to **Annexure 7** for the full Environmental Noise Assessment that was undertaken for the Wonderfontein Area.

The project is located in an area which has the generally low ambient noise levels typical of rural environments.

The proposed mining area is situated in a rural environment, with typically low levels of noise, dominated by the natural sounds of rustling vegetation, wildlife, and man-influenced sounds such as livestock, farming activities, and very occasional traffic from local dirt roads. However, substantial noise emanates from the Carolina and Hendrina roads, along which the product is expected to be transported, both of which bisect the site for part of their routes.

The noise impact is quantified as the predicted increase in ambient noise level, in decibels, which can be attributed to the operation of the proposed colliery appropriate to the proposed operating times and days.

Existing noise sources include:

- Natural sounds of the bush
- Livestock and agricultural activity on surrounding land.
- Local community and domestic noise.
- Vehicles and other transport serving existing collieries and the local community.

Table 42: Typical noise level and human perception of common noise sources

Noise level (dBA)	Source	Subjective description
160-170	Turbo-jet engine	Unbearable
130	Pneumatic chipping and riveting (operator's position)	Unbearable
120	Large diesel power generator	Unbearable
110	Circular saw Blaring radio	Very noisy
90 - 100	Vehicle on highway	Very noisy
80 - 90	Corner of a busy street Voice - shouting	Noisy
70	Voice - conversational level	Quiet
40 - 50	Average home - suburban areas	Quiet
30	Average home - rural areas Voice - soft whisper	Quiet
0	Threshold of normal hearing	Very quiet

Table 43: Acceptable rating levels for noise in districts (Ref.1)

Type of district	Equivalent continuous rating level ($L_{Req.T}$) for noise dB(A)					
	Outdoors			Indoors, with open windows		
	Day-night $L_{R,dn}$ [1)]	Day-time $L_{Req,d}$ [2)]	Night-time $L_{Req,n}$ [2)]	Day-night $L_{R,dn}$ [1)]	Day-time $L_{Req,d}$ [2)]	Night-time $L_{Req,n}$ [2)]
a) Rural districts	**45**	**45**	**35**	**35**	**35**	**25**
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with one or more of the following: workshops; business premises; and main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

Ambient noise measurements were made at 5 locations at the property, two of them on the Carolina and Hendrina roads, along which the product is expected to be transported by truck. These locations were chosen for the following reasons:

1) Useful for comparison purposes after development of the site.
2) Most likely to continue to exist after development of the site.
3) Easily identifiable and with easy access in case of need for future measurements.
4) On the roads most likely to be affected by future traffic noise changes.

The closest habitations around the site are at distances of approximately 1km from the nearest point of blasting.

Location 1

At a point on the Wonderfontein to Carolina road reserve, 20m from the road centreline, at the gate on the farm boundary. GPS coordinates: S25° 49.594′ E29° 53.868′, 1760m ±4.6m.

Note: The opencast workings will extend on both sides of the road at this section

Observations: These values are typical of a rural area with road traffic dominating the LAeq,I value during the day. The L90 (the sound level exceeded for 90% of the time, and usually taken as the background noise without intruding events such as traffic noise) is very repeatable and bounded between 32 and 40 dB(A) during the day. These road noise measurements are used as the baseline values in the assessment of the noise changes to be expected from any additional truck traffic on this route. The truck traffic count on this road is 60% greater than earlier assessments done for Wonderfontein. Approximately 50 trucks per hour were counted on average at this position.

Location 2

At a point on the road reserve boundary, 15m from the centreline of the Wonderfontein to Hendrina road at the entrance to the farm EDEN. GPS coordinates: S25° 50.798′, E29° 52.038′. Height 1762m (±6m).

Note: This farm and the area between the Hendrina road and the railway are now used as a base and laydown areas for the mine and the opencast workings will extend on both sides of the road just north of this section.

Observations: These values are very typical of a rural area with natural sounds such as bird song, the rustling of foliage and insects, and noise from sparse traffic on the road which completely dominates the LAeq,I value during the day. This is typical of natural environments largely uninfluenced by man-made noise. Occasional aircraft overfly the area. Note also that the L90 (the sound level exceeded for 90% of the time, and usually taken as the background noise without intruding events) is rather variable at 23-36 dB(A) during the day, depending on the traffic, and especially trucks which are audible for several minutes during a pass-by. There is now significantly more truck traffic on this road than during the earlier measurements. 22 trucks per hour were counted on average at this position.

Location 3

At a point 20m from the road centreline, at the gate to the Klippan farm. GPS coordinates: S25° 53.041′ E29° 52.640.

Note: This farm entrance is now used to access the adjacent Klippan mine as shown in the photo below. The mining line can be seen in the distance.

Observations: These values are typical of a rural area with unpredictable road traffic dominating the LAeq,I value during the day. The traffic was primarily associated with other existing mines in the area and the LAeq,I value is very variable, depending on the absence or existence of very sparse and unpredictable traffic. The L90 (the sound level exceeded for 90% of the time, and usually taken as the background noise without intruding events such as vehicle noise) is repeatable and bounded between 27 and 36 dB(A) during the day.

Location 4

At a point at the boundary corner at the intersection of the proposed Wonderfontein mining area and the neighbouring Klippan mine area. GPS coordinates: S25° 52.065′ E29° 53.627′

Observations: These values are typical of a rural area with natural sounds which dominate the LAeq,I value during the day. The L90 (the sound level exceeded for

90% of the time, and usually taken as the background noise without intruding events) is very repeatable and narrowly bounded between 26 and 30 dB(A) during the day. This position well represents the pre-mining noise climate of the rural areas distant from the influence of noise from roads. Traffic noise is not audible from this position.

Location 5

At the fence line with the Grootlagte farm property boundary adjacent to the dirt access road as shown in the photographs below. GPS coordinates: S25° 51.038′, E29° 51.582′. Height 1764m (±4m).

Observations: This property was chosen as it is remote from and unaffected by the noise from any current mining activity. The values are typical of a rural area with occasional remote traffic noise audible from the Hendrina road which dominates the noise climate. The LAeq,I falls to a value of around 35 dB(A) after dark and this is in line with the maximum noise level recommendations for rural districts, the SANS recommended night-time value being 35 dB(A). The L90 (the sound level exceeded for 90% of the time, and usually taken as the background noise without intruding events) is very consistent and repeatable and narrowly bounded between 28 and 36 dB(A).

2.1.13 SITES OF ARCHAEOLOGICAL AND CULTURAL INTEREST

The Phase I HIA study for the Wonderfontein Project Area revealed the following types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999), namely:

- Historical houses some associated with outbuildings.
- Formal and informal graveyards.

Refer to **Annexure 8** containing the detailed report.

It must be pointed out that heritage resources can be found in the most unexpected places. It must also be borne in mind that surveys may not detect all the heritage resources in a given project area. While some remains may simply be missed during surveys (observations), others may occur below the surface of the earth and may only be exposed once mining development commences.

The Wonderfontein Project Area stretches across an undulating piece of land which is dotted with a few farmsteads and which is covered with agricultural fields as well as with pieces of land which have not been affected by development activities in the past.

The Wonderfontein Project Area is part of a cultural landscape that is marked by heritage remains dating from the pre-historical into the historical (colonial) period. Stone Age sites, Iron Age remains and colonial remains therefore do occur in the broader area. Heritage surveys up to now have recorded few outstanding Stone Age sites, rock paintings and engravings near the project area - primarily as a result of limited extensive archaeological surveys.

Historical towns closest to Wonderfontein Colliery include Middelburg and Belfast.

Historical structures

Farm homesteads with outbuildings that date from the more recent past occur throughout the project area. Many of these farm homesteads hold little historical significance. However, buildings and other infrastructure which are part of these farm homesteads may be older than sixty years or may approach this age.

All, structures and buildings older than sixty years are protected by Section 34 of the National Heritage Resources Act (No 25 of 1999).

Historical structures consisting of houses with outbuildings and a wagon shed were recorded in the project area. It is possible that more historical structures may occur as some of these structures may have been missed as access to all farmsteads was not possible.

Table 44: Historical Structures

Historical Houses	Coordinates	Significance
HH01	25º 53.147' 29º 52.655'	**HIGH**
HH02 with outbuildings	25º 50.012' 29º 52.645'	**HIGH**

Graveyards

Many of the farm homesteads are associated with formal and informal graveyards. Dwellings which have been used by farm labourers and which have disintegrated over time are in many instances associated with informal graves and sometimes with informal cemeteries. These informal graves and cemeteries may occur in the most unexpected places - such as in maize fields or in plantations such as the Belfast Forest.

The graveyards were geo-referenced and mapped (see Figure 2 in Annexure 8). The significance of the heritage resources was determined by means of stipulations derived from the National Heritage Resources Act (No 25 of 1999) and by means of various other criteria. All graveyards 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 (No 25 of 1999) whenever graveyards are older than sixty years. The act also distinguishes various categories of graves and burial grounds. 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).

Table 45: Coordinates of graveyards

Graveyards	Coordinates	Significance
GY01. North of Grootpan. Three individuals	25º 53.220' 29º 52.761'	**HIGH**
GY02. North of Grootpan. Thirty individuals	25º 53.252' 29º 52.734'	**HIGH**
GY03. Western shoulder of dirt road. Thirty-five graves	25º 52.805' 29º 52.735'	**HIGH**
GY04. Western shoulder of dirt road. Seventeen graves	25º 52.657' 29º 52.813'	**HIGH**
GY05. Near informal settlement. Thirty-seven individuals	25º 53.050' 29º 52.231'	**HIGH**
GY06. Historical graveyard. Five individuals	25º 51.558' 29º 52.402'	**HIGH**
GY07. Five graves on edge of maize field	25º 51.506' 29º 52.216'	**HIGH**
GY08. Historical graveyard. Eleven individuals	25º 50.105' 29º 52.743'	**HIGH**
GY09. Graveyard in wattle bush. More than fifty graves.	25º 50.384' 29º 52.342'	**HIGH**

Graveyards	Coordinates	Significance
GY10. Graveyard near dam. Thirty graves	25º 49.849' 29º 53.548'	**HIGH**
GY11. Not observed by author	Eastern fringes of project area	**HIGH**

See **Figure 11** for the location of the homesteads and graveyards.

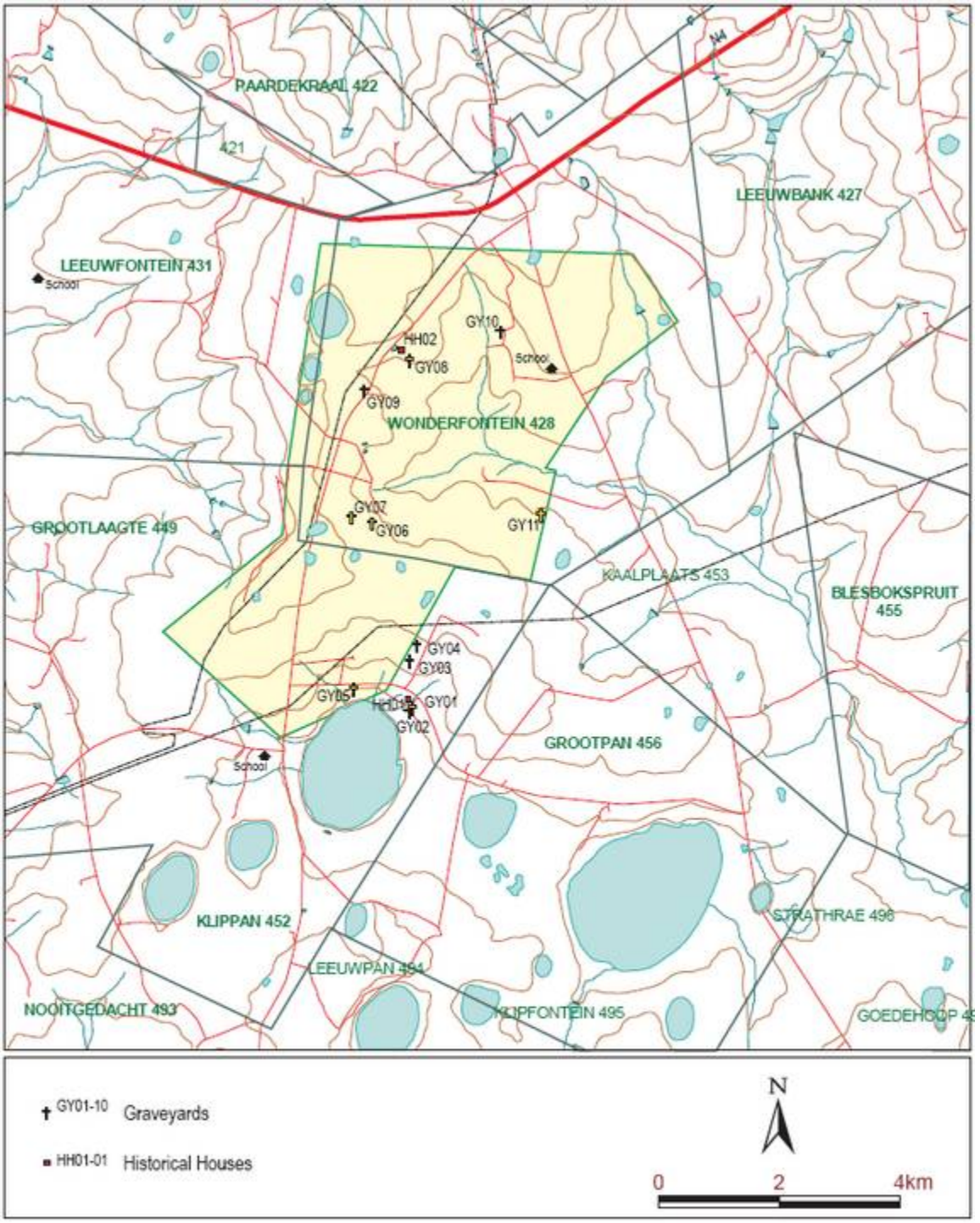

Figure 11: The presence of graves and historical structures in the Wonderfontein Project Area.

2.1.14 SENSITIVE LANDSCAPES

A detailed ecological assessment was conducted by Scientific Aquatic Services and is attached in **Annexure 3.** The wetland areas were classified to be sensitive landscape areas. Also see Section 2.1.7 of this document.

The soil assessment conducted by Rehab Green also classified some of the wetlands indicated in Figure 3a in Annexure 2 as sensitive. The very high potential soils (Hu1 and Hu2) within a favorable climate are of the most productive soils in the country and are not sensitive but irreplaceable. With the current cumulative impact of opencast mining on high potential soils in South Africa and the poor standard of rehabilitation as well as the national food security crises it contributes to the sensitivity of these soils located in the project area.

2.1.15 VISUAL ASPECTS

A Visual Impact Assessment study was undertaken by Golder Associates and is included as **Annexure 9**.

The mine will be situated between Wonderfontein and Carolina; between the tarred main road from the N4 to Carolina (the R33) and a secondary tarred road to Hendrina, but extends beyond these roads. The area has not been mined before, therefore making it a greenfields mining development.

The site and most of its immediate surroundings is not ecologically intact, as most of the natural vegetation has been replaced with crops or stands of alien tree species, greatly reducing the ecological integrity of the site, although the visual quality is affected to a lesser degree. Small, isolated patches of natural vegetation still exist but are mostly associated with low-lying areas and drainage lines, or along road verges. Especially the southern part of the study area around the Klippan is visually pleasing, due to the presence of a significant water body and larger areas of remaining indigenous vegetation. The presence of the human-made elements is relatively limited and does not greatly detract from the aesthetic appeal of the site. In summary it can be stated that visual quality of the study area is of **moderate** value.

Due to the fact that the study area has a distinctly rural character it must be argued that the proposed mining infrastructure will be visually intrusive in the landscape.

When considered individually, the larger elements such as the excavations and dumps will be more intrusive than the simple, smaller elements such as roads or fences. Nevertheless all elements of the mine will be visually intrusive to at least some degree.

The Blesbokspruit, its tributaries and the Klippan are the most prominent hydrological features in the study area. A main tributary of the Blesbokspruit bisects the site and a number of smaller streams feed this tributary. Towards the northwest of the study area the Wonderfontein fountain feeds an irrigation dam. The Blesbokspruit is relatively small and not visually dominant in the landscape, although it does dictate the local topography. However several naturally occurring pans are found within the farm Wonderfontein and especially the Klippan Dam, which is some 2 km across from north to south, is visually significant in the visual landscape. It is situated within view of the southern part of the site and is also visible from the west along the Hendrina road.

Although endowed with a wide variety of species, as a "visual community" the natural vegetation of the region does not vary much and appears relatively uniform at a glance. A multitude of different textures and colours can however be discerned upon closer inspection. Furthermore the natural vegetation cover on most of the site and surrounding areas has been replaced by cultivated maize fields that are also visually. Clumps of alien invader trees (predominantly *Eucalyptus* sp.) occur in the study area and become prominent elements in the landscape. Patches of disturbed veld characterised by weedy herbaceous species are also present.

Regarding the human-made character, the Wonderfontein farmstead with associated outbuildings is situated on the site itself, east of the Hendrina Road. The existing Steelecoal mine is situated less than 3 kilometres east of the site but not visible from the site itself. Other significant anthropogenic features situated in close vicinity of the site include:

- The N4 Highway is situated approximately 3 kilometres north of the site.
- A secondary asphalt road leading to Hendrina runs from north to south through the site.
- The R33 Road leading to Carolina is situated approximately 3 kilometres east of the eastern extent of the site.

- An Eskom power line runs parallel and east of the Hendrina road, which passes through the site.
- A railway line runs from north to south along the western boundary of the site.

Regionally the visual character can be described as rural and is dominated by cultivated agricultural cropland, interspersed with human settlement areas, mining and industrial development. The topography of the region is generally gently rolling and undulating with few prominent landforms, which results in largely unobstructed views of up to approximately 2km. Long-range views, i.e. views that are over distances greater than 7km, are however limited, as the rolling topography creates visual barriers over greater distances. Typically, features in the foregrounds of long-range views are much more prominent.

On a local scale the visual quality of the study area varies relatively little, due to the visually homogenous vegetation cover and limited human-made elements. The most distinctive features are vertical ones such as clumps of trees, buildings and high-voltage power line pylons. Watercourses and especially water bodies such as the perennial pans also form points of interest in shorter-range views.

Although the study area is of a visually pleasing nature due to its rural character, it is similar in character to the surrounding undeveloped areas and cannot be considered visually unique on either a local or a regional scale.

2.1.16 TRAFFIC IMPACT ASSESSMENT

A traffic impact assessment was undertaken for the proposed new Wonderfontein Mine and was compiled by Mr C.J. Venter. See **Annexure 11** for the detailed report.

The proposed Wonderfontein mine access is located on a straight section of the D383 with a relatively flat gradient and no vertical curvature. There is a horizontal curve approximately 250m north of the proposed access which limits the sight distance to the new access, which will impact on the geometric design of the access.

The road environment is rural, with agricultural and mining activities in the immediate vicinity. Existing traffic consists of a mix of light vehicles, farm vehicles,

and heavy vehicles. The D383 connects the Arnot Power Station to the South with Wonderfontein and the N4, which accounts for the relatively high percentage of heavy vehicle traffic (29%). Traffic volumes are nevertheless very light, with no apparent significant capacity or safety problems at present. The road is two-lane and has a design speed of 90 to 120 km/h. The existing road surface is in bad condition with significant potholing and surface deterioration in places.

Data on existing traffic volumes were obtained from manual traffic counts undertaken on Thursday 28 August 2008. The data are given in Appendix A of **Annexure 11**. Counts were taken at the intersection of the R33 and D383. **Table 46** summarizes the relevant data for the peak period, which is between 8 and 9am and a schematic interpretation is also shown in **Annexure 11**.

Table 46: Vehicle counts

On D383		Northbound	Southbound
Peak hour (8-9AM)	Light (veh/h)	29	17
	Heavy (veh/h)	18	6
	Total (veh/h)	47	23

2.1.17 REGIONAL SOCIO-ECONOMIC STRUCTURE

2.1.17.1 Population density, growth and location

There were 3,122,990 people living in Mpumalanga, according to the 2007 mid census. According to the 2001 Census there were 142,778 people living in Middelburg.

The Wonderfontein area is situated in an agricultural hub in the Highveld region of Mpumalanga province. It has high-value agricultural land, an above-average rainfall and relatively higher agricultural yields compared to the surrounding areas. Farms are generally used intensively for dry-crop agricultural and stock farming, producing mostly products such as maize, soya and potatoes.

There are nine full-time farmers on thirteen farming portions in the Wonderfontein area who are directly or indirectly affected through land displacement and possible side-effects from the proposed coal mining. At an estimated average household size of 4 people, this means that 36 people are directly or indirectly affected. There

are also 700 to 1000 other farm residents of whom an estimated 80 are farm labourers. This means that for every one farm labourer there are approximately 10 dependants. Another estimated 90 parttime workers are hired for 2–3 months of the year, mainly to assist with potato farming. In total, therefore, it is estimated that 1038 people at most may be directly negatively affected by the proposed mining operation (see **Table 47**).

Table 47: Estimated number of people at Wonderfontein affected by coal mining operations

Farmers and household dependants	Farmers: 9 Farmers + dependants: 36
Labourers and dependants	Labourers: 80 Labourers + dependants: 700–1000
Seasonal labourers, annual equivalent	Labourers: 90 (2–3 months)
TOTAL	**1038 affected people**

2.1.17.1.1 Major economic activities and sources of employment

As was mentioned, the closest towns where residential and business activities are grouped are Carolina and Belfast, which is approximately 30km to the south-east and north-east from the mining area respectively. The only business activities in the close proximity to the proposed mining area is the Wonderfontein filling station, situated adjacent to the N4 highway. Travellers on route to Mpumalanga low-veld or to Swaziland mainly use this filling station. Behind the filling station is a cooperative, selling mainly farm products for use by the local farmers. Other than the agricultural production, these are almost the only economic activities in the area.

On a regional scale the area further to the south and west of the proposed Wonderfontein mine is already known for the large scale of opencast coal mining fields.

According to the Statistics South Africa's 2001 Census data, there are less than 100 persons per square km in the area. Furthermore, the nearest towns are about 30 km northeast and southeast respectively away from the proposed mine.

2.1.17.1.2 Unemployment estimate for the area

According to the 2001 census 1.9 million people aged 15 to 65 years. Of these, 630 000 were employed, 439 000 were unemployed and 838 000 were not economically active. Overall the National unemployment figure was 24% in 2001.

2.1.17.1.3 Social infrastructure

The closest town in the area is Carolina and Belfast. Both have primary and high schools and have a strong farming community, and some mining to an extent.

Other than that, Middelburg and Witbank (40 minutes and 1hour drive respectively) are situated within comfortable travelling distance and time from the proposed mine. Several state departments have regional offices in Witbank, the most being:

- The Department of Manpower
- The Department of Mineral and Energy Affairs
- Mpumalanga Department of Agriculture and Land Administration.

2.1.18 ASSESSMENT OF ENVIRONMENT LIKELY TO BE AFFECTED

An assessment of the environment likely to be affected was conducted and includes the following: -

- Geology, section 2.1.1
- Climate, section 2.1.2
- Topography, section 2.1.3
- Soils, land capability and land use, sections 2.1.4, 2.1.5 and 2.1.6
- Ecology, sections 2.1.7, 2.1.8 and 2.1.14
- Surface water and groundwater in sections 2.1.9 and 2.1.10
- Air quality, section 2.1.11
- Noise, section 2.1.12
- Archaeology and cultural, section 2.1.13
- Visual, section 2.1.15

- Traffic, section 2.1.16
- Socio economics, section 2.1.17

2.1.19 ENVIRONMENTAL FEATURES THAT MAY REQUIRE PROTECTION, REMEDIATION, MANAGEMENT OR AVOIDANCE

Refer to **Figure 12** showing the features of requirements set in Regulation 2 (2) of the Minerals and Petroleum Resources Development Act. Environmental features on the site that may require protection, remediation, management or avoidance includes:

- The three streams running through the mining area;
- The three wetland systems (including the pans);
- The high potential soils;
- The graves and historical buildings (refer to **Figure 11**);
- The community living on the farms (Refer to **Figure 19**).

2.1.20 CLOSURE OR END USE OBJECTIVES

Closure and end use objectives are defined in **Section 2.10** of this document.

2.2 SECTION 39 (3) (B) (I)

2.2.1 LIST OF MAIN ACTIVITIES

The main mining activities are: -

Activity 1: Relocation of residence located close to the proposed mining area.

- There are people living in certain areas where mining will be conducted. People will have to be relocated for the development to continue, this will be done according to the developed relocation strategy. Community living in the relevant areas were given Questionnaires to fill out in order to provide information to Umsimbithi regarding how many people is living there, their needs, their activities etc. Negotiations with the relevant communities that will have to relocate will be done according to a relocation strategy that was developed. See **Annexure 1** for a map and the Relocation Strategy.

Activity 2. Construction of roads

- Access is required to the D383, a minor provincial road between the Arnot Power Station (southwards) and the N4/Wonderfontein (north).The access entrance will replace an existing farm entrance. Access from the D383 is required in both directions: to the east towards the proposed mine, and to the west to the new process plant and railway siding from where coal will be beneficiated and exported via railway. There are thus two main movements of coal-carrying trucks at the proposed intersection:
  - Coal from the new Wonderfontein mine is transported by road mostly towards the north (N4) for local consumption;
  - Coal from the Strathrae colliery to the south is transported to the new railway siding for export.
- GPS coordinates of new intersection: Lat: 25 50' 50.16"S; Long: 29 50' 02.57"E (see **Annexure 11**)
- The southbound approach on the D383 towards the mine, it is recommended that a deceleration/turning lane be constructed for vehicles turning left into the mine premises. The reason is that sight distance appears to be limited in the southbound direction leading up to the new intersection, which could lead to unacceptably high speed differentials between decelerating heavy vehicles and through traffic.
- The D383 is surfaced but the pavement condition is quite bad, with significant potholing and complete failure of the surface layer in some sections. Rehabilitation of these sections by the mining company will be beneficial in terms of reducing the operating costs of trucks.
- Refer to **Figure 6** showing the locality of the haul roads as well as the access road. A new safe access to the provincial road (D383) is being planned and an application for a way leave will be submitted to the Mpumalanga Roads Department (MRD).
- New haul roads will be constructed to gain access to the various mining areas and activities. Roads will be constructed with clean rock material not containing any carbonaceous rock. Access to the underground will be

obtained from the opencast pits where they will continue mining into the underground sections.

Activity 3: - Opencast mining

- The opencast pits will be developed by constructing box-cuts. 7 Opencast pits are planned for the Wonderfontein Mining area. Refer to **Figure 2** indicating all 7 of the opencast pit areas.
- Mining will start at Pit 8 and Pit 3 simultaneously. Mining at Pit 8 will be from east to north-west and will be accessed by extending the existing cut from Steelecoal Mine. Mining in Pit 3 will be conducted from south to north. A new box cut will be constructed and a vast area will be stripped from topsoil and stockpiled. Discard will be placed in the mined out opencast pit and a discard dump will be constructed at the mined out Pit 3. However, the discard dump will only extend over 78 ha and not over the whole Pit 3 area. Mining at Pit 8 will be approximately 4 years (starting 2010) and mining at Pit 3 will be approximately 9 years (starting 2010).
- Mining will then start at Pit 6 (approximately 2012). Access will be gained by extending the opencast cut at Klippan Mine (if approved) and continued from east to west. Mining at Pit 6 will be approximately 4 years.
- As Pit 6 reaches the end, mining at Pit 5 will commence which will be accessed from Pit 6. Mining at Pit 5 will be approximately 12 years (starting 2016) and will be from south to north.
- Mining at Pit 1 will commence while Pit 5 is still being mined and will last for approximately 3 – 4 years (starting 2023). Mining at Pit 1 will be from south to north.
- Mining at Pit 4 will commence once Pit 1 is reaching the end. Simmultaneously, mining at Pit 2 will also be commencing. Both Pit 4 and Pit 2 will be mined from south to north. Both Pit 4 and Pit 2 will last for approximately 5 – 6 years (commencing 2026 / 2027).
- The activity (opencast mining) will start by stripping the topsoil and storing it on a correct and demarcated stockpile (yellow soils together, red soils together etc.), position of stockpiles are shown on **Figure 6**.

- This will be followed by drilling the overburden material. Blast holes will then be filled with explosives and the overburden material will be blasted. In the cases where box-cuts will be developed material will be removed from the box-cut and placed onto the overburden stockpiles as shown in **Figure 6**.

- Once the box-cut is developed roll over mining will be conducted. Concurrent rehabilitation will be done as part of the roll over mining, a schematic presentation of opencast mining is shown in **Figure 14**.

- The opencast rehabilitation activities that will be conducted concurrently with the mining activities include filling the mined out voids with material that is removed in areas where the coal still needs to be extracted. Topsoil stripping and direct placing on areas where the voids have been backfilled will follow. Topsoil stripping and placement will be done according to the strip and placement plan, refer to **Figure 13**. (Also see **Annexure 2**.)

- At the start of summer the topsoil areas will be seeded. Refer to **Figure 15** showing a schematic presentation of opencast rehabilitation. Coal mined in the opencast will be transported out of the pit to the processing plant located within the mineral rights application area on Portion 2 of Wonderfontein 428 JS.

- It is important to note that proper stripping and stockpiling of the original soil types is the first key to proper rehabilitation which will enable the reconstruction of the pre-mining land capability as far as possible. Proper shaping of the spoil layer to a freely drained surface and as close to the original topography as possible is the second key to proper rehabilitation. Failing in these 2 critical requirements will definitely adversely affect the post-mining land capability even with other rehabilitation procedures at its best.

Activity 4: Underground mining

- Two underground mining areas are planned at Wonderfontein. See **Figure 2** for the positions of the underground areas – two on the western side of the project area (one in the centre and one in the south, including Pit 10 previously earmarked for opencast mining).

- Underground mining areas will be developed by construction of a shaft with three adits accessing coal from the opencast highwalls at Pit 5 and Pit 6 respectively. Refer to **Figure 2** showing the position of the shafts (will be accessed from the opencast workings). Coal mined in the underground will be transported via existing (haul) roads to the processing plant. The underground mining process is shown schematically in **Figure 16**.
- Processing of coal will be done at the authorised Wonderfontein processing plant and is therefore not included as part of this EMP.

Activity 5: Disposal of coarse coal discard

- Refer to **Figure 17** and **18** showing a schematic presentation of coal processing, it also shows the disposal of coal discard. Metallurgical, ESKOM as well as Export products will be produced and some 14.84 million tons of coarse coal discard will be generated during that processes. Monthly production of coarse coal discard will be in the order of 45 000 tons per month. Based on an average density of 1.2 ton/m^3, a spatial capacity of 12.36 million m^3 is required. Refer to **Annexure 1** containing the ROD letter from MDALA for the approval of the Wonderfontein processing plant.
- Three alternative sites were identified for the disposal of coarse coal discard on surface and is shown in Figure 8 in **Annexure 4**. Site 1 is located close the plant on the proposed pit 3 area, site 2 south of the plant and site 3 is located near Steelecoal on the proposed pit 8 area. Only alternative 2 are located on un-disturbed land and both other options are planned on mined out workings. Specialists considered all the alternatives as part of the impact assessments. All of the specialists recommended that site 2 not be considered at all. Site 2 is located on un-disturbed areas, and high productive agricultural land is also present in the area. The two options located on areas that form part of the proposed opencast mining areas were then further considered. Site 3 is located further away from the plant area, meaning that the distance to be travelled is longer, it will also contribute more to the impacts on air quality. Another disadvantage of Site 3 is that higher productive soils are present and it is proposed to rehabilitate the opencast in this area as close as possible to the pre-mining topography. A disadvantage of Site 1 is that any seepage from

the dump will have to be managed to prevent the contamination of the Blesbokspruit tributary that flows into the Nooitgedacht dam. After considering all issues raised, it is recommended that the dump be located on Site 1. Note that a section of Site 1 will be constructed on an area not to be mined just east of the plant. This area will have to be used until the opencast area becomes available for disposal of discard. This discard dump portion will have the capacity of 1.76 million m^3 and will be able to handle discard for a period of 39 months, based on the parameters provided earlier in terms of plant feed of 300 000 tons per month.

- The disposal of coal discard into the opencast pit was also considered and a detailed assessment was conducted by GW^2, refer to **Annexure 5**. In this scenario (scenario 2), a mix of 10% discard and 90% spoil was used and the results will be an average sulphate concentration of 2905 mg/ℓ with a salt load of 19.4 tons per day. Disposal on Pit 3 and Pit 8 resulted in a salt load of 16.78 and 18.38 tons per day respectively. Note that disposal of spoil only (Scenario 1) resulted in a salt load of 14.69 tons per day.
- Disposal of discard on the rehabilitated areas at Pit 3 and at the area just east of the plant is proposed.
- Discard will be loaded from the processing plant stockpile and transported with trucks to the discard dump. At the dump it will be off loaded and spread with a small dozer. An impact roller will be used to compact the discard to prevent spontaneous combustion of the discard.
- Compaction tests need to be conducted quarterly to measure the compaction of the dump.
- At closure the dump must be capped, topsoiled and seeded. Slopes of the discard dump must not exceed 1:5.

<u>Activity 6: - Water Management</u>

- It is important to note that the proposed Wonderfontein mine is located in the Blesbokspruit catchment as well as in the catchment area of the Klippan. The Blesbokspruit drains into the Nooitgedacht dam.

- Management of clean and affected water. Clean and affected water management involves the construction of a series of berms, canals and sumps as well as the installation of pumps and pipelines, refer to **Annexure 4**, the water management plan. Water accumulating in the opencast areas will be diverted in the pit into a sump where it will be pumped with a pump via a 150 mm HDPE pipeline to the newly constructed pollution control dam just east of Pit 3, refer to **Figure 6**. Water will be abstracted from the pollution control dam to be used as process water in the plant and also for dust suppression.

- In total 7 opencast pits are planned to be mined and two underground sections, refer to **Figure 2**. The opencast pits in the north, Pit 1-4 are all separated by either a road or by a stream. Pit 1 and Pit 2 is separated by the R 33 and Pit 3 and Pit 4 is separated by road D383. Pit 2 and Pit 3 is separated by a drainage line where mining will take place outside the 1:50 year floodline and 100 m away from the centre of the drainage line. Pit 3 is also further separated from Pit 5 and the southern opencast pits by a stream. No mining is proposed in the 1:50 year/100 m from the stream requirement. The opencast pits and underground workings in the south is proposed to be linked with no separation or pillars. However, the adits accessing Pit 10 will be sealed with water tight plugs at closure creating a barrier between Pit 6 and the underground workings at Pit 10. Groundwater flow is shown in Figure 5.5 of the groundwater report in **Annexure 5**. In the north the flow is towards the tributary of the Blesbokspruit located between the proposed Pit 3 and Pit 5 meaning that all groundwater in the north will tend to flow towards that stream. Due to the separation of the different pits in the north decant should occur as shown in Figure 5.4 of the groundwater report in **Annexure 5**. The fact that the mining method at Pit 10 was changed from opencast to underground meant that some of the possible decant will occur in the north at Pit 5 but the majority of the possible decant in the south will be towards the Klippan in the south at Pit 6 as shown in Figure 5.5 and Figure A5-1of **Annexure 5**.

- During the operational phase of the project groundwater seepage and accumulated rainfall will tend to drain towards the south both in the northern and southern sections. The proposed mine plan shown in **Figure 3**, shows that mining from south to north in all cases. Mining of the underground section at Pit 10 (underground) will be from north to south. It means that during the

operational activities of Pit 10 seepage and recharge from the mined out areas north of Pit 10 in the southern section will accumulate in Pit 10 during the mining operation and will have to be managed. However the provincial gravel road between Pit 6 and Pit 10 will create some sort of a barrier as it will only be linked via 3 (three) adits that will reduce influx into Pit 10. At all the other opencast pits groundwater seepage and accumulated rainfall recharge will drain away from the open pit into the mined out areas and will reduce the volume of water to be pumped from the opencast areas. According to the groundwater report operational water to be managed will be on average 630 m^3 per day.

- A pollution control dam is proposed to be constructed as shown in Figure 9 of the surface water report in **Annexure 4**. A dam with a capacity of 98 000 m^3 is planned, surface area of 6.3 ha and an average depth of 2 m. This dam will cater for the affected runoff from the affected water areas as well as the water pumped from the various opencast pits during the operational phase. The daily average inflow of water from the pit area is 630 m^3/day and 382 m^3/day will be abstracted for dust suppression. Volume for dust suppression is based on the 0.118 ℓ/m^2/h requirement set in the air quality report, area 134800 m^2. Return water from the slurry dams will drain into the pollution control dam, an average amount of 1 500 m^3 per day. Surplus water will be pumped to the coal processing plant, the plant require an amount of 2 500 m^3 per day, refer to **Figure 22** showing the operational water balance.

Post closure water balance

After closure all infrastructures will be removed, discard dump rehabilitated, underground areas closed and opencast area rehabilitated. Decant volumes and elevations are shown in **Figures 24 - 29**.

Table 48: Decant volumes and elevations – opencast areas

	ℓ/s	m^3/day	Elevation
Pit2	6.8	587.52	1724
	2.7	233.28	1720
Pit3	11.3	976.32	1715
	3.5	302.4	1725
	3.8	328.32	1710.6

	ℓ/s	m^3/day	Elevation
	2.8	241.92	1720
Pit4	1.9	164.16	1738
Pit 5	1.7	146.88	1712
	2.7	233.28	1709
Pit 6	15.3	1321.92	1605
Pit 10	4.3	371.52	1700
	2.7	233.28	1686 - 1690
	2.3	198.72	1689
Total	61.8	5339.52	

As indicated previously the pits in the northern section of the proposed mining area is separated by structures (streams or roads) and therefore decant should occur as shown at the various areas where the decant for the southern areas should occur in the north at Pit 5 and along the boundary with the Klip Pan at Pit 6 and Pit 10 underground. Measures to be implemented post closure will now be discussed per pit in the northern areas, as well as for Pit 5 and combined for the southern areas at pit 6 and pit 10 underground. No decant will occur at Pit 8.

Pit 1

It is recommended that Pit 1 and Pit 2 be linked, via auger drilling underneath the road. This will mean that all recharge and groundwater flow will accumulate at Pit 2. This pit will be closed in total and rehabilitate as close as possible to the pre-mining topography. See **Figure 24**.

Pit 2

Amount of decant expected is 588 m^3 per day. It is recommended that a final void with a size of 19 ha be constructed at the southern end of the pit. **Figure 24** shows the water balance of the pit with inflows of 384 m^3 per day of rain water, 2.3 m^3 per day of surface runoff from the catchment and an evaporation of 963.8 m^3 per day. The void should have a minimum capacity of 100 734m^3.

Pit 3

As shown in **Figure 25** decant should occur at four different positions at this pit. The total amount of decant expected is 1 849 m^3 per day. It is recommended that a final voids with a sizes of 32, 10, 11 and 8 ha be constructed in the areas where the decant will occur. **Figures 24**, **25**, **26**, **27** and **28** show the water balance of the pits.

The total inflows of 1 151 m^3 per day of rain water, 9.2 m^3 per day of surface runoff from the catchment and an evaporation of 2 892 m^3 per day. The void should have a minimum capacity of 791 147m^3.

Pit 4

Amount of decant expected is 164 m^3 per day. It is recommended that a final void with a size of 6 ha be constructed at the southern end of the pit. **Figure 26** shows the water balance of the pit with inflows of 115 m^3 per day of rain water, 2.3 m^3 per day of surface runoff from the catchment and an evaporation of 289 m^3 per day. The void should have a minimum capacity of 71 607 m^3.

Pit 5

Amount of decant expected is 380 m^3 per day. It is recommended that a final void with a size of 12 ha be constructed at the northern end of the pit. **Figure 27** shows the water balance of the pit with inflows of 230 m^3 per day of rain water, 2.3 m^3 per day of surface runoff from the catchment and an evaporation of 578 m^3 per day. The void should have a minimum capacity of 162 249 m^3.

Pit 6

Amount of decant expected is 1 322 m^3 per day. It is recommended that a final void with a size of 30 ha be constructed at the southern end of the pit. **Figure 28** shows the water balance of the pit with inflows of 575 m^3 per day of rain water, 2.3 m^3 per day of surface runoff from the catchment and an evaporation of 1446 m^3 per day. This leaves a surplus amount of 310 m^3 per day that will require treatment before being released into the surface water environment or re-used for the purpose of irrigation. The void should have a minimum capacity of 545 059 m^3. Grout the pillar between the mine and the road to a depth 15m below the coal floor, similar to the proposed measures at the adjacent Klippan Mine. This will create an impermeable pillar that will prevent seepage entering the Klippan.

Pit 10 - Underground

Most of the decant originally realized in this planned opencast pit will realize in Pit 6, but some 803 m^3 per day will possibly decant into the Klippan. Therefore, considering the change of mine plan and the grouting of the pillar between the road and pit 6 only the decant generated from this underground section need to be

managed in this section. Once the underground is filled the water will be pumped to the water treatment plant for treatment. Refer to **Figure 29**.

Activity 7: - Workshop, stores and offices

Infrastructure that will be constructed will include workshops, stores and offices. These facilities will be located in the area of the processing plant, refer to **Figure 6** showing the locality. All maintenance and repairs will be done at these facilities and it will also include the storage of diesel, oil and petrol.

- Drinking water will be obtained from boreholes located on Portion 2 of the Farm Wonderfontein 428 JS.
- Sewage plant will be constructed.
- The pollution control dam is planned in such a position that all contaminated runoff from this area will be collected and stored in the dam for re-use. During the sizing of the dam this runoff was considered and this was addressed in the previous section.
- During the decommissioning phase of the project all this and other infrastructure will be demolished and the waste material disposed into the final mine voids.

2.2.2 PLAN SHOWING MAIN ACTIVITIES

Refer to **Figure 12.** It indicates all the features that require mitigation.

2.2.3 CATEGORIZATION OF MAIN MINING ACTIVITIES

Categorization of the activities is shown in **Table 49.**

Table 49: Categorization of activities

Activity	Construction	Operational	Closure	Post Closure
Activity 1: - Relocation of residences located within proposed mining area	Still in negotiations with relevant communities located at various positions in the Wonderfontein Mining area. People will have to be relocated prior to commencement of mining. Timing – as mining progresses, according to relocation strategy.	None.	None.	None.
Activity 2: - Access roads	New haul roads will be constructed. A new access road to the mine from the D383 will also be constructed. A deceleration left turning lane will be provided southbound to the new intersection. Rehabilitation of the D383 will be undertaken by the mining company in corporation with the Roads Agency. This will be done over a 3 month period.	Roads will be used to gain access to the mine and also to transport coal from the mine to the coal processing facilities and siding and to the various clients.	Roads will be rehabilitated, but not the access road to the mine and the entrance to the D383. Timing: 1 year after closure. Some roads will be used for the management and maintenance period. 3 -5 years	Some roads will be used to gain access for the post closure water management. Indefinitely.
Activity 3: - Opencast Mining	Topsoil will be stripped, area drilled and blasted to develop the opencast box-cuts. Timing – 3 months.	Mining will be done in 15 - 23 years. Rehabilitation will be continuous with opencast mining – roll over method. Mining will continue from existing opencast cuts at Steelecoal and Klippan mines.	Final rehabilitation will be conducted in 1 year and maintenance and management will continue for a further 2 - 3 years.	None.
Activity 4: -	A shaft with three	Underground	Shafts will be	None.

Activity	Construction	Operational	Closure	Post Closure
Underground mining	adits will be developed from the opencast Pit 5 and another at the opencast Pit 6.	mining will be conducted over a period of 3 years.	sealed. This will be done over a period of 3 months.	
Activity 5: - Disposal of coarse coal discard	A discard dump will be constructed. Timing 3 months for initial one and then during mining.	Coarse coal discard residue will be produced and disposed. Timing 15 - 23 years.	Discard dump will be rehabilitated. Timing 1- 3 years after closure of mine.	None.
Activity 6: - Management of water	Clean water high wall drains, affected water channels will be constructed. Pollution control dam will also be constructed. Pumps and pipelines will be installed to ensure that affected water can be pumped to pollution control dam. Time 4 month.	Drains and berms will be maintained. Affected water will be pumped from the pit to the pollution control dam. The post closure evaporation facilities will be formed as part of the backfilling operation. Timing 3 years.	Slopes of the evaporation facilities will be created. Water treatment facility will be constructed. Timing 2 years.	Operating and management of treatment facility. Monitor seepage, decant water and groundwater pollution plume.
Activity 7: - Workshops, stores and offices	Offices, workshops and stores as well as a sewage plant will be constructed for the proposed Wonderfontein Mine. Timing – 3 months	Maintenance and repairs will be conducted at the workshops. Diesel and petrol will also be stored within this area. People will be working at the offices. Timing 15 - 22 years.	Workshops and offices will be demolished. Area will be rehabilitated. Timing – 1- 3 years after closure.	None.

2.2.4 DETAILS OF THE ENGAGEMENT PROCESS WITH INTERESTED AND AFFECTED PARTIES

Interested and affected parties in this part of the country has been identified for quite some time now, since they were also involved in the Steelecoal, Grootpan and Klippan Mines Public Participation processes. The Wonderfontein Plant had a separate EIA process which also involved I&AP's for this area.

During the scoping phase of the Wonderfontein Project the presence of the community living on the relevant portions and adjacent to the mining area was identified.

The first public participation meeting was held on the 29th of December 2008 (since the Scoping Report submission date was the 5th of January 2009) at Strathrae Colliery. The meeting was attended very well by both farmers and community members. It was decided at the meeting that the Morelig School and the Community Centre would act as central distribution points for information to the community. The school is willing to communicate all information through the learners and in future documents could be left at the School and the Community Centre to view and comment on. It was clear that the community have concerns about their future and whether they will have to relocate for the project to continue. Unhappiness about the time of the year that the public participation meeting was held was also expressed, but it was explained that there was no other time, since the due date that was given by the DME for submission of the document was the 5th of January 2009.

Two other public participation meetings followed regarding the Scoping process for the Wonderfontein Project. The first of the two was held at the Morelig School on Saturday 17 January 2009 and attendance was very high. Umsimbithi provided transport to the school for the community. Representatives for the community were chosen who would attend all meetings in the future and provide feedback to the community on the progress of the project. The Wonderfontein Mining Committee was elected and the names can be viewed in **Annexure 12**.

Another meeting was held on much smaller scale on the 10 February 2009 at the Wonderfontein Farmers Hall for the farmers who could not attend the first meeting.

A site notices were placed on site on 9 December 2008 and a news paper notice published on 12 December 2008 in the Middelburg Observer. Refer to **Annexure 12** showing the photos of the site notices as well as a copy of the newspaper advertisement.

The landowners and owners adjacent to the proposed mine was notified by distributing a BID document to them on 8 December 2008. Refer to **Annexure 12** showing proof of engagement with these parties.

A meeting was held on 5 May 2009 where the specialists presented the findings of their assessments. Copies of their presentations as well as a copy of the minutes of the meeting are included in **Annexure 12**. Another meeting is still planned to be conducted on 19 May 2009 where the impact assessments, land use alternative study and ecological studies will be presented to the I&APs. Results of the meeting will be included in the final document to be submitted to DME, issue response register updated and minutes of the meeting will also be included in **Annexure 12**.

A major concern raised by various IAP's and the meetings that were held, was regarding the trucks on the roads that is dangerous. Not only are they seen to be dangerous due to the driving skills, but they also cause damage on the roads in the area. Umsimbithi agreed to engage with the Provincial Roads Agency in order to discuss the rehabilitation of the roads in the area.

See **Annexure 12** for all the minutes of the public participation meetings held and other responses by the IAP's. The names of all registered as interested and affected parties are also included in **Annexure 12**, and can be viewed in the IAP Sheet or in the minutes of the meetings.

As far as engagement with government departments are concerned the following was done: -

- An invitation to hold a site meeting on 21 April 2009 was send out to all government departments including the Mpumalanga Tourism and Parks Agency (MTPA). This was one of the issues raised by MTPA. An Issues and Response Register was sent to the DME.
- The site visit was conducted and was attended by the DME (Ms Martha Mokonyane) and DWAF also attended the meeting. No response was received from the Mpumalanga Department of Agriculture and Land Administration.

Negotiations with relevant community that will have to be relocated are still in progress and will be continuous until the necessity for relocation becomes a priority.

2.2.5 PHYSICAL IMPACTS IDENTIFIED BY INTERESTED AND AFFECTED PARTIES

Refer to the issue response registers included in **Annexure 12**. The following main issues were identified: -

- Pollution of surface water, including the Nooitgedacht Dam and the Klippan
- Pollution of groundwater
- Pollution of soil
- Light pollution
- Impact on sense of place
- Impact on land use and future land use
- Impacts on roads and other infrastructure
- Morelig School adjacent to the proposed mining area
- Community living in and around the proposed mining area.
- Economic impacts on businesses in the area.

2.2.6 POTENTIAL IMPACTS OF EACH OF THE MAIN MINING ACTIVITIES

A description of the potential impacts of each of the aforesaid main mining activities will follow. The proposed mitigation measures will also be listed in this section and will be summarised again in table format in **section 2.6**. **Tables 50 - 56** summarised the impacts, the proposed management measures, significance rating prior to mitigation and significance rating after mitigation. **Tables 60 - 62** in **section 2.6** show the cost to implement the various mitigation measures.

Note that the use of vehicles will create air quality and noise related impacts in all phases and for each of the activities. This will be addressed first with no reference to a specific activity or phase in **section 2.2.6.1,** Impacts all activities. Important to note that the cost to mitigate these impacts will be reflected in the relevant year when the expenditure will be incurred, as indicated in **Tables 73**. This is an attempt to prevent duplication of the same impact and mitigation description per activity and per phase.

2.2.6.1 Impacts all activities

- During the **construction phase** dust will be generated due to vehicle movement as well as the movement of materials. Usage of machinery will also

cause an increase in background noise. Vehicle emissions will potentially cause deterioration in air quality.

- Usage of roads during the **operational phase** will also cause the generation of dust, cause an increase in noise levels and create vehicle emissions.

Mitigation dust: -

Use water for dust suppression, affected water will be abstracted from the pollution control dam and applied on all roads with water bowsers. It is recommended that 0.118 ℓ/m^2/h be applied. Further, the main haulroads will be treated with Dust-a-side or similar product as recommended by Airshed Planning Professionals. Continue with monitoring of dust fall out at the 4 dust fall stations of Wonderfontein and extend the network as suggested by Airshed Planning Professionals (see **Annexure 6**), as included / indicated in various graphs in **Annexure 6**. 11 single dust fallout buckets will be placed at the sensitive receptor areas and 3 directional dust fallout buckets should be placed at strategic positions around the mine (thus a total of 14 dust buckets for monitoring at Wonderfontein Mine). These will indicate where extra mitigation measures are necessary due to dust fallout impacts caused by the mine.

Mitigation for vehicle emissions: -

Ensure that all vehicles are maintained according to the manufactures maintenance schedule.

Mitigation noise: -

Construct berms around the mining area.

- Fuel and lubricant spillages from vehicles within the bounds of the various activities will result in a decline in surface water quality. Contaminated runoff from the mine site, if allowed to leave the site, could cause surface water quality deterioration.

Mitigation: -

Maintain all vehicles according to the manufactures planned maintenance programme. Clean all spills as soon as possible according to the Umsimbithi cleaning of spills procedure.

- As part of the **decommissioning phase** vehicle movement will cause impacts similar to that already described aforementioned.

2.2.6.2 Access roads

Potential impacts during the **construction phase** are the following: -

- Vegetation will be lost until rehabilitation starts during and after the operational phase of the proposed mine due to the construction of access and haul roads.

Mitigation: -

Peg out the area where the roads will be constructed and limit the disturbance as far as possible. Rehabilitate and seed the area as soon as it becomes available for rehabilitation.

- During the construction phase dust will be generated due to vehicle movement as well as the movement of materials. Usage of machinery will also cause an increase in background noise. Vehicle emissions will potentially cause deterioration in air quality. (This was already discussed in **section 2.2.6.1**)
- During the construction of the haul roads and access roads the topsoil will have to be removed. Soils within these areas will thus be impacted upon by removal and mixing of the soil.

Mitigation: -

Keep topsoil and sub soil separate and stockpile separately. Also ensure that topsoil is stockpiled correctly (with the same type of topsoil). Ensure that trucks are not overloaded as that will potentially cause spillages.

- Construction material can cause a decrease in the quality of surface water runoff due to an increase in suspended solids.

Mitigation: -

Loose material on surface will mix with storm water during rain events and will cause an increase in suspended solids. Ensure that highwall drains are

constructed; refer to Figure 8 in **Annexure 4** showing the position of the highwall drain.

Potential impact during the **operational phase** is the following: -

- Coal spillages on the roads can cause deterioration of the soils, surface water, groundwater and air quality. Coal spillages will dry out and will become easily airborne, while contact with runoff water during rain events may cause deterioration in surface water quality and the seepage from this water may affect groundwater.

Mitigation: -

Clean spills daily and remove it from the road surface. All spill coal collected from the road surfaces will be transported back to the pit.

- Usage of roads during the operational phase will also cause the generation of dust, cause an increase in noise levels and create vehicle emissions. (This was already discussed in **section 2.2.6.1**)

Potential impact during the **decommissioning phase** is the following: -

- During the rehabilitation of the roads the increased activity will potentially cause an increase in noise and dust levels. (This was already discussed in **section 2.2.6.1**)
- Surface water runoff from roads during rain events can potentially cause deterioration of surface water quality.

Mitigation: -

Attempt to conduct the decommissioning phase during the dry season of the year. Rip the area, cover it with topsoil and seed.

Potential impact during the **post closure phase** is the following:-

- Usages of the roads that were not rehabilitated can potential cause the generation of dust and noise. (This was already discussed in **section 2.2.6.1**). This refers to the roads that will remain for monitoring purposes.

2.2.6.3 Opencast Mining

During the **construction phase** the following potential physical impacts were determined (please note that this applies to all opencast areas and where relevant):

- Topsoil will be stripped from the box-cut areas and stockpiled according to types of soil and the topsoil stripping plan. Mixing of topsoil cannot be excluded. This has the potential to cause deterioration in soil quality and soil can also be lost during the stripping, transporting and disposal activities.

Mitigation: -

Strip all possible topsoil and keep the topsoil and subsoil separate as per **Figure 13** and as indicated on **Figure 6** and Table 8 of the Soil Specialist report in **Annexure 2**. Stripping of topsoil according to soil types and specified depths is crucial. It is the only way to ensure that proper rehabilitation of high standards is possible. Failure to do this will result in failure to restore soil potential, land capability and land use close to pre-mining conditions which implies deterioration of the most important natural resource which provide national food security. Mixing of topsoil and subsoil has a dramatic effect on soil physical properties and post-mining land capability. Prevent overloading of trucks as that may cause spillages and loss of topsoil. It is also recommended that the topsoil stockpiles are vegetated to prevent further deterioration of the resource. See **Annexure 2** – Appendix 1 for guidelines for stripping and handling of soils during the construction and operational phases and apply to all mining activities where these activities are related. The mine should adhere to Table 8 of the Soil Specialist and **Figure 13** / (Figure 5 in **Annexure 2**) as the ultimate guideline regarding topsoil stripping and stockpiling, as well as the rehabilitation procedures.

- This activity will also generate dust and noise. Vehicle emission can potentially deteriorate air quality. (This was already discussed in **section 2.2.6.1**)

- Surface water runoff from the stockpile areas can potentially cause deterioration in water quality. Vegetation from the box-cut area will be removed and only be re-established after the operational phase. No known red data populations that require special measures have been identified in the opencast areas. However, a red data fauna species was identified and the probability of a list of possible red data species in the area is available.

Mitigation: -

Construct highwall drains as shown in **Figure 6** (and also in **Annexure 4**). That will reduce the volume of water that can be contaminated and ensure that clean and dirty water is separated. Natural vegetation should be allowed to establish in all water management structures as well as on topsoil stockpiles.

- Drilling of blast holes can potentially cause an increase in background noise levels. It also has the potential to cause deterioration in air quality due to generation of dust and vehicle emissions.

Mitigation: -

Use water for dust suppression when drilling is done. Also ensure that the drill is maintained according to the maintenance scheduled issues by the manufacturer of the drill.

- Blasting of overburden in the box-cut can cause damages to the surrounding infrastructure. At the same time noise levels can increase and dust will be generated potentially causing deterioration in air quality.

Mitigation: -

Conduct a proper structural survey within a radius of 3 km around the proposed opencast area. It is recommended that members of the Wonderfontein Mine Community committee accompany the structural engineer during the survey. All blasts need to be designed by a professional and seismographs located at the closest receptors. Use electronic blasting techniques to ensure that the impact is limited as far as possible. Notify affected and interested parties prior to blasting via signboards, Morelig School as well as the notice board at the community centres. Avoid blasting on overcast days. Blasting should be limited to daily working hours. Refer to **Figure 19** showing 500 m radius around the proposed mining area as well as the community currently located within that radius. People in this area need to be moved for Health and Safety reasons. Relocation will be done according to the relocation protocol as already referred to earlier. On the time of the blast ensure that everyone is vacated within 500 m of the proposed blast.

- Material handling (box-cut material) will generate dust and this and vehicle emissions can potentially cause deterioration in air quality. (This was discussed in section 2.2.6.1)

- Material will be stockpiled and runoff from the bare surfaces and seepage from this stockpile has the potential to impact upon surface and groundwater.

Mitigation: -

Construct highwall drains as shown in **Figure 6**, this will ensure separation of clean and dirty water. All affected water from the stockpiles will drain into the pits from where it will be pumped to the pollution control dam at the plant. All overburden stockpiles need to be constructed inside the dirty water area of the mine.

- During the excavation of the void (box-cut) excess water from the surrounding aquifer may have to be pumped out of the excavation to allow safe mining (at all pits). This will happen if the excavations are below the local groundwater table. Pumping water could result in aquifers being dewatered at a faster rate than they are recharged. This will result in a potential lowering of the groundwater level in the vicinity of the mining area. See Figure 5.7 in **Annexure 5** for the extent to where groundwater levels will be influenced due to mining.

Mitigation: -

Continue with the monitoring of groundwater levels in the boreholes as shown in **Figure 30**. As discussed previously the community living on the relative farms will be relocated. See **Annexure 5** for the indications of the maximum and minimum extent of groundwater dewatering.

- Surface water runoff will also be intercepted by the development of the void (box-cut) and it can cause a reduction in catchment yield or cause a deterioration of surface water quality.

Mitigation: -

Construct the highwall drains as shown in **Figure 6** and continue with monitoring of the surface water quality of the pans and the Blesbokspruit, monitoring points are depicted in **Figure 30**. Limit the disturbed area to a minimum to ensure that as little as possible water is affected. Install a sump and a pump in the void. Water accumulating in the sump will be pumped via a 150 mm HDPE pipe to the pollution control dam.

- During the **operational phase** the following physical potential impacts were determined:
- Topsoil will be stripped from the proposed mining area and placed directly onto rehabilitated levelled areas. This has the potential to cause soil loss during the stripping, transporting and disposal activities.
- Mixing of soils can also occur and may lead to lower fertility of soils.

Mitigation – Soils: -

Strip all available topsoil and keep topsoil and subsoil separate. Place topsoil in layers in the opencast areas and ensure that the top 30 cm be placed at the top.

Conduct soil analysis to determine the soil fertility requirements and apply fertilizers according to this determined specification. Do not use scrapers to strip and place topsoil as that causes compaction of soils.

Do not overload trucks to prevent spillages of topsoil. Also do not use topsoil for any purpose other than for rehabilitation.

The rehabilitation process consisting of the stripping, stockpiling and replacing actions should be monitored progressively by a competent third party.

Shaping of spoils to the original topography is crucial. Failure to do this will probably adversely affect the post-mining land capability and sustainability of rehabilitated land. Spoils should be placed during the mining process in such a way and position to reduce shaping and related costs.

Proper management of the total rehabilitation process starting at the planning phase up to supervision of the dozer operators is the key to successful rehabilitation and so-called sustainable development.

- This activity will also generate dust and noise. Vehicle emission can potentially deteriorate air quality. (This was already discussed in **section 2.2.6.1**)
- Surface water runoff from the bare soil surface areas can potentially cause deterioration in water quality due to erosion. All vegetation cover and habitats

in the proposed mining area will be removed and only be replaced when areas become available for rehabilitation.

Mitigation: -

Establish vegetation as soon as possible and conduct regular inspections to identify erosion areas as soon as possible. Erosion areas must be rehabilitated as soon as possible. Vegetate topsoil stockpiles to prevent erosion and to prevent soils from further degradation.

- Mining of drainage lines (which form part of the Klippan and Wonderfontein wetland systems) will cause deterioration of the biodiversity of the area impacting on migration routes. The proposed opencast areas will intercept the drainage lines.

Mitigation: -

Develop new drainage lines post closure; refer to **Figure 33** showing the position of the new drainage lines. Vegetation from the area not to be mined will be used to re-establish similar habitats. The drainage line will be curved and constant slopes and widths will be avoided to ensure a natural re-establishment of the structure. Note that there is very little benefit to preserve this area as it was already mined out on the adjacent property and the area feeding the drainage line in this section will be mined providing no source to maintain the drainage line in its current state.

- Drilling of blast holes can potentially cause an increase in background noise levels. It also has the potential to cause deterioration in air quality due to generation of dust and vehicle emissions. (Mitigation measures are similar to that discussed in the construction phase of this activity.)

- Blasting of overburden can cause damages to the surrounding infrastructure. (Mitigation measures were discussed in the construction phase of this activity.) At the same time noise levels can increase and dust will be generated potentially causing deterioration in air quality. These blasting related impacts on air and noise are different from the impacts described in section 2.2.6.1., but see the construction phase for pre-cautionary measures.

- Material handling (removal and disposal of overburden material) will generate dust and this and vehicle emissions can potentially cause deterioration in air quality. (This was already discussed in **section 2.2.6.1**)

- Material will be disposed into the mined out void and runoff and seepage from this unrehabilitated surface has the potential to impact upon surface and groundwater.

Mitigation: -

Maintain the drains constructed as shown in **Figure 6**. Conduct concurrent rehabilitation. Attempts must be made to topsoil and seed the rehabilitated areas as soon as possible.

- In the event that the mining excavations are deeper than the local groundwater table, water will flow from the surrounding aquifer into the mining area. In order to ensure safe mining conditions this water will be pumped out into the pollution control dam. Pumping water could result in aquifers being dewatered at a faster rate than they are recharged. This will result in a lowering of the groundwater level in the vicinity of the mining area. See Groundwater Assessment, **Annexure 5**, and Figure 5.7 for maximum and minimum extent of dewatering.

Mitigation: -

Continue with the monitoring of groundwater levels in the boreholes as shown in **Figure 30**. Provide alternative water to IAP's that will be affected.

- Surface water runoff will also be intercepted by the open void (s) and it can cause a reduction in catchment yield or cause a deterioration of surface water quality. The pre-mining mean annual runoff from the Wonderfontein Mine catchment area 1.112mil m^3. The proportion of runoff originating on the Wonderfontein Mine boundary area is 0.739mil m^3, constituting 66% of the mine's natural catchment.

  The total runoff from the Quaternary Catchment area X11C is 14.2 mil m^3 /a (source: Surface Water Resources of South Africa, Volume VI). Therefore, the total natural pre-mining mean annual runoff originating on the Wonderfontein Mine site constitutes 5.21% of the Quaternary Sub-Catchment X11C's mean annual runoff.

Mitigation: -

As indicated in previously all affected water will be collected in the sump located in the opencast pits. From the sump the water will be pumped via a 150 mm HDPE pipeline to the pollution control dam. The presence of the highwall drains as shown in **Figure 6** will limit the amount of water becoming affected. Conduct regular inspections to ensure that the highwall drains are functional and maintained and also that no pipeline leaks are present. Conduct concurrent rehabilitation, this will ensure that more runoff can return back to the streams reducing the impact on catchment yield.

During the **decommissioning phase** the following physical potential impacts were determined: -

- Topsoil will be loaded from the stockpiles and placed onto rehabilitated levelled areas. This has the potential to cause soil loss during the loading, transporting and disposal activities.
- This activity will also generate dust and noise. Vehicle emission can potentially deteriorate air quality. (This was already discussed in section 2.2.6.1)

Mitigation – Soils

Load all available topsoil from the stockpiles. Place topsoil in per soil type as recommended by Rehab_Green.

Conduct soil analysis to determine the soil fertility requirements and apply fertilizers according to this determined specification. Seed the area with government certified seed.

Do not use scrapers to strip and place topsoil as that causes compaction of soils.

Do not overload trucks to prevent spillages and loss of topsoil. Also do not use topsoil for any purpose other than for rehabilitation.

- Surface water runoff from the bare soil surface areas can potentially cause deterioration in water quality due to erosion.

Mitigation: -

Topsoil and seed the levelled areas as soon as possible. Level areas to be similar as what the pre-mining topography was.

- Material handling (loading and disposal of overburden material) will generate dust and this and vehicle emissions can potentially cause deterioration in air quality. (This was discussed in **section 2.2.6.1**.)
- Groundwater levels will start to recover during this phase if it became affected during the construction and the operational phases.
- Surface water runoff will also be intercepted by the open void until it is closed and it can cause a reduction in catchment yield or cause a deterioration of surface water quality. This was discussed in the operational phase section. This impact will decrease as final rehabilitation is progressing.

Mitigation

Implement the final rehabilitation of the final voids and last levelled areas as shown in **Figure 33**.

- The permeability of the backfilled material is higher than the pre-mined aquifer material resulting in a higher recharge rate of water into the area. A recharge value of 15% and a predicted total decant at various areas of some 6 600m^3 per day will be present at the Wonderfontein mined out workings. Refer to **section 2.2.1.6** for a detailed description of the specific areas where decant will form and where the decant positions are predicted to be. Also refer to **Annexure 5** for more detail.

Mitigation: -

This mitigation measure will be discussed in detail under the water management activity that will be discussed in **section 2.2.6.6**.

During the **post closure phase** the following physical potential impacts were determined: -

- Loss in vegetation, quality of soils, land capability and eventually land use if rehabilitation is not done properly or neglected. As mentioned, soil fertility should be tested and supplemented if necessary. The correct mix of seeds should be planted and maintained. Mixing of soils when stockpiled or placed for levelling (even mixing of different type of topsoils) will most definitely cause a loss in soil fertility and quality. This will eventually cause a degradation of land capability and eventually prevent the rehabilitated land from being used for another land use other than a 'rehabilitated mine'.

Mitigation:-

See the construction, operational and decommissioning phases for mitigation measures and adhere to best practice guidelines for effective rehabilitation. Also refer the **Annexure 2**, Soil, Land Capability and Land Use Assessment for recommendations for proper topsoil stripping and rehabilitation measures.

- Decant will continue during the post closure phase as discussed above, in **section 2.2.1.6** and in **Annexure 5**.

Mitigation:-

This mitigation measure will be discussed in detail under the water management activity that will be discussed in **section 2.2.6.6**.

2.2.6.4 Underground Mining

During the **construction phase** the following potential physical impacts were determined: -

- An increase in activity and vehicle movement will generate dust, vehicle emissions and noise. (This was discussed in **section 2.2.6.1**.)
- Due to the fact that access is obtained via the highwalls of the opencast cuts at Pit 5 and Pit 6 no additional disturbance of soil and vegetation occur. This is a positive impact, no further mitigation is required.
- The development of an incline shaft (3 adits) via the highwall will potentially cause a lowering of the local water table in the area. Surface water runoff will also be intercepted by the development and it can cause a reduction in catchment yield or cause a deterioration of surface water quality.

Mitigation: -

Continue with the monitoring of groundwater levels in the area as per the monitoring programme depicted in **Figures 30**. In the event that groundwater levels in the immediate vicinity drop significantly compile a compensation protocol in consultation with the affected user.

During the **operational phase** the following physical potential impacts were determined:

- Transporting coal from the underground to the stockpiles or processing plant will generate dust, emissions and noise. (This was discussed in section 2.2.6.1.)
- Continuous mining will potentially cause a cone of depression in the local groundwater table in the area; the influence zone was determined to be anything between 100 m and 1 km around the mine. Mitigation measures were discussed in the construction phase of this activity. See **Annexure 5**, Figure 5.7.
- Spontaneous combustion could occur as a result of preferential pathways for oxygen entering the underground from sinkholes/subsidence or through the ignitial of methane gas in the underground workings.

Mitigation: -

During the operational phase, the application of stone dusting of pillars will occur so as to minimise the normal flow of air igniting the pillars. Gas monitoring will take place on a daily basis to ensure that adequate ventilation is provided to prevent a built up of methane gas in the underground workings. Areas that are mined out will be sealed off by means of ventilation walls.

During the **decommissioning phase** the following potential physical impacts were determined: -

- Material handling (loading and disposal of overburden material into the incline shaft to close the adits and opencast void) will generate dust and vehicle emissions that can potentially cause deterioration in air quality. This activity

has also the potential to increase noise levels. This was discussed in **section 2.2.6.1**.

- Topsoil will be loaded from the stockpiles and placed onto rehabilitated levelled areas. This has the potential to cause soil loss during the loading, transporting and disposal activities. This activity will also generate dust and noise. Vehicle emission can potentially deteriorate air quality. This was discussed in **section 2.2.6.1** and **section 2.2.6.3**.

- Surface water runoff from the bare soil surface areas (closing of the shaft area) can potentially cause deterioration in water quality due to erosion. The area will be without a vegetation cover until being seeded. This was discussed in **section 2.2.6.3**.

- The influence on the water table will continue during this phase as the area that is mined out underground will have a higher permeability than the surrounding un-mined area if the excavation is below the local groundwater table.

- Surface water runoff will also be intercepted by the open void (incline shaft area) until it is closed and it can cause a reduction in catchment yield or cause a deterioration of surface water quality. This impact will decrease as final rehabilitation is progressing.

Mitigation: -

Berms will be constructed around the shaft areas to prevent storm water flowing into the void area. These areas are small and will therefore have a low impact on the catchment yield of the area. Fill the adit area with overburden, cover it with topsoil and seed.

- Pillar (underground pillars developed during the board and pillar mining method) collapse may cause the development of sinkholes and or subsidence that will influence groundwater recharge as well impact on the free draining profile of the area. This could also have an impact on the catchment yield of the pan.

Mitigation: -

Design underground pillars to have a safety factor adequate for the conditions that will prevent the formation of sinkholes and or subsidence areas. This is a low risk, but the area will be monitored annually to determine if any settlement occurred. Should a sinkhole or subsidence occur the area need to be filled with material, topsoiled and seeded. This will be done for a period of 3 years, or until closure has been obtained.

- Spontaneous combustion could occur as a result of preferential pathways for oxygen entering the underground from sinkholes/subsidence or through the ignition of methane gas in the underground workings.

Mitigation: -

Construct concrete seals at the adits of the underground operations to prevent ingress of oxygen onto the workings.

If sinkholes or cracks on surface occur, these will be filled in and rehabilitated in order to prevent the ingress of oxygen into the workings.

- In the event that underground excavation is lower than the local groundwater table water from the surrounding aquifer will flow into the mine. In the underground mined out areas it is expected that such recharge may be in the order of 5% of average rainfall. Decant volumes from the underground workings were included in the values previously stated for the opencast areas.

Mitigation: -

Drill a monitoring borehole into the underground workings to monitor the rate at which the underground workings will fill. Other mitigation measures will be discussed in **section 2.2.6.6**.

During the **post closure phase** the following physical potential impacts were determined:

- Pillar (underground pillars developed during the board and pillar mining method) collapse may cause the development of sinkholes and or subsidence

that will influence groundwater recharge as well impact on the free draining profile of the area. This could also have an impact on the catchment yield of the pan.

Mitigation: -

See decommissioning phase for mitigation measures.

2.2.6.5 Disposal of coarse coal discard

During the **construction phase** the following potential physical impacts were determined: -

Please note that it is assumed that Site 1 will be chosen for the discard dump position as recommended by the respective specialists involved, and also from a management perspective it was chosen as the most suitable site for a discard dump.

- An increase in activity and vehicle movement will generate dust, vehicle emissions and noise. (This was discussed in section 2.2.6.1.)
- This activity will also generate dust and noise. (This was already discussed in **section 2.2.6.1** and formed part of the Wonderfontein Processing Plant EIA process.)
- The section of the discard dump that will be developed on the area that will not be mined east of the processing plant will have to be stripped from topsoil, which will have to be stockpiled and saved for rehabilitation of this part of the discard dump. Mixing of topsoil could occur and should be avoided. The stripping and stockpiling procedure has the potential to cause deterioration in soil quality and soil can also be lost during the stripping, transporting and disposal activities. See **section 2.2.6.3** and apply similar mitigation measures.
- It was assessed how discard has to be disposed to minimize the salt loads and sulphate concentrations created by this activity in the future. It was assessed that discard and spoils mixed together would result in the highest salt levels. Keeping it separate would result in fewer salts that will form post closure. See **section 2.2.1**.

- Disposal of discard will be on the rehabilitated areas of Pit 3. Therefore the rehabilitation of Pit 3 (without topsoil replacement) will form the construction phase of the future extended discard dump. Thus, see mitigation measures and procedures for rehabilitation of the opencast mining area at Pit 3 in **section 2.2.6.3.**

- Surface water runoff from the bare areas (stripped from topsoil) and discard stockpile areas can potentially cause deterioration in water quality.

Mitigation: -

Construct drains as shown in **Figure 6**. That will reduce the volume of water that can be contaminated and ensure that clean and dirty water is separated. Natural vegetation should be allowed to establish in all water management structures as well as on topsoil stockpiles. Construct stockpile areas within affected water area.

- Surface water runoff from the bare plant and mine residue surface areas can generation of high volumes of silt that may impact the capacity of the pollution control dam.

Mitigation: -

Construct a silt trap that will prevent the accumulation of silt in the pollution control dam.

- Surface water and seepage from mine residue facilities will contaminate soil and water.

Mitigation: -

Construct coal discard facilities as shown in **Figure 6** and as discussed in **Annexure 4**.

During the **operational phase** the following physical potential impacts were determined:

- Storage and handling and transport of coal discard will generate dust, emissions and noise. (This was discussed in **section 2.2.6.1**.)

- Runoff and seepage from the coal discard stockpiles and discard dump can cause a deterioration of surface water and groundwater quality. It can also cause soil pollution.

Mitigation: -

All mine residue deposit systems will be located within the affected water system which will be isolated from the clean water system as shown in **Figure 6**. A pollution control dam (lined) will be located downstream of the processing plant (to the east) and mine residue facilities, all runoff and seepage will be collected and contained in the dam. Cut off drains around the discard dump will prevent the contamination of groundwater. Inspect and maintain all drains. Provision is made from the 1:50 year 24 hour rainfall event in the design capacity and surface area of the pollution control dam. Maintain and clean the silt trap that will be constructed just upstream of the pollution control dam.

- Surface water runoff from the bare soil / discard dump surface areas can potentially cause deterioration in water quality due to erosion.

Mitigation: -

Rehabilitate and establish vegetation as soon as possible (when an area becomes available) and conduct regular inspections to identify erosion areas as soon as possible. Erosion areas must be rehabilitated as soon as possible.

- Spontaneous combustion could take place on the discard dump.

Mitigation: -

An impact roller should be used to compact the discard to prevent spontaneous combustion. Compaction tests need to be conducted quarterly to measure the compaction of the dump.

During the **decommissioning phase** the following physical potential impacts were determined: -

- Vehicle emissions during the final rehabilitation of the discard dump will have an impact on air quality and can potentially cause deterioration. Noise levels will also remain and could potentially increase. This was discussed in **section 2.2.6.1**.
- Topsoil will be loaded from the stockpiles and placed onto the levelled discard dump. This has the potential to cause soil loss during the loading, transporting and disposal activities. This activity will also generate dust and noise. Vehicle emission can potentially deteriorate air quality. This was discussed in **section 2.2.6.1** and **section 2.2.6.3**.
- Surface water runoff and groundwater seepage from the un-rehabilitated mine residue facilities can impact the surface and groundwater.

Mitigation: -

Shape, topsoil and seed the discard dump area. Any rubble from this site will be disposed into the opencast voids that will be rehabilitated as indicated previously.

- Salt loads and sulphate levels of seepage water will increase.

Mitigation: -

Ensure all water management facilities post closure is in place and that seepage water can be managed in a passive manner. See **section 2.2.6.6** for water management mitigation measures.

During the **post closure phase** the following physical potential impacts were determined:

- Surface water runoff and groundwater seepage from the mine residue facilities can impact the surface and groundwater. The will especially be if rehabilitation was not done in a proper manner. Erosion could also occur.

Mitigation: -

Ensure that seepage will end up in the constructed pollution control dam or as described in **section 2.2.6.6**. Monitor rehabilitation of the dump and possible occurrence of erosion. Also monitor the pollution plume of groundwater by taking groundwater samples on a quarterly basis.

- An increase in salt load and sulphate concentrations will continue. This will be managed as described during the decommissioning phase and also as described in **section 2.2.6.6**.

2.2.6.6 Water management

During the **construction phase** the following potential physical impacts were determined: -

- An increase in activity and vehicle movement will generate dust, vehicle emissions and noise. (This was discussed in **section 2.2.6.1**)
- Disturbance of soil and vegetation during the construction of water management structures (such as berms, canals and sumps as well as the installation of pumps and pipelines) will cause impacts on soil and vegetation. (This was discussed in **section 2.2.6.3**.)

During the **operational phase** the following physical potential impacts were determined:

- Recharge of the highly permeable mined out areas will continue as discussed in **section 2.2.6.3** and **section 2.2.6.4**. Also note that potential groundwater seepage and rainfall will tend to drain towards the south both in the northern and southern sections. In the northern sections this will reduce the volume of water to be pumped from the opencast areas. Recharge from the mined out areas north of Pit 10 in the southern section will accumulated in Pit 10 during the mining operation and will have to be managed. According to the groundwater report operational water to be managed will be on average 630 m^3 per day.

Mitigation:-

Water accumulating in the mined out pits will be caught in a sump and then pumped to the pollution control dam. Water from the pollution control dam will be used in a closed circuit and will be separated from the clean water areas. Water from the pollution control dam will be used in the processing plant as well as for dust suppression at the plant area and at all opencast areas. Some 382 m^3/day will be abstracted for dust suppression (based on the 0.188 ℓ m^2/h requirement set in the air quality report for area 134 800 m^2). Affected run-off from the affected water areas will also be stored in the pollution control dam.

- The impact on the lowering of the local groundwater table was also discussed and defined in **section 2.2.6.3** and **section 2.2.6.4**.

During the **decommissioning phase** the following physical potential impacts were determined: -

- Material handling (closure of trenches and storm water canals that are no longer required) will generate dust and vehicle emissions that can potentially cause deterioration in air quality. This activity has also the potential to increase noise levels. This was discussed in **section 2.2.6.1**.
- The impact on the lowering of the local groundwater table was also discussed and defined in **section 2.2.6.3** and **section 2.2.6.4**.
- The permeability of the backfilled material is higher than the pre-mined aquifer material resulting in a higher recharge rate of water into the area. Decant values for each pit was calculated and can be viewed in **Table 47**. The possible decant points are shown in Figures 5.4 and 5.5 of **Annexure 5**. An average sulphate concentration of 2905 mg/ℓ is expected, amounting to different salt loads (depending on scenario and pit location) of between 14.69 ton per day (for spoils only) and 19.4 ton per day (if discard and spoils are mixed). See Annexure 5 for the exact calculated sulphates and salt loads at the respective pits.

Mitigation: -

Final voids will be constructed in the relevant positions where decant was predicted (Figure 5.4 and 5.5 in Annexure 5) and as described **section 2.2.1**. The final voids will intercept the decant and evaporate it. Monitoring of the surface water in the area, including the Blesbokspruit will continue during the decommissioning phase. Refer to **Figure 33**. Another water management system will be constructed to manage subsurface decant from the Northern opencast pits. Subsurface decant will realize in the upper reached of the un-named tributary of the Blesbokspruit. A dam will be constructed in the stream and clean water drains will be constructed around the dam to transport clean water upstream of the section to the spruit, refer to **Figure 33** showing this system.

- Post closure the pollution control dam will remain to capture seepage from the discard dump facility. The dam will then act as an evaporation facility.

Mitigation: -

Ensure that the pollution control dam liner is still efficient during decommissioning and maintain where necessary.

- Some opencast areas will have a surplus volume of water since the final voids will not have enough capacity to cater for all the water.

Mitigation: -

A water treatment plant will have to be constructed to manage water that cannot be catered for by final voids, on average it will vary between 1.1 and 1.2 Mℓ per day. It is recommended that the water be treated to a quality suitable for irrigation, Class II.

During the **post closure phase** the following physical potential impacts were determined: -

- The water treatment plant will have to be managed to ensure the efficiency thereof.

Mitigation: -

It is recommended that the water be treated to a quality suitable for irrigation.

2.2.6.7 Workshops, stores and offices

During the **construction phase** the following potential physical impacts were determined: -

- An increase in activity and vehicle movement will generate dust, vehicle emissions and noise. (This was discussed in **section 2.2.6.1**.)
- Additional impacts on soils and vegetation will occur due to the construction of buildings (offices, workshops and sewage plant). The same procedures will apply, by stripping the topsoil of the areas affected and stockpiling correctly for use in rehabilitation of the area during decommissioning. See **section 2.2.6.1**. and **2.2.6.3** for mitigation of removal of topsoil and vegetation, as well as dust and noise generated by vehicles used for these processes.
- Sewage generated at the workshop and offices can potentially impact the groundwater of the area.

Mitigation: -

Construct a sewage plant to handle the sewage produced.

- Waste will be generated as part of the construction phase of the project. Waste should be separated and disposed off correctly. Failure thereof will result in mixing of waste and therefore incorrect disposal of waste at sites not adequate therefore.

Mitigation: -

Waste should be separated into: 1) General waste; 2) Industrial waste; 3) Scrap metals and 4) Hazardous waste. A waste contractor should remove the waste once a month or as required. Waste removal and volumes should be recorded.

During the **operational phase** the following physical potential impacts were determined:

- Vehicle maintenance and repairs will be conducted on the site where the workshops will be located. This will therefore increase the risk of carbon spills and contamination of the soil.

Mitigation: -

Clean spills as soon as possible and dispose of the waste in a hazardous bin. Use drip trays when maintenance are conducted and ensure that all activities are conducted on concrete floors. Also conduct decanting as per controlled procedures and clean any spills as soon as possible. Storage areas of oil, diesel and petrol need be properly bunded.

- Waste separation should continue. Failure thereof will result in mixing of waste and therefore incorrect disposal of waste at sites not adequate therefore.

Mitigation: -

As discussed in the construction phase, waste separation should be conducted throughout the life of mine. Waste storage areas should be concreted and bunded and within the affected water areas. Waste should be removed by a contractor once a month or as regular as possible and as required. General waste should be taken to an approved general waste site and as agreed with local municipalities. Hazardous waste should be taken to an approved hazardous waste site. Industrial waste and scrap metals can be sold.

- Ensure proper maintenance is conducted on the sewage plant. Water purified in the plant should adhere to DWAF special standards. The water could be re-used.

Mitigation: -

Failure of mismanagement of the sewage plant can result in sewage water being released into the streams of the area. A sewage plant will be constructed and operated to the applicable standards to ensure effluent is properly managed.

During the **decommissioning phase** the following physical potential impacts were determined: -

- Material handling during the demolishment of the infrastructure will generate dust and vehicle emissions that can potentially cause deterioration in air quality. This activity has also the potential to increase noise levels. This was discussed in **section 2.2.6.1**.
- Topsoil will be loaded from the stockpiles and placed onto cleared areas. This has the potential to cause soil loss during the loading, transporting and disposal activities. This activity will also generate dust and noise. Vehicle emission can potentially deteriorate air quality. This was discussed in **section 2.2.6.1** and **section 2.2.6.3**.
- Surface water runoff from the bare soil surface areas (decommissioning of the offices and workshop / store areas) can potentially cause deterioration in water quality due to erosion. The area will be without a vegetation cover until being seeded. This was discussed in **section 2.2.6.4**.
- Waste separation should continue. Failure thereof will result in mixing of waste and therefore incorrect disposal of waste at sites not adequate therefore.

Mitigation: -

See construction and operational phase. Waste separation should continue during the decommissioning phase.

During the **post closure phase** the following physical potential impacts were determined: -

None.

2.2.7 POTENTIAL PHYSICAL IMPACTS RAISED BY I&APS

Refer to **Sections 2.2.5** and **2.2.6**. In these sections the proposed mitigation measures are also discussed and the significance rating of the impacts are shown in **Tables 50 – 56**.

2.2.8 POTENTIAL PHYSICAL IMPACTS RAISED BY STATE DEPARTMENTS

Refer to **Annexure 12**. The complaint letter from the Mpumalanga Tourism and Parks Board is included where issues regarding the development of the mine are raised. Also see the Issue and Response Register as included in **Annexure 12**.

A summary of potential impacts as raised by the Mpumalanga Tourism and Parks Board were:

- Concerns about the large long term project in a water and wetland rich area, specifically the Leeuwbankspruit, Blesbokspruit and Nooitegedacht Dam.
- Concerned about the process that was followed concerning the NEMA procedures for the conduction of an EIA.
- Concerned about the numerous strong fountains and pure underground water and biodiversity rich soils can be contaminated to such extent that it cannot be economically rehabilitated.

2.2.9 CLASSIFICATION OF IMPACTS IN TERMS OF RESPECTIVE PHASES

Refer to **Section 2.2.6** as well as **Table 49**.

2.2.10 ASSESSMENT OF POTENTIAL IMPACTS

The classification of all environmental impacts identified will be done in terms of the respective phases of construction, operational, closure and post closure phases of the mining operation. Impacts will be assessed in terms of: -

- their nature,
- their extent,
- their probability,
- their significance.

The following simplified and easy to apply ratings have been utilised in this assessment:

Nature	Extent	Probability	Significance
Short Medium Long Permanent	Site Local Regional International	Definite Possible Not possible	High Moderate Low

Nature of the impact:

This specifies the duration of the impact as well as whether the impact is positive or negative. Short is taken to indicate < 5 years; Medium is taken to be equal to the life of the mine; Long is taken to be > 20 years; and Permanent is a life time.

Extent of the impact:
The spatial component of the impact determines the geographical extent of the impact.

Probability of the impact occurring:

The probability is an indication of whether the impact will occur or not.

Significance of the impact:

The potential significance of every environmental impact was identified by using a ranking scale, based on the following (terminology from the DEAT's guideline document on EIA Regulations, April 1998). Note that an assessment was done considering not mitigation measures and an assessment was then conducted for impacts with a high and moderate environmental significance after the implementation of mitigation measures**.**

i) Occurrence, based on

- Probability of occurrence (how likely is it that the impact may occur?), and
- Duration of occurrence (how long may it last?)

ii) Severity, based on

- Magnitude (severity) of impact (will the impact be of Higher Low severity?), and

- Area/extent of impact (will the impact affect the national, regional or local environment, or only that of the site?)

The following ranking scales were used to assess the significance of each impact:

Probability (P)	**Duration (D)**
5 – Definite / don't know	5 - Permanent
4 – Highly probable	4 – Long-term (ceases with the operational)
3 – Medium probability	3 – Medium term (5 – 15 years)
2 – Low probability	2 – Short term (0 – 5 years)
1 – Improbable	1 - Immediate
0 - None	
Scale (S)	**Magnitude (M)**
5 – International	10 – Very high / don't know
4 – National	8 – High
3 – Regional	6 – Moderate
2 – Local	4 – Low
1 – Site only	2 – Minor
0 - None	

Once the above factors had been ranked for each impact, the environmental significance of each was assessed using the following formula: -

*SP = (Magnitude + duration + scale) * Probability*

The maximum value is 100 significant points (SP). Environmental impacts (R) were rated as either High (H), Moderate (M) or Low (L) Significance on the following basis:

More than 75 significance points indicated High (H) environmental significance;

Between 50 and 75 significance points indicated Moderate (M) environmental significance;

Less than 50 significance points indicated Low (L) environmental significance.

Table 50: Significance rating Impacts all activities

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
All phases	Dust will be generated due to vehicle movement	8	4	1	4	52	M	Treat road with chemicals, use water for dust suppression. For vehicle emissions no other mitigation is proposes other than regular maintenance on vehicles. Fuel and lubricant spillages should be cleaned immediately and if it occurs, it should be restricted to the affected water areas. Overloading of trucks should be prevented.	8	4	1	3	39	L
	Dust will be generated due to materials handling	8	4	1	4	52	L		8	4	1	3	39	L
	Use of machinery will cause an increase in noise levels	6	4	1	4	44	L							
	Vehicle emissions can cause deterioration in air quality	6	4	2	5	60	M							
	Fuel and lubricant spillages will result in a decline in surface water quality	8	4	2	4	56	M		6	4	2	4	48	L

Table 51: Significance rating Activity 2 Access roads

Phase	Impact	Significance before mitigation						Mitigation Measures	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
Construction phase	Vegetation will be removed	4	4	1	5	45	L	Low significance, not evaluated with mitigation measures.						
	Topsoil will be removed and could spill	10	5	1	5	80	H	The removal of topsoil should be done according the topsoil strip plan in **Annexure 2** and	8	2	1	5	55	M
	Topsoil will be mixed and	8	4	1	5	65	M		6	4	1	4	44	L

Phase	Impact	Significance before mitigation						Mitigation Measures	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
	could become compacted							stockpiled correctly according to the plan to prevent mixing of topsoil. No vehicle movement should be allowed over the stockpiles to prevent compaction. Topsoil will be replaced during rehabilitation.						
	Contamination of surface water when storm water mixes with loose construction material	8	1	2	4	44	L	Surface water contaminated by loose construction material should be restricted to the dirty water area.	6	4	2	5	60	M
	Increase in vehicle volumes on provincial roads	8	4	2	5	70	M	Construct new access to D383 and slow lane. See **Annexure 11**. This will regulate the traffic better and be less dangerous. However, traffic will reduce when LOM comes to an end.	6	4	2	5	60	M
Operational Phase	Coal spillages will cause deterioration in soil quality	8	4	1	4	52	M	Topsoil will be stripped from road surface areas and should therefore not be affected by coal spillages. However, spills should still be cleaned as soon as it occurs since the roads will be constructed from clean rock materials.	6	4	1	4	44	L
	Coal spillages will cause deterioration in surface water	8	4	1	5	65	M	Clean coal spillages immediately in order to reduce contamination	6	4	1	3	33	L

Phase	Impact	Significance before mitigation						Mitigation Measures	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
	quality							of surface water.						
	Coal spillages will cause deterioration in ground water quality	8	4	1	5	65	M	Clean coal spillages immediately in order to reduce the chance of contamination of groundwater.	6	4	1	3	33	L
	Coal spillages will cause deterioration in air quality	6	2	1	4	36	L	Spillages should be cleaned immediately to avoid further deterioration in air quality.						
Decommissioning phase	Surface runoff from roads can potentially cause deterioration of surface water quality	6	2	2	4	40	L	Rip the soils and rehabilitate						
	Activity increase will increase noise levels	4	2	1	3	21	L	However, mining in the specific area would have ceased and therefore the impact will not contribute to higher noise levels.						
	Activity will increase dust levels	2	2	1	5	25	L	However, mining in the specific area would have ceased and therefore the impact will not contribute to higher dust levels.						

Table 52: Significance rating Activity 3 Opencast Mining

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
Construction phase	Vegetation will be removed	4	2	1	5	35	L	Low significance since most of area was used for agricultural purposes and the vegetation has already been removed, thus not evaluated with mitigation measures.						
	Topsoil will be removed	10	5	1	5	80	**H**	Topsoil will be removed as described in **Annexure 2**. However, removal of topsoil will destruct the natural soil structure and this will be permanent. No mitigation, except correct depth stripping to prevent loss of natural resource.	8	3	1	5	60	M
	Topsoil will be mixed	10	4	1	5	75	M	Topsoil will be placed on different stockpiles as described in **Annexure 2**. If the mine adheres to this commitment it will ensure that the quality of the different soils remains.	8	4	1	3	39	L
	Surface runoff from bare surfaces can potentially cause deterioration of surface water quality	8	4	2	4	56	M	Surface runoff in the opencast will be contained within the dirty water area. Highwall drains will be constructed to ensure separation of clean and dirty water.	6	4	2	4	48	L
	Drilling of blasting holes will increase the background	4	2	1	5	35	L	No mitigation. Berms however will be constructed around the mining						

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
	noise levels							areas and can act as sound barriers.						
	Dust will be generated when drilling blast holes	4	2	2	5	35	L	No mitigation.						
	Blasting of overburden can cause damage to surrounding infrastructure	10	2	1	5	65	M	USBM standards for blasting will be used. Vacate everyone within 500m of blast. Design all blasts by a professional and use electronic blasting techniques to limit the impact as far as possible. Place seismographs at infrastructure of offices and workshops and as required.	10	2	1	3	39	L
	Blasting generates dust	4	1	2	5	35	L	Low significance, not evaluated with mitigation measures. Dust suppression will be conducted at the mining site, but no mitigation is possible for blasting causing dust.						
	Runoff from stockpiles will cause contamination of surface runoff and groundwater	8	4	2	5	70	M	Construct highwall drains to separate clean and dirty water. Dirty water will be contained in the pit and pumped to the pollution control dam.	8	4	2	3	42	L
	The development of the box-cuts will cause a drop in the local groundwater table	8	4	2	4	56	M	If any outside users are affected by the drop in local groundwater, water will be provided to them.	6	4	2	3	36	L
	Development of the box-cuts will intercept surface water	8	4	2	5	70	M	Divert clean water run-off around the box-cuts, keep disturbance to a	6	4	2	3	36	L

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
	runoff and reduce the catchment yield of the area							minimum and monitor water quality in the surrounding area, including the Blesbokspruit and Nooitgedacht dam						
Operational Phase	Vegetation will be removed	4	2	1	5	35	L	Low significance, not evaluated with mitigation measures. Most of area was used for agricultural purposes and the vegetation has already been removed, thus not evaluated with mitigation measures.						
	Topsoil will be removed	10	5	1	5	80	**H**	Topsoil will be removed as described in **Annexure 2**. However, removal of topsoil will destruct the natural soil structure and this will be permanent. No mitigation, except correct depth stripping to prevent loss of natural resource.	8	3	1	5	60	M
	Topsoil will be mixed	10	4	1	5	75	M	Topsoil will be placed on different stockpiles as described in **Annexure 2**. If the mine adheres to this commitment it will ensure that the quality of the different soils remains.	8	4	1	3	39	L
	Coal spillages will cause deterioration in soil quality	8	4	1	4	52	M	Topsoil will be stripped from road surface areas and should therefore not be affected by coal spillages. However, spills should still be	6	4	1	4	44	L

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
								cleaned as soon as it occurs since the roads will be constructed from clean rock materials. Ensure that no coal spillages occur on or near topsoil.						
	Coal spillages will cause deterioration in surface water quality	8	4	1	5	65	M	Clean coal spillages immediately in order to reduce contamination of surface water.	6	4	1	3	33	L
	Coal spillages will cause deterioration in ground water quality	8	4	1	5	65	M	Clean coal spillages immediately in order to reduce the chance of contamination of groundwater.	6	4	1	3	33	L
	Coal spillages will cause deterioration in air quality	6	2	1	4	36	L	Spillages should be cleaned immediately to avoid further deterioration in air quality.						
	Surface runoff from bare surfaces can potentially cause deterioration of surface water quality	8	4	2	4	56	M	Surface runoff in the opencast will be contained within the dirty water area. Highwall drains will be constructed to ensure separation of clean and dirty water.	6	4	2	4	48	L
	Drilling of blasting holes will increase the background noise levels	4	2	1	5	35	L	No mitigation. Berms however will be constructed around the mining areas and can act as sound barriers.						
	Dust will be generated when drilling blast holes	4	2	2	5	35	L	Dust suppression will be conducted.						
	Blasting of overburden can cause damage to surrounding infrastructure	10	2	1	5	65	M	Vacate everyone within 500m of blast. Design all blasts by a professional and use electronic	10	2	1	3	39	L

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
								blasting techniques to limit the impact as far as possible. Place seismographs at infrastructure of offices and workshops and as required.						
	Blasting generates dust	4	1	2	5	35	L	Low significance, not evaluated with mitigation measures. Dust suppression will be conducted at the mine.						
	Mining of drainage lines will cause deterioration of biodiversity	8	5	1	5	70	M	Develop new drainage lines as part of the rehabilitation, refer to **Figure 33.**	8	5	1	2	28	L
	Runoff and seepage from material disposed into the mined out voids will become contaminated	8	5	1	5	70	M	Construct highwall drains to limit influx of storm-water. Conduct concurrent rehabilitation and topsoil and seed as soon as possible.	8	5	1	3	42	L
	Continuous mining will cause a drop in the local groundwater table	8	4	2	3	56	M	Where necessary, groundwater will be provided if an adjacent landowner is affected.	6	4	2	3	36	L
	Continuous mining will intercept surface water runoff and reduce the catchment yield of the area	8	4	2	5	70	M	Divert clean water run-off around the mining areas, keep disturbance to a minimum and monitor water quality in the surrounding area, including the Blesbokspruit and Nooitgedacht dam. Conduct concurrent rehabilitation.	6	4	2	3	36	L
Decommissioning Phase	Loading of topsoil from the stockpiles will have an	8	5	1	4	56	M	Prevent topsoil spillages. Correct soil placement (in terms of depth	8	4	1	3	39	L

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
	impact on soil volume and quality and spillages could occur. Wrong depth placement and mixing of topsoil will have an impact on the soil quality.							and similar soils together) is crucial for proper rehabilitation to succeed. See **Annexure 2** for proper rehabilitation guidelines. It is also necessary that a competent third person check on a regular basis that rehabilitation is done properly.						
	Surface runoff from bare surfaces can potentially cause deterioration of surface water quality	8	4	2	4	56	M	This was discussed above in both construction and operational phases. Surface runoff in the opencast voids will be contained within the dirty water area.	6	4	2	4	48	L
	Permeability of backfilled material is higher than the pre-mined aquifer material resulting in a higher recharge rate. This water is accumulating in the opencast area and when storage capacity is depleted may result in the formation of decant to surface	10	5	2	5	85	H	Construct various evaporation voids as shown in **Figure 33** as well as a water treatment plant to treat some 1.2 Mℓ per day. Also grout the pillar between Pit 6 and the gravel road and construct the sub-surface water management system as shown in **Figure 32**.	10	5	2	3	51	M
	Surface runoff will be intercepted by the final void until it is closed, this will reduce the catchment yield of the area	8	4	2	4	56	M	Conduct the final rehabilitation by closing the final void and ramp. Place topsoil on the leveled areas and topsoil and establish vegetation as soon as possible.	6	2	2	3	30	L

Table 53: Significance rating Activity 4 Underground Mining

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
Construction phase	The development of the adits will cause a drop in the local groundwater table	8	3	2	5	65	M	Monitor groundwater tables and compile a compensation protocol in consultation with affected user	4	3	2	5	45	L
Operational Phase	Potential for spontaneous combustion to occur in the underground workings	10	5	2	5	85	H	The stonedusting of pillars will be done so as to minimise the normal flow of air igniting the pillars. Gas monitoring will take place on a daily basis to ensure that adequate ventilation is provided to prevent a built up of methane gas in the underground workings.	10	5	2	3	51	M
Decommissioning phase	Pillar collapse may cause the development of sinkholes and subsidence areas	10	5	1	4	64	M	Design the underground mine according with adequate safety factors that will prevent pillar failure. In the event of sinkholes and or subsidence developing, fill the area with material, topsoil and seed	10	5	1	2	32	L
	Potential for spontaneous	10	5	2	5	85	H	Construct concrete seals at the adits of the	10	5	2	3	51	M

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
	combustion to occur in the underground workings							underground operation to prevent ingress of oxygen onto the workings. If sinkholes or cracks on surface occur, these will be filled in and rehabilitated in order to prevent the ingress of oxygen into the workings						
	In the event that underground excavation is lower than the local groundwater table water from the surrounding aquifer will flow into the mine. In the underground mined out areas it is expected that such recharge may be in the order of 5% of average rainfall. North of the gravel road all the underground seepage/decant will drain towards the opencast areas and will be managed as indicated in the opencast section. At Pit	10	5	2	5	85	H	Drill monitoring holes to determine the rate at which the underground workings will be flooded. Once the underground is filled it will be maintained at level by extracting the surplus water and treating it. The total estimated surplus for both underground and opencast is between 1.1 and 1.2 Mℓ per day. See water management for further mitigation measures. (And also below in the post-closure phase.)	8	5	1	3	42	L

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
	10 it is expected that some 803 m^3 per day will decant. Time to decant will depend on the operational water management.													
	Loading of topsoil from the stockpiles will have an impact on soil volume and quality	8	5	1	4	56	M	Prevent topsoil spillages. Correct soil placement (in terms of depth and similar soils together) is crucial for proper rehabilitation to succeed. See **Annexure 2** for proper rehabilitation guidelines. It is also necessary that a competent third person check on a regular basis that rehabilitation is done properly.	8	4	1	3	39	L
	Surface runoff from bare surfaces can potentially cause deterioration of surface water quality	6	2	2	4	40	L	Will not occur at large proportions at the underground mining areas.						
Post Closure	Permeability of backfilled material is higher than the pre-mined aquifer material resulting in a higher	10	5	2	5	85	H	Drill monitoring hole into workings and determine rate of filling. Manage water with opencast water as discussed previously.	8	5	1	3	42	L

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
	recharge rate. This water is accumulating in the underground area and when storage capacity is depleted may result in the formation of decant to surface													
	Potential for spontaneous combustion to occur in the underground workings	10	5	2	5	85	H	Construct concrete seals at the adits of the underground operation to prevent ingress of oxygen onto the workings. If sinkholes or cracks on surface occur, these will be filled in and rehabilitated in order to prevent the ingress of oxygen into the workings	10	5	2	2	34	L

Table 54: Significance rating Activity 5 Disposal of coarse coal discard

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
Construction phase	Vegetation will be removed							See **Tables 50**, **51** and **52**. Similar impacts with similar mitigation measures.						
	Topsoil will be removed													

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
	Topsoil will be mixed													
	An increase in dust and noise, as well as vehicle emissions.													
	Surface runoff from bare surfaces and loose construction material can potentially cause deterioration of surface water quality													
	Runoff from stockpiles and mine residue deposit areas will cause contamination of surface runoff and groundwater, and could also cause deterioration in soils.	8	4	2	5	70	M	Construct drains to separate clean and dirty water. Dirty water will be contained in the dirty water area and pumped to the pollution control dam. A silt trap will be constructed to prevent solids from entering the pollution control dam.	8	4	2	3	42	L
Operational phase	Surface runoff and seepage from the discard stockpiles and discard dump can contaminate the soil.	8	4	2	5	70	M	See above in construction phase. Also note that the mine residue deposit will be located within the affected water area. Maintain and clean the silt trap.	8	4	2	3	42	L
	Surface runoff from the discard stockpiles and discard dump can contaminate the surrounding surface water resources	10	4	2	5	80	H	Construct pollution control dam and clean and affected water berms to ensure containment of affected water runoff.	10	4	2	3	48	L

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
	(Blesbokspruit and ultimately the Nooitgedacht dam).													
	Surface runoff and seepage from the discard stockpiles and discard dump can contaminate the groundwater.	8	5	1	4	56	M	Cut-off drains will be constructed around all the mine residue facilities that will collect any seepage from the facilities and diverted it into the lined pollution control dam. This however form part of the Wonderfontein Plant EIA.	8	5	1	2	28	L
	Spontaneous combustion may occur, causing an increase in air pollution as well as deterioration in working conditions.	10	4	1	4	60	M	Dispose discard in layers and compact when stored temporarily. Use an impact roller to compact the discard. Compaction tests need to be conducted quarterly to measure compaction of the dump.	8	4	1	3	39	L
	Disposal of coal discard will cause an impact on air, soil and water	8	2	2	5	60	M	Dispose coal discard on the discard dump (which will be built in the old pit at opencast section 3) and cover with material when ready for rehabilitation.	8	2	2	3	36	L
Decommissioning Phase	Runoff and seepage from un-rehabilitated mine residue deposits can impact surface and groundwater	10	5	2	5	75	M	Remove all remaining mine residue from the area and shape it. Topsoil (0.6 m) and seed it as well.	10	5	1	2	32	L
	Salt loads and sulphates levels of seepage water will	8	5	2	4	60	M	Ensure that the rehabilitation is conducted properly. Contain all	6	5	2	4	52	M

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
	increase.							seepage water in the existing pollution control dam and leave for evaporation.						
Post closure	Groundwater seepage from the mine residue facility could impact the surface and groundwater.							See decommissioning phase.						
	Erosion on the rehabilitated discard dump could occur.	6	5	1	4	44	L	Although the significance is low, this is a possibility to occur. No mitigation is proposed except that monitoring on the rehabilitated dump continues.						
	Salt loads and sulphates levels increase of seepage water will continue.							See decommissioning phase.						

Table 55: Significance rating Activity 6 Water Management

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
Construction phase	Disturbance of soil and vegetation due to construction of water management features. Also increased levels in noise, dust and vehicle emissions.							Discussed in **Table 50, 51** and **52**	4	2	2	5	40	L
Operational Phase	Management of water in pits.							Discussed in **Table 50, 51** and **52** This refers to the collection of water in the pits within sumps, and pumping the water to the pollution control dam. This will ensure the water is not released into the clean water areas. Water will be re-used for dust suppression and in the processing plant.						
Decommissioning phase	Permeability of backfilled material is higher than the pre-mined aquifer material resulting in a higher recharge rate. This water is accumulating in the	10	5	2	5	85	H	Construct final voids in areas as described in **section 2.2.1** and as shown in Figure 5.4 and 5.5 in **Annexure 5**. The pollution control dam will also remain in order to	10	5	2	2	34	L

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
	mined out areas and when storage capacity is depleted may result in the formation of decant to surface.							capture seepage water from the mine residue facility. A water treatment plant will be constructed to treat the excess water that cannot be accommodated by the voids. This water should be treated to irrigation quality water.						
Post closure	Surplus water not accommodated by voids will seep to surface areas.	10	5	2	5	85	H	The water treatment plant will have to be operated and maintained in order to treat this water and make it available for irrigation.	6	5	2	3	39	L

Table 56: Significance rating Activity 7 Workshops, Stores and offices

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
Construction phase	Additional areas will be disturbed due to the construction of offices, stores and workshops. (disturbance of natural vegetation and topsoil)							Discussed in **Tables 50**, **51** and **52**.						
	Sewage will be	10	4	1	5	75	M	Construct a sewage plant	10	4	1	2	28	L

Phase	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
	generated and can potentially impact on groundwater.							to manage sewage.						
	Waste will be generated as part of the project and will be continuous throughout the operational and decommissioning phase	8	4	1	5	65	M	Store waste on a temporary waste storage site in the relevant waste skips and get contractors to remove waste and dispose of it in the correct manner.	6	4	1	4	44	L
Operational Phase	Handling and management of hydro-carbons can cause impacts on soil and water.	8	5	1	5	70	M	Clean spills and dispose waste into hazardous bins. Use drip trays when servicing vehicles and conduct activities on concrete floors. Ensure that all hydro carbons are stored within a bunded area.	8	5	1	2	28	L
Decommissioning phase	Workshops, stores and offices will no longer be occupied, they will have no use and will negatively impact on land-use	6	5	1	5	60	M	Demolish infrastructure and dispose rubble into opencast void, topsoil and seed. Discussed in **Table 50**, **51** and **52**.	6	2	1	2	18	L

2.2.11 CUMULATIVE IMPACTS

Assessment of the cumulative impacts will be done according to the procedure set out in **Section 2.2.10**. Results are shown in **Table 57**.

The planned Wonderfontein Mine is located in the northern-most regions of Quaternary catchment X11C, with insignificant/zero coal reserves to its north, east and west. To the southeast, the Klippan Mine has recently been commissioned and Grootpan-Steelcoal Mining is almost complete. Wonderfontein Mine will be physically connected to these neighbouring mines and sharing the same groundwater systems. The potential interaction with these mines, aquifers and nearby surface water systems must therefore be assessed.

2.2.11.1 All activities

- In the first three to four years of the project, dust creation might have a cumulative impact, since the Klippan Mine will also be in operational phase.

Mitigation: -

Dust suppression will be conducted at both collieries throughout the life of mine and also as part of the decommissioning phase. However as operations at Klippan Mine ceases dust levels will be reduced in the greater area.

- A noise increase will contribute to the noise already created by Klippan Mine. However, Klippan Mine will only be operational for approximately 3 years. The Environmental Noise Assessment however stated that the noise created at Wonderfontein Mine will be of VERY LOW to LOW significance. Therefore no other mitigations that the building of berms around the mine is suggested.

2.2.11.2 Access roads

- During all phases of the project the volume of traffic on provincial access roads will potentially increase.

Mitigation: -

A new access entrance to the provincial road will be constructed for

Wonderfontein Mine; this will ensure safe access for coal transported via Wonderfontein Mine to the various clients. Position of the access road is shown on **Figure 6**. Also ensure that vehicles are well maintained and road worthy.

2.2.11.3 Opencast mining

The following cumulative impacts were identified: -

- Land use will change from agriculture to mining (construction and operational phases). The proposed mining area comprises of some 1320 ha opencast and 146 ha underground mining (thus total some 1466 ha will be allocated to mining) and during the mining operation none of the area will be available for agricultural activities (except underground mining areas where agricultural practices can continue). The cumulative impact entails the fact that Klippan Mine and also the completed Steelecoal / Grootpan Mines are within close proximity to this area. Opencast mining will / has been conducted in those areas which were also mainly used for agricultural purposes, contributing to a vast area of agricultural land being used for mining purposes instead.

Mitigation: -

Keep the disturbance of the area to a minimum. Make area available for agricultural purposes as soon as possible. If rehabilitation is not properly done (including incorrect topsoil stripping and stockpiling for all development areas) the disturbed area will never reach a potential to be used for agriculture again. This area is a very high potential agricultural area and need to be rehabilitated properly in order for agriculture to continue after mining has ceased.

- Arable land will reduce (all phases). In total 765.86 ha of arable land will be affected by the proposed mining activity within the mineral rights area. The total mineral rights area amounts to approximately 1466 ha (however, only 1274.51 was used by the Soil Scientist), and therefore the impact (as calculated by the Soil Scientist) is 60.09%. Thus, Wonderfontein Mine will contribute to more arable land being lost for the life of mine in order to cater for mining purposes. Grazing land will also be lost and will have an impact of 15.04%.

Mitigation: -

Implement mitigation measures to prevent the impact on soils as described in **section 2.2.6.3**. Proper planning, management and execution of rehabilitation procedures are therefore crucial. After mining and proper rehabilitation, make the area available for agricultural use.

- Cumulative impacts on water and water management as a result of the proposed mining activity will be discussed under water management in **section 2.2.11.6**.

2.2.11.4 Underground Mining

The following cumulative impacts were identified:-

- The possibility of subsidence and sinkholes could result in further loss of very high potential agricultural land.

Mitigation: -

Ensure that regular inspections are done in these areas and monitor continuously. If the safety factor is applied correctly when bord and pillar mining is conducted, subsidence should not occur.

- The possibility of the formation of methane gas in the old underground workings is possible and could contribute to air quality deterioration.

Mitigation: -

Ensure that regular monitoring of the old underground workings is conducted. Ensure that the workings are sealed properly and that the gas cannot escape.

2.2.11.5 Disposal of coarse coal discard

Cumulative impacts related to the processing of coal is mostly related to the additional impact on water management, and therefore discussed in **section 2.2.11.5**.

However, the possibility of spontaneous combustion could occur on the discard dump.

Mitigation: -

Ensure that the dump is compacted before final rehabilitation is conducted. Regular compaction tests should be conducted.

- The discard dump will remain as a permanent feature on site. It is necessary that the rehabilitation is conducted in a proper manner to ensure the ling term visual impact is reduced.

Mitigation: -

Refer to the Soil Specialist Report Appendix 1 in **Annexure 2** for the Guidelines for stripping and handling of soils during the construction and operational phases and the Environmental Impact Assessment. The procedures for proper rehabilitation are listed in this document and should be followed by the mining company to ensure compliance with rehabilitation standards. This also refers to all final rehabilitation that will be conducted, including the opencast areas, underground areas, roads, offices, workshops and stores.

2.2.11.6 Water Management

The following cumulative impacts were identified: -

- The MAR measured at DWAF measure station B1H002 was determined to be 8.5 million m^3 per year. Runoff from the proposed mine area that will be contained amounts to 0.13 million m^3 per year (Surface water report **Appendix 5**), this is a reduction of 1.53%.

Reduction in yield = 130 000 / 8,500,00 * 100 = 1.53%.

This reduction in catchment yield is seen to be negligible.

Mitigation: -

Implement mitigation measures to prevent the impact on soils as described in section 2.2.6.3. After mining make the area available for agricultural use.

- The MAR measured at DWAF measure station B1H002 was determined to be 8.5 million m^3 per year. Runoff from the proposed mine area that will be contained amounts to 0.13 million m^3 per year (Surface water report **Appendix 5**), this is a reduction of 1.53%.
- As far as the cumulative impact on quality on the Nooitgedacht dam the following. The MAR of the Nooitgedacht dam is 64.1 million m^3 and the current sulphate concentration is 23.5 mg/ℓ meaning a salt load of 1506 ton per year. Should the subsurface decant from the northern sections be released into the stream it will add 432 ton per year to the salt load of the Nooitgedacht dam. This could lead to an increase of water quality in the Nooitgedacht dam. The expected sulphate concentration in the dam will be some 30.25 mg/ℓ.

Mitigation: -

Implement mitigation measures to prevent surface and subsurface decant flwoing into the Nooitgedacht dam as described earlier.

2.2.11.7 Workshops, Stores and office

No other impacts other than already described were identified.

Mitigation: -

Ensure proper rehabilitation and disposal of rubble during the decommissioning phase.

Table 57: Significance rating Cumulative impacts

Activity	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
All activities	Increase in dust levels, due to the cumulative effect of other mines in the area.	8	4	2	4	56	M	Dust suppression will be conducted at all collieries throughout the life of mine and also as part of the decommissioning phase. However as operations at Klippan Mine ceases dust levels will be reduced in the greater area.	6	4	2	4	48	L
Access roads	Increase in vehicle volumes on provincial roads	8	4	2	5	70	M	Construct new access to D383 and slow lane. See **Annexure 11**. This will regulate the traffic better and be less dangerous. However, the life of mine is at maximum 22 years, and thereafter traffic volumes due to the Wonderfontein Mine will reduce.	6	4	2	5	60	M
Opencast Mining	Less land will be available for agriculture	10	4	3	5	85	H	High significance, due to loss of very high potential agricultural	6	5	3	5	70	M

Activity	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
	Arable land will reduce	10	4	3	5	85	H	land. Mitigation measures to be implemented are proper stripping and stockpiling of topsoil and proper rehabilitation of disturbed area. Mining will however be done in phases and therefore not all agricultural land will be lost at once. Adhere to procedures for stripping and stockpiling and rehabilitation as set out in **Annexure 2**, the Soil Assessment – Appendix 1.	6	5	3	5	70	M
Opencast Mining, underground mining and coarse coal discard disposal and water management	Reduction on the catchment yield. Due to other mines in the area, the cumulative impact on catchment yield is increased.	10	5	2	5	85	H	Conduct proper concurrent rehabilitation and level soils according to correct topographical plan to ensure effective drainage patterns.	8	5	2	4	60	M

Activity	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
	Decant will cause further deterioration of surface water in the area if not contained.	10	5	2	5	85	H	Construct final voids where necessary (as described in section 2.2.1.3) in **Figure 33** and contain affected water. Also construct the northern sub-surface water management plan as shown in **Figure 33**. Monitor surface water quality in surrounding areas (current monitoring points, including Blesbokspruit and pans). Construct water purification plant for excess water.	8	5	2	4	60	M
	Groundwater pollution plume that will expand over a period of time. The groundwater impacts caused by other mines in the area will contribute to a larger impact than would be expected if Wonderfontein was the only mine.	10	5	2	5	85	H	Ensure seepage from mine residue deposit to enter the pollution control dam that will remain for evaporation to reduce the pollution plume. Monitor groundwater constantly to have relevant information regarding degradation of the groundwater resource due to mining activities. Ensure groundwater seepage from opencast areas flows towards the final voids.	8	5	1	5	70	M
	Flooding of old underground workings.	10	5	1	5	85	H	Once the underground is flooded it will link with the adjacent opencast areas. Management of water was described previously.	8	5	1	5	70	M

Activity	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
Underground mining	Possible subsidence and formation of sinkholes. Areas where subsidence occurs will not be available for agricultural use any longer.	10	5	1	4	64	M	Rehabilitation will be conducted in cases of subsidence or sinkhole formation.	6	5	1	4	44	L
	Possible forming of methane gas in old underground workings.	8	5	1	4	56	M	Monitor old underground workings for methane gas. Ensure all shafts are sealed off properly and monitor. This will be in the old underground workings if methane gas if formed. It will be properly sealed off and no access will be possible. Therefore no further mitigation other that this mentioned will be recommended and the significance will be lowered.	6	5	1	4	44	L
Disposal of coarse coal discard	Spontaneous combustion could occur on the mine residue deposit which will have an impact on air quality.	10	4	1	4	60	M	Ensure that the discard dump is compacted. Regular compaction tests should be conducted throughout the life of mine. Test compaction before final rehabilitation is conducted.	8	4	1	3	39	L
	The visual impact will increase due to the fact that the discard dump will be a permanent feature in a rather flat topographical area.	6	5	1	5	55	M	Ensure that rehabilitation on the discard dump is done properly to ensure that the visual impact is reduced.	4	5	1	4	44	L

2.3 SECTION 39 (3) (B) (I) (KNOWLEDGE GAPS)

Various predications were made from constructing models, these models should be calibrated with actual information once it becomes available. Results from the weather station should be used to update the air quality results and borehole levels, water qualities and pump volumes from the opencast and underground areas should be used to update and refine the water balances.

2.4 SECTION 39 (3) (B) (II) (SOCIO ECONOMIC ISSUES)

2.4.1 ENGAGEMENT OF I&APS

Details of the engagement process were defined in **Annexure 12** and have been described in **section 2.2.4** of this document.

Several meetings were held with the community living on the respective farms. They were given questionnaires regarding their every day living conditions and daily procedures to confirm their needs. These questionnaires will be used in the relocation process of community living on portions where mining will take place. See **Figure 19** for the plan indicating the positions of these families and the relocation plan as drafted.

Relocation will be done according to the relocation strategy. It should be noted that mining is planned over a prolonged period, some 23 years and in some instances people will only become affected later. Negotiations with landowners have not started and will be done once a decision on this application is obtained. According to the IAPs, some land claims have been logged on certain of the farm portions involved. Cameron Cross INC (CCI) conducted research in this matter and it was found that a claim was lodged on Portion 3 of Wonderfontein and Portion 14 of Klippan, refer to the letter from the Commission of Restitution of Land Rights attached in **Annexure 1**. Note that according to the Acting Commissioner for Restitution of Land Rights and we quote from the letter “It is not in the power of the Commission on Restitution of Land Rights to grant or withheld permission for the development or allenation in respect of land being claimed until such a claim has been gazetted, unless such development would constitute an obstruction to the achievement of the aims and objectives of the Restitution of Land Rights Act 22 of 1994.”

Although several claims have been lodged in respect of portion 3 of the Farm Wonderfontein and portion 14 of the Farm Klippan, CCI have been advised that these claims are still under investigation. According to the RLCC these claims have not yet been published in the Gazette and accordingly it will in our view not have an effect on the authorisation process for the proposed Wonderfontein mine.

Once the aforesaid claims have been published in the Gazette and one or more of the steps provided for in rule 13(2) have been taken by the RLCC, Umsimbithi (Pty) Ltd must give the RLCC a month's written notice of its intention to conduct mining activities on the land in question. Furthermore, in terms of rule 13(1)(d) the notice must invite interested parties to comment on/or object to the claim within the time period specified.

If the RLCC or an interested party has reason to believe that the mining activities will defeat the achievement of the objects of the RLRA, the RLCC or interested party may apply to the LCC for an interdict prohibiting the mining activities on the land in question. This application may be made prior to the publication of the notice in the Gazette as provided for in section 11(1).

It is recommend that the RLCC be notified of the application for a mining right and request the RLCC to notify JKC, as a possible interested party, of the notice to be published in terms of section 11(1) as provided for in rule 13(2)(b) set out above.

In addition, it is recommend that the Government Gazette be scanned on a regular basis in order to ascertain whether any land claims in respect of the Farms Wonderfontein and Klippan have been published.

2.4.2 SOCIO-ECONOMIC ISSUES RAISED BY I&APS

Some issues that were raised included: -

- The community living on and around the respective portions of the farm Wonderfontein 428 JS as well as Portion 14 of Klippan 452 JS will potentially be impacted by the proposed mining activity. Potentially some 228 people can be directly negatively affected by the proposed mining activity (See **Annexure 10**).
- Some families will have to relocate in order for mining to continue.

Mitigation measures: -

Meetings will be held with the relevant community members and procedures described in the relocation strategy will be executed.

Once mining is in progress, regular liaison with IAP's will be conducted through annual Public Participations meetings. A complaints register will be available at the mine where any affected person can log a complaint.

- People might be losing their jobs (those jobs related to farming) and is uncertain whether they will get a job at the new proposed mine.
- Outsiders will come to this area to fill the jobs that will be created and locals will still be without jobs.

Mitigation measures: -

The mine should consider employing local people who would loose their jobs when agriculture in the areas ceases. These people should be considered for a job first before any outsiders if they have the necessary skills involved. The mine could also educate the local people to help them develop a certain skill in order to work at the mine.

- There are land claims on some of the properties involved in the project and it is uncertain how this will be handled.

Mitigation measures: -

The mine will deal with the current landowners at the time of sale.

It is recommend that the RLCC be notified of the application for a mining right and request the RLCC to notify JKC, as a possible interested party, of the notice to be published in terms of section 11(1) as provided for in rule 13(2)(b) set out above.

In addition, it is recommend that the Government Gazette be scanned on a regular basis in order to ascertain whether any land claims in respect of the Farms Wonderfontein and Klippan have been published.

Significance ratio of the socio economic impacts was done and is shown in **Table 58.**

Table 58: Significance rating Socio economic impacts and Activity 1

Activity	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
All activities	Community that lives on and to the adjacent portions of the Farm Wonderfontein and Portion 14 of Klippan may be affected by the proposed mining activity (approximately 1038 people will be affected).	10	3	1	5	70	M	Consultation was conducted with all families and community. An agreement will have to be reached with those that will have to relocate. This is still an ongoing process and no agreement has been reached.	4	5	1	5	50	L
	Some people of the community will loose their jobs (those working on farms) and will not necessarily be granted a job at the new mine. That also includes the temporary workers that are appointed for potato farming. They will loose that income. Outsiders will most probably be appointed and the local people will still be jobless.	10	5	2	5	85	H	The mine must bare in mind that where agriculture is lost due to mining, people will loose their jobs permanently. Land owners will move away and indications are there that some of the employees will relocate with the farmers. However some farmers will perhaps pursuing another occupation, and therefore leave the community and employees behind. Attempts will be made to employ people from the current community.	8	3	2	4	52	M
	There are land claims on some of the properties involved in the project and it is uncertain how this will be handled	6	2	1	2	18	L	Low significance, therefore no mitigation. The mining company will negotiate with the landowner at the time when purchase is necessary.						

2.4.3 SOCIO-ECONOMIC ISSUES RAISED BY THE STATE DEPARTMENTS

None received.

2.4.4 ASSESSMENT OF IMPACTS

Refer to **Tables 48 - 54**. Assessment was done according to **section 2.2.10**.

2.4.5 COMPARATIVE ASSESSMENT OF LAND USE AND DEVELOPMENT ALTERNATIVES

An assessment was conducted by De Wit Sustainable Options (**Annexure 10**). In the report options that were evaluated are: -

- coal mining
- agricultural production (maize, soya and potatoes)

The key question addressed in the report was "What is the best land use option in Wonderfontein" from,

- a financial-economic perspective
- an employment perspective and
- a sustainability perspective?

The answers to that assessment can be summarised as follows, as per the specialist report: -

"From a financial and broader economic perspective, coal mining is the preferred land use option. When net revenue from alternative land use options for the directly and indirectly affected 800 hectares are compared over a 30 year horizon and at a 6% discount rate, the net financial benefit of coal mining is almost 4 times as much as potatoes and 88 times as much as maize.

From an employment perspective, coal mining is likely to be the best option in the short- and long-term. Maize and soya farming (currently the dominant land use

options) employ approximately 9 farmers and estimated 80 labourers. Potato farming is the most labour-intensive agricultural land use and could employ up to an estimated maximum 136 labourers if all 800 hectares were to be converted. Labourers are coming from communities highly dependent on farm labour income, own subsistence farming as well as pensions and grants.

From an environmental cost perspective, it is highly unlikely that the preferred land use option will change when (i) site-specific environmental side-effects or costs are taken into account and when (ii) additional external costs of additional water use are taken into account. The implied individual willingness-to-pay (WTP) for preserving environmental quality will have to be a NPV of between R10.5m–R14.7m per affected person. This amounts to R854 000–R935 000 per affected person per annum, assuming that all 460 affected people are equally affected and all have an equal willingness and ability to pay for environmental quality. This amount, for most, if not all of the affected people, will be far more than their annual income.

This does not mean, however, that affected farmers, labourers, dependents and downstream water users will incur losses, but the focus should change as to how such damages can best be avoided, minimised, mitigated, offset or compensated for. If system-wide environmental impacts (beyond the Wonderfontein area) occur other people then those residing at Wonderfontein may be affected. This can reduce the implicit WTP per affected person. Given the relative large scale and long time frames of the project, and the absence of information on the consequence and probabilities of residual spill-over impacts after mitigation, no assessment on the socio-economic consequences of such impacts could be done."

2.5 SECTION 39 (3) (B) (III) NATIONAL ESTATE AND HERITAGE

The Phase I HIA study for the Wonderfontein Project Area revealed the following types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999), namely:

- Historical structures such as houses and associated outbuildings.
- Graveyards.

Refer to **Annexure 8** containing the detailed report. Also refer to **Table 59** for the significance ratings.

- The structures that were identified in the Wonderfontein Project Area are older than sixty years and therefore are protected by Section 34 of the National Heritage Resources Act (No 25 of 1999). The significance of these historical structures therefore has been indicated as HIGH. The significance of individual historical structures must further be determined if any of these structures are to be affected by the mining development project. The following criteria can be used to determine the significance of these historical remains, namely: the cultural-historical background of these structures; their scientific or architectural value; their use in the field of tourism, museums or education as well as their aesthetic appearance; their repeatability (abundance/scarcity), or their emotional (ideological) value.

  Mitigation measures:
  Historical structures may not be affected (demolished, renovated, altered) by the mining development project *prior* to their investigation by a historical architect in good standing with the South African Heritage Resources Agency (SAHRA). The historical architect has to acquire a permit from the South African Heritage Resources Authority (SAHRA) *prio*r to any of these historical structures been affected or altered as a result of the mining development project.

- Graveyards are located close to the proposed mining activities, refer to **Figure 11**. Some of these graveyards will be affected by the proposed mining activities and will therefore be required to be relocated.

  Mitigation measures:

  Graveyards that will not be moved will be conserved *in situ* by means of demarcating these features with brick walls or with fences. A buffer zone of at least twenty metres will be maintained between the graveyards and new developments. Refer to **Figure 11** showing the position of the graveyards as well as the buffer zone around it.

  Conserving graveyards *in situ* in mining areas create the risk and responsibility that they may be damaged, accidentally, that the mine remains responsible for its future unaffected existence, maintenance and that controlled access must exist for any relatives or friends who wish to visit the deceased.

Graveyards can also be exhumed and relocated. The exhumation of human remains and the relocation of graveyards are regulated by various laws, regulations and administrative procedures. This task is undertaken by forensic archaeologists or by reputed undertakers who are acquainted with all the administrative procedures and relevant legislation that have to be adhered to whenever human remains are exhumed and relocated. This process also includes social consultation with a 60 days statutory notice period for graves older than sixty years. Permission for the exhumation and relocation of human remains have to be obtained from the descendants of the deceased (if known), the National Department of Health, the Provincial Department of Health, the Premier of the Province and the local police.

Table 59: Significance rating Heritage assessment

Activity	Impact	Significance before mitigation						Mitigation Measure	Significance after mitigation					
		M	D	S	P	SP	R		M	D	S	P	SP	R
All activities	Historical structures exist within the minerals boundary area, but will not be affected by the proposed mining activities. Only the historical structures classified at HH02 will be affected and not the structures at HH01.	10	5	1	1	16	L	Low significance, not evaluated with mitigation measures.						
	Grave yards exist in the proposed activities and may be affected by the proposed activities. Some might stay in situ and others might have to be relocated in order for development to continue.	10	5	1	5	80	H	Various graveyards exist on the property of which all is of high significance and protected by various laws. Graveyards that will stay in situ will have to be demarcated with brick walls and fenced off. It will remain the responsibility of the mine that these graveyards are not damaged. Graveyards that will have to be relocated for further development will have to be done according to the procedures described by the National Heritage Resources Act (No 25 of 1999) and as described above in **Section 2.4**.	8	5	1	5	70	M

2.6 SECTION 39 (3) (C) ENVIRONMENTAL AWARENESS

The main risks to the mine include:

- Waste segregation and disposal;
- Water wastage;
- Protection of sensitive areas;
- Pollution prevention;
- Rehabilitation; and
- Protection of National Heritage sites and graveyards.

The mine will develop on-site management standards drawn up in accordance with the standards outlined in this EMP document detailing the daily operations and functions of employees of the mine to reduce the mine impacts and manage it responsibly. These standards will be written by management and approved by employee representatives or Union representatives and will be available on site.

A mine induction process shall be implemented to ensure that new workers will be trained in these standards before they commence work. An awareness talk will be given weekly to ensure employees are continuously trained on how to manage the risks according to mine standards.

2.7 SECTION 39 (3) (D) ENVIRONMENTAL MANAGEMENT PLAN

Mitigation measures were identified already in **sections 2.2**, **2.3**, **2.4** and **2.5** and a significance rating for each impact was done, refer to **Tables 50** to **56**. In some cases impacts are similar of nature and therefore measures to either modify, remedy, control or stop any actions, activities, processes leading to, or causes of pollution or degradation are discussed per specific impact and not per activity. Also the implementation of some management measures actually acts as mitigation measure for more than one impact. Therefore, to prevent double accounting of costs duplication of management measures will not be done in this section. If a specific management measure has been discussed and the cost determined it will not be repeated unless it occurs in different phases of the project. The focus will be on all the mitigation measures that will be required as well as the cost to implement those measures. Refer to **Tables 60 - 65**.

Table 60: Summary of Impacts, mitigation measures and costs per impact for construction phase activities

Activity	Impact	Mitigation	Months 0 -4 R	Closure cost R
All activities	Generation of dust due to vehicle movement as well as material movement	Use water for dust suppression during construction. It is recommended that 0.118 ℓ/m^2/h be applied.	70 400	
		Monitor dust monthly at the current and new monitoring points, refer to **Annexure 6**.	12 240	
		Apply dust-a-side or similar chemical product to prevent generation of dust.	1 912 017	
		Develop air quality management plan in line with new act	184 000	
		Record on-site meteorological data	34 000	
	Generation of noise by vehicle movement as well as the generation of emissions	Maintain vehicles according to the manufactures maintenance schedule to ensure that noise levels are maintained within the specified levels. Place berms on the edge of the mine to reduce the impact of noise.	1 440 000 119 421	
		Confirm presence of efficient silencers and closed engine compartments	48 000	
		Damp mechanical vibrations – confirm manufacture specifications and improve if required.	50 000	
		Conduct annual noise audits.	54 000	
		Conduct environmental noise audits annually.	54 000	
		Establish vegetation to act as screens to limit visual impact.	65 000	
	Generation of vehicle emissions which could cause deterioration in air quality.	Proper maintenance will also ensure that fuel and lubricant leaks are prevented and	Maintenance cost already	

Activity	Impact	Mitigation	Months 0 -4 R	Closure cost R
		maintained and that emissions are also within the specifications.	included.	
	Fuel and lubricant spillages within the bounds of the various activities will result in a decline of water and soil quality	Clean spills as soon as possible to prevent the contamination of water and soils.	50 000	
Access and haul roads	Clearing of vegetation	Peg out the road and limit disturbance to the minimum.	48 000	
	Stripping of topsoil Mixing of topsoil Spillage of topsoil	Strip all possible soil, keep topsoil and subsoil separate. Stockpile it on different stockpiles as stipulated. Prevent overloading of trucks to avoid spills. See **Annexure 2** for proper guidelines regarding stripping, stockpiling and replacement of topsoil.	2 683 576	
		Construct cut-off drains that will prevent contaminated runoff entering the clean water resources.	145 500	
Opencast Mining	Clearing of vegetation	Limit disturbance to a minimum, by pegging out the area.	48 000	
	Stripping of topsoil Mixing of topsoil Spillage of topsoil	Strip all possible topsoil, keep topsoil and subsoil separate. Stockpile it on different stockpiles as stipulated. Prevent overloading of trucks to avoid spills. See **Annexure 2** for proper guidelines regarding stripping, stockpiling and replacement of topsoil.	2 035 950	
	Surface runoff from bare surface may impact the surface water quality.	Construct berms and canals as shown in **Figure 6**.	4 157 270	
	Impact on infrastructure due to blasting	Vacate everyone within 500 m of the	42 667	

Activity	Impact	Mitigation	Months 0 -4 R	Closure cost R
	Impact on noise due to blasting Impact on air due to blasting	proposed blast. All blasts need to be designed by a professional and seismographs located at the workshop, stores and offices. Use electronic blasting techniques to ensure that the impact is limited as far as possible.		
	Construction of the box-cut may influence the local groundwater table.	Monitor boreholes as indicated in **Figure 30** and refer to **Annexure 5**.	7 500	
	Surface runoff will be intercepted by the opencast box-cuts, it will impact the catchment yield of the area (referring to the Blesbokspruit and eventually Nooitgedacht dam catchment).	Limit disturbance to a minimum and construct highwall drains that will direct clean water runoff upstream of the mine around the mine to the streams. When it is no longer feasible to re-direct the clean water runoff around the mine, construct a sump and install a pump and 150 mm pipeline system to pump the water to the pollution control dam.	125 874 450 000	
		Monitor surface water in the tributary and Blesbokspruit, as well as in the Nooitgedacht dam as per monitoring points shown in **Figure 30**.	14 000	
Underground Mining	Construction of the adits may influence the local groundwater table.	Monitor boreholes as indicated in **Figure 30** and refer to **Annexure 5**. If groundwater is affected by the mining operation compile structure compensation protocol in consultation with affected user.	Monitoring cost already shown	
		Develop sump to manage water seeping from opencast areas.	70 000	
		Construct stone dust storage containment facilities.	120 000	

Activity	Impact	Mitigation	Months 0 -4 R	Closure cost R
Disposal of coarse coal discard	Stripping of topsoil Mixing of topsoil Spillage of topsoil This is relevant for the initial discard dump since the extended area will be in the old pit 3.	Strip all possible topsoil, keep topsoil and subsoil separate. Stockpile it on different stockpiles as stipulated. Prevent overloading of trucks to avoid spills. See **Annexure 2** for proper guidelines regarding stripping, stockpiling and replacement of topsoil.	1 396 080	
	Generation of dust due to vehicle movement as well as material movement	Use water for dust suppression during construction. It is recommended that 0.118 ℓ/m^2/h be applied.	70 400	
		Monitor dust monthly at the current monitoring points and refer to **Annexure 6** and also on **Figure 30**.	Monitoring cost already included	
	Generation of noise by vehicle movement as well as the generation of emissions	Maintain vehicles and equipment according to the manufactures maintenance schedule to ensure that noise levels are maintained within the specified levels and emissions are also within the specifications. Proper maintenance will also ensure that fuel and lubricant leaks are prevented and maintained.	Maintenance cost of equipment already shown	
	Contamination of surface water when storm-water mixes with loose construction material	Construct cut off drains that will prevent contaminated runoff entering the clean water resource.	200 000	
	Surface run-off from the bare soil / mine residue deposit surface areas can potentially cause deterioration in water quality due to erosion.	Conduct regular inspections to identify erosion. Fix erosion as soon as possible.	115 000 140 000	
	Surface water run-off from mine residue	Construct the option 1 coal discard facility	2 940 000	

Activity	Impact	Mitigation	Months 0 -4 R	Closure cost R
	deposit areas will contaminate soil and water.	as shown on **Figure 6**.		
Water Management	Management of affected water from the discard dump, opencast and underground mining areas.	Construct pollution control dam with capacity of 98 000m^3 and an evaporation area of 6.3 ha. Also construct a silt trap that will prevent deposition of silt in the pollution control dam. Install pipelines where necessary to pump water from the open pits and underground section to the pollution control dam. Develop sumps in open pits to accumulate water for pumping to the pollution control dam.	11 810 000 550 000	
		Peg out the 1:50 year floodlines or 100 m away from the stream, whatever is the further away from the stream to ensure mining is done outside this area.	48 000	
Workshops, Stores and offices	Additional areas will be disturbed for the construction of offices, workshops and stores. Vegetation will be removed, topsoil removed, etc.	Strip all possible topsoil, keep topsoil and subsoil separate. Stockpile it on different stockpiles as stipulated. Prevent overloading of trucks to avoid spills. See **Annexure 2** for proper guidelines regarding stripping, stockpiling and replacement of topsoil.	138 500	
		Construct oil/water separator.	56 000	
	Sewage will be generated at the workshop, stores and offices.	Construct sewage plant	1 450 000	
	Waste will be generated at the	Construct waste storage areas. Develop	950 000	

Activity	Impact	Mitigation	Months 0 -4 R	Closure cost R
	workshops, stores and offices and will have to be separated and temporarily stored on site.	waste removal system with contractors and cover expenses.		

Table 61: Summary of Impacts, mitigation measures and costs per impact for operational phase activities

Activity	Impact	Mitigation	Annual Cost R	Closure cost R
All activities	Generation of dust due to vehicle movement as well as material movement	Use water for dust suppression during construction. It is recommended that 0.118 ℓ/m^2/h be applied.	211 200	
		Monitor dust monthly at the current and new monitoring points, refer to **Annexure 6**. Also see **Figure 30** for current dust monitoring points.	36 720	
		Maintain "dust-a-side" roads.	6 013 068	
	Generation of noise by vehicle movement as well as the generation of emissions	Maintain vehicles according to the manufactures maintenance schedule to ensure that noise levels are maintained within the specified levels and emissions are also within the specifications. Proper maintenance will also ensure that fuel and lubricant leaks are prevented and maintained. This includes the maintenance of drills.	4 320 000	
	Fuel and lubricant spillages within the bounds of the various activities will result in a decline of water and soil quality	Clean spills as soon as possible to prevent the contamination of water and soils.	50 000	

Activity	Impact	Mitigation	Annual Cost R	Closure cost R
Access Roads	Coal spillages causing an impact on soil, surface water, groundwater and air quality	Clean spills as soon as possible to prevent further contamination of water and soils.	50 000	
Opencast Mining	Clearing of vegetation	Limit disturbance to a minimum, by pegging out the area. Conduct concurrent rehabilitation and re-establish vegetation as soon as possible.	48 000	
		Develop alien vegetation management plan and remove alien vegetation accordingly.	162 176	
	Stripping and placing of topsoil. Mixing of topsoil. Spillage of topsoil by transporting topsoil in trucks.	Strip all available topsoil and keep topsoil and subsoil separate. Place topsoil as pre stripe and placement plan in the opencast areas. Limit leveling of topsoil to a once off operation. Prevent overloading of trucks to avoid spills. This is part of the management costs. See **Annexure 2** for proper guidelines regarding stripping, stockpiling and replacement of topsoil.	9 730 565 48 000	
		Conduct soil analysis to determine fertilizer requirements.	85 000	
		Monitor stripping, stockpiling and replacement of topsoil by third party.	43 500	
	Shaping of mined out area	Shape area to as close as possible to the pre-mining topography.	2 973 228	
		Update rehabilitation design annually.	87 000	

Activity	Impact	Mitigation	Annual Cost R	Closure cost R
	Contamination of surface water due to erosion.	Establish vegetation as soon as possible and conduct regular inspection to identify erosion. Conduct maintenance on erosion areas as soon as possible. Also monitor surface water quality as per **Figure 30**.	115 000	
	Mining of drainage lines will cause deterioration of biodiversity.	Develop new drainage lines post closure as part of the final rehabilitation, refer to **Figure 33**.	152 000	
		Conserve wetland areas within 100 m of the streams and ensure connectivity.	48 000	
	Impact on infrastructure due to blasting. Blasting can cause an increase in noise Blasting can cause an increase in dust	Vacate everyone within 500 m of the proposed blast. All blasts need to be designed by a professional and seismographs located at the workshops, stores and offices. Use electronic blasting techniques to ensure that the impact is limited as far as possible.	80 000	
		The community living within 1 km of the blasting area will have to be relocated.	Cost to be determined	
	Runoff and seepage from the un-rehabilitated areas has the potential to impact on surface and groundwater.	Maintain all drains. Conduct concurrent rehabilitation (backfilling of the mined out areas as mining continues), topsoil and seed as soon as possible.	145 000 518 963	
	Surface water runoff and seepage intercepted by the open void may potentially impact on surface and groundwater.	Affected water in the pit will be collected in the sumps and pumped to the pollution control dam. Maintain pipeline and inspect regularly for pipeline leaks.	180 675 30 000	

Activity	Impact	Mitigation	Annual Cost R	Closure cost R
	Continuous mining may influence the local groundwater table.	Monitor boreholes as indicated in **Figure 30** and see **Annexure 5**.	15 000	
	Coal spillages will cause deterioration in soil, water and air quality.	Clean spills as soon as possible to prevent further contamination of water and soils.	50 000	
Underground Mining	There is a danger that spontaneous combustion could occur in the underground.	Stone dusting and gas monitoring will occur on a daily basis.	38 500	
		Pump surplus water to the pollution control dam.	216 810	
Disposal of coarse coal discard	Management of affected water runoff, return water and seepage from the mine residue area. If not managed, it could have an impact on the surface and groundwater.	Maintain drains around discard dump area.	145 000	
		Clean silt trap to ensure no silt is deposited in the pollution control dam	55 000	
		Re-use the water contained in the pollution control dam as source for the washing plant.	50 400	
		Ensure shaping of dump is done according to the design.	48 000	
		Topsoil and seed the areas that had reached the pre-design slopes and elevations.	1 121 472	
	There is a danger that spontaneous combustion could occur at the discard dump.	Compact the discard to prevent spontaneous combustion during the operational shaping of the dump.	300 000	
	An amount of 14.84 million tons of coal discard will be generated and disposal of it may impact soil, air and water.	Dispose the coal discard in layers and compact at the constructed discard dump facility.	9 033 043	

Activity	Impact	Mitigation	Annual Cost R	Closure cost R
	Spontaneous combustion may occur causing an increase in air pollution.	Dispose the coal discard in layers and compact at the constructed discard dump facility. Use an impact roller to compact the discard. Compaction tests need to be conducted quarterly to measure compaction of the dump.	46 000	
Water Management	Management measures have already been specified in the earlier sections and will not be repeated here. Additional measures to prevent the impact on water resources will be discussed further.	Clean silt trap to ensure that no silt is deposited in the pollution control dam. Re-use water contained in the pollution control dam as source for the washing plant and for dust suppression. Maintain all drains. Construct high wall drains as required. Conduct daily inspections.	108 000 50 400 300 000 750 000 48 000	
Workshops, stores and offices	Due to increased activity in vehicle and equipment presence there will be an increase in the risk of hydro-carbon spills that will impact soil and water.	All hydro-carbon areas to be bunded. Clean spills and dispose into hazardous waste bins. Use drip trays during maintenance and services and conduct activities on concrete floor.	102 000 50 000	
	Management of waste.	Waste separation is very important and should be conducted by the mine. Contractors should be hired for the removal of waste.	56 000	
	Sewage can cause pollution of water, soil and air.	Operate and manage the treatment plant according to the operational requirements and license conditions.	74 400	

Table 62: Summary of Impacts, mitigation measures and costs per impact for decommissioning phase activities

Activity	Impact	Mitigation	Annual Cost R	Closure cost R
Access Roads	Activity increase (equipment use during decommissioning) will increase noise levels	Maintain vehicles according to the manufactures maintenance schedule.	4 320 000	
		Maintain berm until very last minute, Remove, level and seed.	145 000	
	Activity increase will increase dust levels	Use water for dust suppression. It is recommended that 0.118 ℓ/m^2/h be applied. Continue with dust monitoring during the decommissioning phase.	211 200	
	Runoff during rain events can cause deterioration in surface water quality (suspended solids)	Attempt to conduct decommissioning during the dry season. Rip the roads and cover it with topsoil. Establish vegetation as soon as possible. Maintain monitoring programme as per **Figure 30**.		714 000
Opencast Mining	Loading and placing of topsoil	Load all topsoil from the stockpiles and place on leveled areas as per prescribed procedure in Appendix 1 of **Annexure 2**.		2 520 000
		Conduct soil analysis to determine fertilizer requirements.		43 000
		Apply fertilizer as per recommendation and seed.		174 283
	Contamination of surface water due to erosion	Conduct regular inspections and vegetate areas as soon as possible. Repair erosion areas as soon as possible. Conduct maintenance on all rehabilitated areas		1 114 000
	Surface water runoff will be intercepted by the open voids until it is closed, this will prevent runoff entering the streams.	Conduct the final rehabilitation by closing the final void and ramp where appropriate (see **section 2.2.1**). Place		5 304 568

Activity	Impact	Mitigation	Annual Cost R	Closure cost R
		topsoil on the leveled areas and establish vegetation as soon as possible. In cases where final voids will not be closed, but remain as post-closure water management features; ensure that the volumes of the voids are enough to accommodate the post closure water make.		
	Permeability of backfilled material is higher that the pre-mined aquifer material resulting in a higher recharge rate. This water is accumulating in the opencast area and when storage capacity is depleted may result in the formation decant to surface.	This is related to the voids discussed above and other water management measures.		1 348 384
Underground Mining	Surface water runoff will be intercepted by the open void (adit areas) until it is closed, this will prevent runoff entering the catchment area.	Close the adit area by filling it with overburden material, covering it with topsoil and seeding it with grass.		Part of opencast rehabilitation cost.
	There is a risk that pillar collapse may occur resulting in the development of sinkholes and subsidence.	Monitor the development of sinkholes and subsidence. In the closure cost provision was made for this unlikely event. The sinkhole will be filled with material, topsoiled and seeded.		144 000
	Potential for spontaneous combustion to occur in the underground workings.	Construct concrete seals at the adits of the underground operations to prevent ingress of oxygen and water into the workings. If sinkholes or cracks develop on surface, these have to be rehabilitated to prevent the ingress of		4 560 000

Activity	Impact	Mitigation	Annual Cost R	Closure cost R
		oxygen into the workings.		
	Underground workings might be flooded.	Drill monitoring boreholes into the underground workings to measure the water levels in the underground workings.		250 000
	Loading of topsoil from the stockpiles Could spill and mix topsoil.	See Opencast sections above as well as **Annexure 2** for management and replacement of topsoil.		
Disposal of coarse coal discard	Runoff and seepage from un-rehabilitated mine residue deposits can impact surface and groundwater.	Shape the discard dump into the final rehabilitation shape, compact, and rehabilitate (topsoil and seed).		1 627 083 9 159 000
	Salt loads and sulphate levels of seepage from the dump will increase.	Ensure that all cut-off drains are well maintained and operational. Ensure that clean water runoff is diverted into the streams.		50 000
Water Management	Permeability of backfilled material and underground mined out area is higher than the pre-mined aquifer material resulting in a higher recharge rate of water into the area. An influx of water into the area will occur and will become contaminated.	Remove all the coal from the stockpiles and dispose it into the opencast workings. The basin of the evaporation facilities (voids) at the various opencast pits will be developed as part of the concurrent backfill rehabilitation process. The floor of the voids need to be shaped to the elevations set in **Figure 33**, 3m below the decant elevations. Side slopes of the facility will be constructed during this phase.	Part of mining costs already shown.	
		Construct a desalination plant with a capacity of 1.5 Mℓ/day.		60 000 000

Activity	Impact	Mitigation	Annual Cost R	Closure cost R
		Construct northern area subsurface water management plan.		25 450 000
		Grout pillar between Pit 6 and the gravel road.		7 500 000
Workshops, stores and offices	Workshops, stores and offices will not be in use after all activities have ceased.	Demolish infrastructure and dispose rubble into opencast voids.		145 000
	Waste generated as part of the decommissioning phase.	Continue waste separation and removal until it becomes unnecessary and all operations has ceased.		50 000

Table 63: Cumulative Impacts Summary of Impacts, mitigation measures and costs per impact

Activity	Impact	Mitigation	Annual Cost	Closure cost
All activities	Increase in dust levels, due to the cumulative effect of other mines in the areas.	Dust suppression will be conducted.	Cost shown in other sections.	
Access roads	Increase in vehicle volumes on provincial roads	Construct an access road at the D383. Vehicles associated with the mine will be road worthy and regular inspections will be done.	3 500 000	
Opencast Mining	Less land will be available for agriculture	After rehabilitation the land can be used for agricultural purposes. If rehabilitation	Refer to **Table 71** for	

Activity	Impact	Mitigation	Annual Cost	Closure cost
		is done according to the procedures as described in Appendix 1 of **Annexure 2**, the land could be arable again.	the costs.	
	Arable land will reduce.	Limit disturbance to a minimum and allow agriculture on areas not disturbed as soon as possible. Carry on utilizing the current land for agriculture until mining commences.	Refer to **Table 71** for the costs.	
Underground mining	Possible subsidence and formation of sinkholes.	Rehabilitation will be conducted where subsidence or sinkhole formation occur.		942 276
	Possible formation of methane gas in old underground workings.	Ensure that all shafts are sealed off properly. Monitor continuously, and check for surface cracks or sinkholes. If any occur, rehabilitate immediately.	Refer to **Table 71** for the costs.	
Disposal of coarse coal discard	The occurrence of spontaneous combustion if rehabilitation was not done properly.	Monitor and ensure that compaction is done. Topsoil and vegetate as soon as possible.	Refer to **Table 71** for the costs.	
	The visual impact will increase due to the fact that the discard dump will be a permanent feature in a rather flat topographical area.	Ensure that surface rehabilitation (topsoil and seeding) is conducted in a proper manner and that the feature could blend in with the natural surroundings.	Refer to **Table 71** for the costs.	
Water Management	Runoff of the Blesbokspruit catchment will be affected.	No additional measures other than that previously described are proposed. The impact was defined as negligible.	Refer to **Table 71** for the costs.	
	There will be a cumulative impact on the water quality of the Blesbokspruit	Current status of the Blesbokspruit is still relatively good, cumulative impact was	Refer to **Table 71** for	

Activity	Impact	Mitigation	Annual Cost	Closure cost
	catchment as a result of the mined out areas.	defined to be negligible. No additional measures are proposed other to that already defined.	the costs.	
	Mining activities in the area will impact on the catchment of the Blesbokspruit and eventually the Nooitgedacht Dam.	Refer to the mitigation measures described previously under water management.	Refer to **Table 71** for the costs.	
	Groundwater pollution plume will expand over a period of time.	Monitor groundwater. Ensure that seepage and decant flows towards the final voids, and to the pollution control dam where possible.	Refer to **Table 71** for the costs.	
	Flooding of the underground workings.	Continue with groundwater monitoring programme to know when the mine workings are flooded and to have information on the exact water qualities present in the workings.	Refer to **Table 71** for the costs.	
Workshop, stores and offices	No other impacts were defined.			

Table 64: Socio Economic Impacts Summary of Impacts, mitigation measures and costs per impact

Activity	Impact	Mitigation	Annual Cost	Closure cost
All activities	Community that lives on and adjacent to the portions of the Farm Wonderfontein and portion 14 of Klippan may be affected by the proposed mining activity. Blasting could damage infrastructure and endanger the life of the community	A relocation strategy was developed and affected parties will be treated accordingly.	Cost not yet determined.	

Activity	Impact	Mitigation	Annual Cost	Closure cost
	residing on some of the relevant portions of Wonderfontein as well as portion 14 of Klippan.			
	There are land claims on some of the properties.		No cost	

Table 65: Cultural and Heritage Impacts Summary of Impacts, mitigation measures and costs per impact

Activity	Impact	Mitigation	Annual Cost	Closure cost
All activities	Historical structures are present within the mineral rights area of the mine, but not within the opencast mining area, refer to **Figure 11** and can be damaged as a result of the activity.	Historical structures need to be investigated by historical architect and need to acquire a permit from SAHRA prior to any of the structures been affected.	85 000	
	Graveyards are located within the mineral rights area. Refer to **Figure 11**.	Graveyards that will not be moved will need to be conserved with a brick wall and fences. A buffer zone of 20 m is required. Access for family members and friends who wish to visit the deceased will have to be granted. Those that are located in the opencast mining area will have to be relocated / exhumed. Refer to **Annexure 8** for the adequate procedures that will have to be followed.	1 094 965	

2.7.1 MANAGEMENT ACTIVITIES

Refer to the **Table 66** showing the management activities

Table 66: Management Activities

Activity	Frequency
Water level in the pollution control dam	Weekly
Water level in slurry dams and position of penstock relevant to water and slurry levels	Weekly
Water volume pumped from the pit (s) to the pollution control dam	Weekly
Inspect pipelines for leakages	Weekly
Water volume extracted from the pollution control dam for dust suppression	Weekly
Presence of dust fall out buckets	Weekly
Stripping of all available topsoil, when topsoiling is done.	Weekly.
Check for pipeline leakages	Daily
Maintenance of berms and canals	Monthly in summer
Maintenance of equipment	Monthly
Volume of discard disposed	Monthly
Compaction of discard dump	Four times per year
Covering of trucks to prevent spillages	Continuous
Cleaning of coal spills on roads	Continuous
Monitoring of surface –, groundwater and dust fall	Monthly,

Activity	Frequency
out	groundwater quarterly
Recording any complaints and incidents	Continuous
Record the areas disturbed, leveled, topsoiled and seeded.	Monthly
Update closure cost assessment	Annually
Conduct EMP performance assessment	Annually
Submit various documentation to various parties as may be required and specified	As specified by the documents

2.7.2 ACTION PLAN TO IMPLEMENT MITIGATION MEASURES

In terms of the guideline this action plan need to be compiled in terms of each phase of the mining operation.

2.7.3 CONSTRUCTION PHASE

Peg mining area to ensure that mining will be conducted within the approved area. *Timing* – 1 month after mining right is issued.

Construct berms around the mine or area that will be affected at first (this can be done in phases, since the mining area is very big and will not be mined all at once) as well as the highwall drains. *Timing* – 1 month after mining right is issued and as mining progresses.

Construct pollution control dam and discard dump footprint. Timing – to be completed 4 months after mining right is issued.

Supply pipes and a pump that will be used to dewater the pit (s) (and underground). *Timing* – 2 weeks after the mining right is issued.

Institute monitoring program. *Timing* – 1 week after mining right is issued.

Suppress dust with water. *Timing* – immediately when activities starts.

Maintain all equipment. *Timing* – at the start of the construction phase.

Construct office buildings, workshops, stores and sewage plant –Create bunded areas for diesel storage and for storage of waste. *Timing* – 1 week after mining right is issued.

2.7.4 OPERATIONAL PHASE

Implement procedures that will prevent overloading of trucks as well as the covering of trucks. *Timing* – At the start of the operational phase.

Strip all topsoil (in relevant areas as needed) and place on leveled areas according to the strip and replacment plan, per soil type. *Timing* – at the start of the operational phase.

Concurrent rehabilitation. *Timing* – at the start of the operational phase.

Construct sump in (relevant) pit (s) to collect all accumulated water in the pit. *Timing* – start of the operational phase (as required – when mining in an area commences).

Determine fertility requirements of soils. *Timing* – start of the growing season.

Check pipelines. Continously upgrade and extend as necessary. *Timing* – continuous.

2.7.5 DECOMMISSIOING PHASE

Develop a final rehabilitation plan. *Timing* – 3 years prior to closure.

Implement final rehabilitation plan (opencast, underground as well as mine residue facilities). *Timing* – Implementation will start 8 weeks after the final rehabilitation plan is approved.

Complete the evaporation facilities. *Timing* – 1 months after final rehabilitation.

Construct a desalination plant. *Timing*, 3 years after closure of the mine.

Construct northern mine subsurface water management system. *Timing* – 2 years after mine closure.

Grout pillar between Pit 6 and the gravel road. *Timing* – 1 year after mine closure.

2.7.6 POST CLOSURE PHASE

Operate and maintain desalination plant.

2.8 ENVIRONMENTAL EMERGENCIES AND REMEDIATION

At Wonderfontein Mine the following will be regarded as an emergency: -

- Failure of the pollution control dam at Wonderfontein and the evaporation dam post closure;
- Increase of more than 50% in the sulphate concentration in the downstream groundwater as well as surface water bodies in the area;
- pH of groundwater entering the acidic range of less than 5;
- Dust fall out exceeding 2400 mg/m^2/day;
- Incorrect stripping and stockpiling of topsoil.
- Post closure topography that is significantly different to the pre-mining topography.

An independent specialist will be tasked to investigate such emergencies and to determine the desired remediation. Such emergencies will be communicated to the relevant authorities.

2.9 MONITORING

2.9.1 WATER MONITORING

Surface water monitoring will be done on a monthly basis. Currently 4 surface water sampling points are monitored on a monthly basis and is included in **Table 68** below. The results for the past two years can be viewed in **Annexure 1**. The sampling of the Blesbokspruit is included in the Steelecoal EMPR program (included in the Steelcoal and Grootpan EMPs); hence it will form part of the Wonderfontein monitoring programme, since Grootpan and Steelecoal Mines are no longer operational. Two new surface water monitoring points will be established and

sampling of these points will commence soon. Recently the Nooitgedacht dam was also included in the monitoring plan. The sampling points are indicated on **Figure 30**. All surface water samples must be analysed for the constituents tabularised below in **Table 67** on a monthly basis.

Table 67: Water Quality Variables

	Background Water Quality Range	SA Water Quality Guidelines for Domestic Use, 1996 [effect at higher concentration]	
		Target Water Quality Range	Critical Values
pH	6.0-8.5	(<5.5&>9.5) & (<6.0&>9.0)	<4 & >11
EC (mS/m)	3.5-39	70 [salty taste – no effect]	450
TDS (mg/l)	16-193	450 (= EC x 6.5)	3000
Ca (mg/l)	<24	32 [slight scaling problems]	80
Mg (mg/l)	<11	30 [slight scaling problems]	200
Na (mg/l)	<47	100 [slightly salty]	600
K (mg/l)	<10	50 [undesirable for infants or renal disease]	400
Total Alkalinity (mg/l)	6-100	No standard	No Standard
Cl (mg/l)	<12	100 [corrosion increase]	600 [objectionable salty taste, corrosion]
SO_4 (mg/l)	<22	200 [slight taste, tendency for diarrhoea]	600 [pronounced salty/bitter taste, diarrhoea
NO_3-N (mg/l)	<6	6 [rare instances of methaemoglobinaemia]	20
Fe (mg/l)	<1	0.1 [slight taste, slight plumbing deposits]	10
Mn (mg/l)	<0.5	0.05 [slight staining]	20
Al (mg/l)	<0.05	0.15 [slight colour effect in assoc. with iron or manganese]	0.5
F (mg/l)	<0.77	1 [slight mottling of dental enamel in sensitive individuals]	8

The surface water monitoring programme at Wonderfontein will include the following points on a monthly basis:

Table 68: Surface Water Monitoring Points at Wonderfontein

Sampling Point	Description	Coordinates	Status
WS1	Steele Pan Large		Current point
WS2	Steele Pan Small		Current point
WS3	Petie Bezuidenhout Dam		Current point
SW4	Downstream point at R33		Current point

Sampling Point	Description	Coordinates	Status
Nooitgedacht Dam	Nooitgedacht Dam		Current point
Blesbokspruit Upstream	Upstream on gravel road		New point to be established
Blesbokspruit Downstream	Downstream on farm road off the R33.		New point to be established

- Bio-monitoring of the Wonderfontein area where the wetland systems occur as specified in the Ecological assessment must be conducted bi-annually to ensure degradation of the wetland systems are not taking place.

Groundwater monitoring is conducted on a quarterly basis at boreholes listed in **Table 69** (levels measured on a monthly basis). All water samples must be analysed for the constituents tabularised above in **Table 67**.

Table 69: Current groundwater monitoring points at Wonderfontein

Borehole Number on Map	Owner	Farm Name and Number	Latitude and Longitude	Status
WF 1	Monitoring Borehole	Wonderfontein 428 JS	25.88598 29.88017	Current point
WF 2	Monitoring Borehole	Wonderfontein 428 JS	25.87160 29.88675	Current point
WF 3	Monitoring Borehole	Wonderfontein 428 JS	25.88507 29.88828	Current point
WF 4	Monitoring Borehole	Wonderfontein 428 JS	25.88082 29.89100	Current point

The pollution control dam must also be tested for oils and soaps on a monthly basis and for mercury, cadmium and arsenic and a 6 monthly basis.

According to the Groundwater assessment three sets of monitoring boreholes exist (existing *Umcebo* monitoring, boreholes identified during the hydrocensus and newly drilled boreholes). These boreholes are listed in **Table 30** and **Table 70** (also in Tables 3.1A and 3.2, and also see Table 5.3, also depicted in Figures 3.4 and 3.5 of the Groundwater Assessment in **Annexure 5,** as well as Figure 6.1).

Table 70: Newly drilled boreholes – physical borehole parameters

Borehole Number	Coordinate (WGS84)			Borehole depth (m)		
	X	Y	Z	End of hole	Overburden	Weathered rock
BH-1M	-89646	2858898	1726.59	26	5	21
BH-1S	-89644	2858907	1726.13	6	5	
BH-2M	-87877	2859272	1730.16	30	8	16
BH-3D	-87376	2858317	1760.47	70	5	20
BH-3M	-87390	2858315	1760.47	30	5	24
BH-3S	-87384	2858316	1760.47	6	6	
BH-4M	-88892	2860540	1708.99	30	1	21
BH-5D	-87666	2861353	1734.08	51	5	23
BH-5M	-87660	2861349	1734.08	30	10	26
BH-5S	-87656	2861347	1734.08	6	>6	
BH-6M	-87805	2862151	1747.26	30	6	21
BH-7M	-90017	2857946	1752.1	30	2	18
BH-8D	-87255	2864251	1703.22	46	3	26
BH-8M	-87252	2864256	1703.22	25	3	15.5
BH-8S	-87251	2864263	1703.22	6	2	
BH-9M	-88863	2860675	1711	18	4	17
BH-9S	-88867	2861004	1718.17	5.5	4	

Recommended groundwater monitoring boreholes according to Groundwater specialist:

- All boreholes situated in the predicted groundwater level impact zone and groundwater quality impact zone, should be included in the regular monitoring programme. These monitoring boreholes are listed in Table 5.3 and depicted in Figure 6.1 in **Annexure 5**;
- Hydrocensus boreholes which were identified during this investigation, but fall outside the regular monitoring zones, should also be monitored (less frequently);

- Although the Wonderfontein Village falls outside of the modelled groundwater level and groundwater quality impact zones, the main water supply boreholes should also be monitored together with the external users' boreholes;
- Many monitoring boreholes will be destroyed as mining progresses. Dedicated monitoring boreholes should be drilled to observe any potential contamination impacts (as advised by hydrogeological studies);
- During the latter stages of mining, the flooding status of the rehabilitated areas will become critical in predicting decant. In-pit boreholes are therefore important as a means of collecting accurate data for the Integrated Water Management Plan, which will be continually updated.
- Recommended spring flow monitoring:
- The flow rates of both springs WN-F1 and WN-F2 should be monitored;
- It may be necessary to install flow monitoring weirs.
- Recommended groundwater sampling methodology:
- Boreholes should be grab-sampled at predetermined depths, as determined from the borehole water column geochemical profile (EC and pH), geology and occurrence of water intersections;
- Several privately owned boreholes are equipped with pumps and groundwater level measurement is therefore difficult. A dedicated effort should be made to gain access to these boreholes. Possibly the best option is to drill a 25mm hole into the borehole cover and fit a screw cap, which can be easily accessed when the groundwater level has to be measured;
- Boreholes containing pumps, should be sampled under application conditions, i.e. collecting a pump sample.
- Recommended groundwater and spring water monitoring frequency – for boreholes and springs situated within the predicted impact zones (see Table 5.3 in **Annexure 5**):

Table 71: Groundwater and spring water monitoring frequency

	Groundwater level (on-site)	Groundwater and spring water quality	Stream quality	Dam quality (also record dam water level status)
Prior to mining	Six-monthly	Annually (Lists 1 and 2)	As recommended by surface water expert	-
After commencement of mining	Monthly	Quarterly (List 1) Annually (List 2) Annually (List 3)		Quarterly (List 1) Annually (List 2) Annually (List 3)

- "List 1": pH, EC, TDS, Ca, Mg, Na, K, Cl, SO4, NO3, Tot.Alk.;
- "List 2": Si, Fe, Mn, Al, additional recommendations by geochemist;
- "List 3": TPH;
- Once the various impacts of potential contamination sources have been established (enough information gathered), monitoring schedules and analyses can be adapted, as determined by groundwater expert in consultation with DWAF.
- Recommended groundwater and spring water monitoring frequency - boreholes and springs identified during the hydrocensus, but not falling within the predicted impact zones:
- Wonderfontein Village;
- Monitoring on an annual basis;
- Groundwater levels;
- Groundwater quality for "List 1".
- Reporting:
- Data should be collated in a well structured formal database;
- Six-monthly data reports should be submitted to management;
- Monitoring data should be reviewed in detail on an annual basis, specifically addressing any actions that should be undertaken to reduce impacts.
- If groundwater qualities are found to exceed the "Critical Values" of the SAWQG-DU (specified in **Table 67**), or site-specific water quality objectives,

action may be required to improve/replace the liner systems at the source of contamination.

- Surface water monitoring should comply with recommendations by the project surface water expert. In this regard, it is advisable:
- To monitor both the water quality and flow volumes of the local spruits;
- To monitor water levels and in/out-flow volumes in all dams constructed on site that will contain, store or reticulate water;
- To monitor wetland qualities and saturation status (qualitatively).

Furthermore new monitoring boreholes must be drilled once mining has ceased to monitor post closure impacts.

Out of the recommendations by the groundwater specialist it was decided that the boreholes as tabulated in Table 70 will be used as the quarterly monitoring boreholes (water levels on a monthly basis). The current boreholes as stated in Table 69 will also be monitored. The other boreholes as indicated by the specialist (the hydrocensus holes and those within close proximity to the mine in the villages) will be monitored on a six monthly basis for water levels, and annually for quality tests.

2.9.2 DUST LEVELS

Single bucket dust fall out monitoring are currently undertaken on a monthly basis. Buckets are placed at the locations indicated on **Figure 30**. Dust levels are checked on a monthly basis. The PM_{10} concentrations should not exceed the DEAT ambient air quality guidelines as stated in the air quality assessment in **Annexure 6**.

Table 72: Current dust sampling points at Wonderfontein

Dust Sampling Point	Status
WD1	Current point.
WD2	Current point.

Dust Sampling Point	Status
WD3	Current point.
WD4	Current point.

However, during the Air Quality Impact Assessment the specialists suggested that more buckets for sampling should be placed strategically at relevant points. See **Annexure 6** (Figure 1.1) for an indication of possible positions of these buckets. According to the study, a total of 11 single buckets should be placed and optionally 4 directional buckets should be planted at Wonderfontein. Thus, the new dust monitoring plan will consist of the following dust monitoring points and has therefore been included on **Figure 30**:

Table 73: New dust monitoring plan for Wonderfontein Mine

Dust Sampling Point	Coordinates	Status
B1 (Suggested name WDB1)	Unknown (point indicated)	New point
B2 (Suggested name WDB2)	Unknown (point indicated)	New point
B3 (Suggested name WDB3)	Unknown (point indicated)	New point
B4 (Suggested name WDB4)	Unknown (point indicated)	New point
B5 (Suggested name WDB5)	Unknown (point indicated)	New point
B6 (Suggested name WDB6)	Unknown (point indicated)	New point
B7 (Suggested name WDB7)	Unknown (point indicated)	New point
B8 (Suggested name WDB8)	Unknown (point indicated)	New point
B9 (Suggested name WDB9)	Unknown (point indicated)	New point
B10 (Suggested name WDB10)	Unknown (point indicated)	New point

Dust Sampling Point	Coordinates	Status
B11 (Suggested name WDB11)	Unknown (point indicated)	New point
DB1 (Suggested name WDDB1)	Unknown (point indicated)	New point
DB2 (Suggested name WDDB2)	Unknown (point indicated)	New point
DB3 (Suggested name WDDB3)	Unknown (point indicated)	New point
DB4 (Suggested name WDDB4)	Unknown (point indicated)	New point

All haul trucks leaving the site laden the coal should be covered with a tarpaulin to prevent coal dust. Refer to **Annexure 6** Figure 1.1.

2.9.3 NOISE AUDITS

Periodic noise sampling will be undertaken in case of a serious or consistent complaint.

2.9.4 TOPOGRAPHY

At new areas to be rehabilitated the post mining topography must be modelled, surveyed and stacked out before levelling commences as per the agreed mine. A preliminary rehabilitation plan is shown in Figure 18. Once levelled these areas should be re-measured to ensure correct elevation and slope for free draining design. Measuring to take place as per rehabilitation schedule or as required.

2.9.5 SOILS

The topsoil of each soil unit will be stripped at spatial distribution and depths and also stockpiled as indicated by Figure 4.3.1 and Table 4.3 in **Annexure 2** (also see **Figure 13**). To ensure correct soils depths are stripped this must be reviewed and recorded by the surveyor on a monthly basis. Stripping, stockpiling and replacement

of topsoil levelled areas should also be monitored by an independent specialist on a quarterly basis to ensure proper management of this very scarce resource is conducted in a proper manner. Once areas are re-topsoiled, soils are to be ripped and fertilized prior to seeding. Fertilisation requirements must be recorded and monitored. Annual rehabilitation audits should also be conducted by an independent soil specialist.

2.9.6 REHABILITATED VEGETATION COVER

A minimum of 60 % basal vegetation cover should be achieved to ensure the veld continues to establish itself with irrigation and risk to erosion.

Rehabilitation audits should be undertaken annually to assess vegetation cover performance. This should also include measurement of species diversity, soil nutrient content (fertilisation requirements) and invader plants. Appropriate actions should be outlined based on the outcome of the audits.

2.10 REPORTING

The information above should be compiled (using tabular and graphical formats) and submitted as part of the annual EMP performance assessment.

2.11 CLOSURE OBJECTIVES

Surface closure objectives are:

- The area is to be returned as close as possible to the pre-mining environment;
- All management system required post closure should be passive;
- Maintenance requirements should be minimal;
- The impact of the mine on surface and ground water should comply to the overall management strategy of the Inkomati River Catchment.

Groundwater objectives are:

- To restrict the cone or depression around the mining area to 500 m;
- To ensure alternative water sources to those persons who have been negatively affected;

- To restrict the migration of the potential polluted water present within the strip-mine workings to the pollution control dam and the plume so that it is does not threaten the quality of the ground water of surrounding users and the natural environment;
- Water stored in the mined out areas are contained in the evaporation facilities as shown in **Figure 32** and **33** and allowed to evaporate.
- Water treatment plant be constructed and operated to treat 1.5 Mℓ/day.
- Construct northern subsurface decant water management measures to prevent subsurface decant entering the Nooitgedacht dam.

Rehabilitation of haul roads, ramps, final voids and overburden stockpiles:

- All haul roads will be constructed of non-pollutive material allowing them to be ripped and covered with topsoil at closure unless an alternative need for them is identified;
- Ramps will be back filled and contoured to act as preferential waterways on the rehabilitated areas. The rehabilitated areas will not be constructed of discard and thus will be shaped and levelled to fit in the post closure rehabilitation design.
- Final voids will be backfilled with the material taken from the initial boxcuts and rehabilitated. This is to ensure voids are free draining. Landscaping the highwalls to a minimum of 1:3 to ensure it does not pose a safety risk
- All overburden dumps will be removed and used to fill the voids; no dumps will remain after the decommissioning of the final rehabilitation is complete.

2.12 MAINTENANCE

During decommissioning and closure the following will be required:

- All necessary maintenance will be undertaken on the remaining permanent pollution control structures;
- Rehabilitated land, erosion control and vegetation maintenance will be undertaken.

3 COMPLIANCE WITH SECTION 39 (4) (A) (II) – FINANCIAL PROVISION

3.1 CLOSURE COSTS

This section was compiled in terms of Section 39 (4) (a) (ii) of the Act, read together with Section 41(1). Refer to **Figure 6** showing the infrastructure and the mining layout respectively.

The mitigations, monitoring and reporting of the impacts have already been discussed in this document.

3.2 CALCULATION

The closure costs for Wonderfontein Mine were assessed using the "Guideline Document for the Evaluation of the Closure-related Financial Provision Provided by a Mine – April 2004"). A rules-based approach was used and related back to the surface area of the various components included in the closure costs. This costs was determined as per the guideline for end of Year 1. This closure cost and the determination of the quantum must be reviewed annually as required.

Table 74: Closure cost

Component	Comments	Calculation
1 Dismantling of processing plant and related structures	Discussed in Wonderfontein Processing Plant EIA	4452 m^3
2(A) Demolition of steel buildings and structures	Some steel structures are planned	1328 m^2
2(B) Demolition of reinforced concrete buildings	No Reinforced concrete structures	3023 m^2
3 Rehabilitation of access roads	Haul roads constructed for first year	49000 m^2
4 (A) and A (B) Demolition and rehabilitation of electrified and non electrified railways	Railways were included in the Wonderfontein Processing Plant EIA	
5 Demolition of housing and administrative	Offices and change houses are planned	845 m^2

Component	Comments	Calculation
centres		
6 Opencast rehabilitation including final voids and ramps	Final voids that require closure.	16.8 ha
7 Sealing of shafts, adits and inclines	UG is planned later in the LOM	
8(A) Rehabilitation of overburden and stockpiles	Truck and shovel operation, only final spoilpile leveling required.	12 ha
8(B) Rehabilitation of basic evaporation ponds	Facilities will manage acid seepage and runoff	0 ha
8(C) Rehabilitation of acidic evaporation ponds	Dump 2 of option 1, total footprint	8.4 ha
9 Rehabilitation of subsided areas	No underground in year 1, planned later	
10a General surface rehabilitation	Area to be topsoiled at closure.	42 ha
10b General surface rehabilitation	Area to be seeded at closure	68 ha
11 River Diversions	No river diversions required	0
12 Fencing	Perimeter fence will be constructed during the operational phase, no provision required for this.	0
13 Water Management	Water management of area mined up to end of Y1	63 ha
14 Maintenance	Provision was made for 3 years of maintenance	68 ha

Refer to **Annexure 1** showing the detailed calculation sheet for the determination of the quantum and provision for year 1, it amounts to R 18,409,171 excluding VAT.

3.3 END OF LOM CLOSURE COST ASSESSMENT

Refer to **Annexure 1** for the detailed assessment detailing the estimated final rehabilitation cost at the end of life after all areas were mined. This information will be used in the evaluation in section 4.

In support of the calculation the following: -

Opencast mining will be done with a truck and shovel operation and therefore backfilling of the mine will occur concurrent with the mining operation. This means that the only areas requiring rehabilitation of the opencast area will be the last open required. For this purpose it was assumed that a 70 m wide section of the levelled areas still need to be finally shaped, topsoiled and seeded.

- Mining will be conducted at eight separate pits in sequence as indicated on Figure 3. Rehabilitation will be concurrent with mining, therefore some of the pits will be rehabilitated as part of the operational phase. Costs to close the voids are indicated in Table 75.
- Truck and shovel opencast mining will be conducted. Box-cuts will be created at some of the pits (1, 2, 3 and4) and the material stockpiled to be used at the closure of the voids and ramps. After establishing the box-cut (s) steady state mining can be practised. This means that as new areas are disturbed, mined out areas are backfilled (roll over mining will be conducted). These areas will then also be topsoiled and seeded during the operational phase and the costs are indicated in Table 75.
- The only areas remaining at closure of the mine will be the void and backfilled area at the Pit 1 and Pit 2. All others will be closed during the operational life of the mine as the areas are mined out.
- Final voids will be left as evaporation facilities and provision is also made for the treatment of water to irrigation standard Class II water. Capital costs are based on current construction costs. Provision was also made for operating costs.

The plant area will also be demolished and rehabilitated, including the slurry facilities. This however, has been addressed as part of the Wonderfontein EIA.

The discard dump area will also be rehabilitated concurrently with mining, however, the final rehabilitation will take place at the decommissioning phase.

Underground areas will have to be sealed off and rehabilitated. All waste and scrap metals will have to be removed from the underground workings and then final rehabilitation can continue. No surface rehabilitation is required unless subsidence took place or sinkholes have formed.

The area to be maintained includes the total opencast area, the roads, all the stockpile areas, the discard dump, and the underground areas entrance and surface (in case of subsidence and or sinkhole formation) all amounting to some 1500 ha.

All other rehabilitation costs will be enquired during the operational phase of the project.

4 COMPLIANCE WITH SECTION 39 (4) (A) (III) - CAPACITY TO MANAGE AND REHABILITATE THE ENVIRONMENT

In **Tables 60** to **62** the costs to modify, remedy, control or stop any actions, activities and processing that could cause pollution or degradation was shown for each impact and activity. Also indicated in the tables are the phase in which the impact will occur. **Table 75** below indicates only a summary of all the relevant measures for some of the years that are proposed and the cost associated with that activity. It will further be presented in a cash flow format and it will also be separated distinguishing between closure costs and operating costs (part of mining costs).

Table 75: Summary of Proposed Measures and Costs

Mitigation measure description (All amounts in R '000)	0-4 month	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
Construction Phase									
All activities									
Use water for dust suppression during construction. It is recommended that 0.118 ℓ/m2/h be applied.	70								
Monitor dust monthly at the current monitoring points	12								
Treat haulroads with chemical (Dust a side or similar) to reduce dust	1 912								
Develop an air quality management plan in line with the new air quality act.	184								
Install on-site meteriological monitoring that measures wind speed and direction, temperature, solar radiation and rainfall	34								
Maintain vehicles according to the manufactures maintenance schedule to ensure that noise levels are maintained within the specified levels and emissions are also within the specifications.	1 440								
Proper maintenance will also ensure that fuel and lubricant leaks are prevented and maintained.	0								
Place berms on the edge of the mine to reduce the impact of noise.	119								
Confirm the presence of efficient silencers and closed engin compartements, fit if not present	48								
Damp mechanical vibrations - confirm manufacture specifications and improve if required.	50								
Conduct annual equipment noise audits	54								
Conduct environmental noise audits annually	54								
Establish vegetation to act as screens to limit the visual impact	65								

Mitigation measure description (All amounts in R '000)	0-4 month	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
Embankments and dumps should have undulating or rounded silhouettes.	48								
Clean spills as soon as possible to prevent the contamination of water and soils.	50								
Haulroads									
Peg out the road and limit disturbance to the minimum.	48								
Strip all possible soil, keep topsoil and subsoil separate - roads. Stockpile it on 4 different stockpiles. Prevent overloading of trucks.	2 684								
Construct cut off drains that will prevent contaminated runoff entering the clean water resource - roads.	146								
Opencast	0								
Peg out soil types. Strip all possible soil, keep topsoil and subsoil separate. Stockpile topsoil on 4 different stockpiles.	2 036								
Construct berms and canals.	4 157					312			
Conduct a proper detailed pre-blasting survey within 2 km of the porposed opencast minnig activities	750								
Vacate everyone within 500 m of the proposed blast. All blasts need to be designed by a professional and seismographs located at the workshop, stores and offices. Use electronic blasting techniques to ensure that the impact is limited as far as possible.	43								
Monitor boreholes.	8								
Limit disturbance to a minimum and construct highwall drains that will direct clean water runoff upstream of the mine around the mine to the streams. When it is no longer feasible to re-direct the clean water runoff around the mine, construct a sump and pump the water to the pollution control dam.	126								
Purchase, deliver and construct 150 mm pipeline, 2 km	450								
Monitor surface water as per monitoring points.	14								

Mitigation measure description (All amounts in R '000)	0-4 month	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
Underground development	0								
Develop sump to manage water seeping from the opencast areas	70								
Construct stone dust storage facilities and ensure containment	120								
Discard development	0								
Strip all possible soil, keep topsoil and subsoil separate - discard dump area.	1 396								
Use water for dust suppression during construction. It is recommended that 0.118 ℓ/m2/h be applied.	70								
Maintain vehicles and equipment according to the manufactures maintenance schedule to ensure that noise levels are maintained within the specified levels and emissions are also within the specifications.	200								
Establish vegetation as soon as possible on berms.	4								
Conduct regular inspections to identify erosion.	115								
Fix erosion as soon as possible.	140								
Construct coal discard facility, Option 1.	2 940								
Water Management	0								
Peg out 1:50 year floodlines or 100 m of the centre of the river, whatever is the further away from the stream to ensure mining is done outside this buffer.	48								
Construct pollution control dam with capacity of 98 000m3 and an evaporation area of 6.3 ha.	11 810								
Also construct a silt trap that will prevent deposition of silt in the pollution control dam.	550								
Workshops, stores and offices.	0								

Mitigation measure description (All amounts in R '000)	0-4 month	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
Strip all possible soil, keep topsoil and subsoil separate - office area. Stockpile it on 4 different stockpiles. Prevent overloading of trucks.	139								
Construct measures to prevent pollution caused by hydro-carbon spills	56								
Construct oil/water separation systems	950								
Construct sewge plant	1 450								
Operational Phase									
All activities									
Use water for dust suppression during construction. It is recommended that 0.118 ℓ/m2/h be applied.		141	211	211	253	253	304	304	304
Monitor dust monthly at the monitoring points.		24	37	37	37	37	37	37	37
Maintenance on dust a side type roads		4 009	6 013	6 013	6 013	6 013	6 013	7 817	7 817
Maintain vehicles according to the manufactures maintenance schedule to ensure that noise levels are maintained within the specified levels and emissions are also within the specifications.		2 880	4 320	4 320	4 320	4 320	4 320	4 320	4 320
Clean spills as soon as possible to prevent the contamination of water and soils.		33	50	50	50	50	50	50	50
Roads									
Clean spillages as per the Umsimbithi procedure daily.		33	50	50	50	50	50	50	50
Opencast									
Strip all available topsoil and place in consolidated blocks as per the post mining landcapability map.		6 487	9 731	9 731	9 731	9 731	9 731	9 731	9 731
Limit levelling of topsoil to a once-off operation by planning and dumping sufficient topsoil in an area		32	48	48	48	48	48	48	48
Conduct soil analysis to determine fertilizer requirements.		57	85	85	85	85	85	85	85

Mitigation measure description (All amounts in R '000)	0-4 month	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
Monitor stripping, stockpiling and replacement of topsoil by third party.		29	44	44	44	44	44	44	44
Do not overload trucks and ensure that topsoil is not lost. This is part of the management costs.		32	48	48	48	48	48	48	48
Shape area to as close as possible to the pre-mining topography.		1 982	2 973	2 973	2 973	2 973	2 973	2 973	2 973
Update the rehabilitation design annually		58	87	87	87	87	87	87	87
Limit disturbance to a minimum. Conduct concurrent rehabilitation and re-establish vegetation as soon as possible.		32	48	48	48	48	48	48	48
Develop alien vegetation management programme and remove alien vegetation accordingly.					162	97	58	58	97
Conserve wetland areas within 100 m of the centre of the streams and ensure connectivity.		32	48	48	48	48	48	48	48
In the areas where wetlands will be imapcted by the opencast mine, re-establish the wetlands, during ongoing rehabilitation									
Develop and implement a bio-diversity management plan.			290						58
Conduct follow up investigations on rocky outcrop, wetland systems and grassland areas to continuously update the biodiversity of the area			75			75	75		
Establish vegetation as soon as possible and conduct regular inspection to identify erosion. Conduct maintenance on erosion areas as soon as possible.		77	115	115	115	115	115	115	115
Develop and implement a land management plan.		59	59	59	59	59	59	59	59
Also monitor surface water quality.		28	42	42	42	42	42	42	42
Vacate everyone within 500 m of the proposed blast. All blasts need to be designed by a professional and seismographs located at the workshops, stores and offices. Use electronic blasting techniques to ensure that the impact is limited as far as possible.		53	80	80	80	80	80	80	80

Mitigation measure description (All amounts in R '000)	0-4 month	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
Maintain all drains.		97	145	145	145	145	145	145	145
Conduct concurrent rehabilitation (backfilling of the mined out areas as mining continues), topsoil and seed as soon as possible.		346	519	519	519	519	519	519	519
Affected water in the pit will be collected in the sump and pumped to the pollution control dam.		120	181	181	181	181	181	181	181
Maintain pipeline and inspect regularly for pipeline leaks.		20	30	30	30	30	30	30	30
Monitor boreholes.		10	15	15	15	15	15	15	15
Underground									
Monitor methane gas in underground		26	39	39	39	39	39	39	39
Pump surplus water to pollution control dam		145	217	217	217	217	217	217	217
Disposal of coal discard									
Maintain drains around coal discard dump area.		97	145	145	145	145	145	145	145
Compact the discard to prevent spontaneous combustion during the operational shaping of the dump.		200	300	300	300	300	300	300	300
Measure compaction of coal discard quarterly		31	46	46	46	46	46	46	46
Ensure that shaping of discard dump is done according to the predesigned slopes		32	48	48	48	48	48	48	48
Topsoil and seed areas that reached the pre-designed slopes and elevations		748	1 121	1 121	1 121	1 121	1 121	1 121	1 121
Water Management									
Clean silt trap to ensure no silt is deposited in the pollution control dam		72	108	108	108	108	108	108	108
Re-use the water contained in the pollution control dam as source for the washing plant and for dust suppression		34	50	50	50	50	50	50	50
Maintain all drains.		200	300	300	300	300	300	300	300
Construct highwall drains as required		750	750	750	750	750	750	750	750

Mitigation measure description (All amounts in R '000)	0-4 month	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
Conduct daily inspections.		32	48	48	48	48	48	48	48
Workshops, stores and offices									
Operate the sewage plant according to the operational and license requirements		50	74	74	74	74	74	74	74
Ensure that waste is managed according to the Umsimbithi waste management procedure		68	102	102	102	102	102	102	102
All hydro-carbon areas to be bunded.		37	56	56	56	56	56	56	56
Clean spills and dispose into hazardous waste bins.		33	50	50	50	50	50	50	50
Use drip trays during maintenance and services and conduct activities on concrete floor.		19	28	28	28	28	28	28	28
Decommissioning phase									
Opencast									
Load all topsoil from the stockpiles and place on leveled areas. Prevent mixing of topsoil groups and placement should be done according to soil type.							221		
Conduct soil analysis to determine fertilizer requirements. Apply fertilizer and seed as per recommendation.							35		
Conduct regular inspections and re-vegetate areas as required. Repair erosion areas as soon as possible. Conduct maintenance on all rehabilitated areas				371	743	1 114	1 114	1 114	1 114
Conduct the final rehabilitation according to the rehabilitation plan, including closing the final voids and ramps.							209		
Cumulative									
Construct an access road at the D383.	3 500								
Vehicles will be road worthy and regular inspections will be done.	80	80	80	80	80	80	80	80	80

Mitigation measure description (All amounts in R '000)	0-4 month	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
After rehabilitation the land can be used for agricultural purposes, mainly grazing but some sections would not have been disturbed and it can be used as arable land again.	no cost								
Limit disturbance to a minimum and allow agriculture on areas not disturbed as soon as possible	48	48	48	48	48	48	48	48	48
Heritage									
Historical structures need to be investigated by historical architect and need to acquire a permit from SAHRA prior to any of the structures been affected.									
Graveyards need to be conserved with a brick wall and fences. A buffer zone of 20 m is required.	1 095								
Total	39 382	19 371	28 953	28 960	29 535	30 229	30 393	31 658	31 755

Mitigation measure description (All amounts in R '000)	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17
Construction Phase									
Opencast									
Peg out soil types. Strip all possible soil, keep topsoil and subsoil separate. Stockpile topsoil on 4 different stockpiles.									
Construct berms and canals.								1 174	
Operational Phase									
All activities									
Use water for dust suppression during construction. It is recommended that 0.118 ℓ/m2/h be applied.	304	304	304	365	365	365	365	438	438

Mitigation measure description (All amounts in R '000)	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17
Monitor dust monthly at the monitoring points.	37	37	37	37	37	37	37	37	37
Maintenance on dust a side type roads	7 817	7 817	7 817	7 817	7 817	9 380	9 380	9 380	9 380
Maintain vehicles according to the manufactures maintenance schedule to ensure that noise levels are maintained within the specified levels and emissions are also within the specifications.	4 320	4 320	4 320	4 320	4 320	4 320	4 320	4 320	4 320
Clean spills as soon as possible to prevent the contamination of water and soils.	50	50	50	50	50	50	50	50	50
Roads	0								
Clean spillages as per the Umsimbithi procedure daily.	50	50	50	50	50	50	50	50	50
Opencast	0								
Strip all available topsoil and place in consolidated blocks as per the post mining landcapability map.	9 731	9 731	9 731	9 731	9 731	9 731	9 731	9 731	9 731
Limit levelling of topsoil to a once-off operation by planning and dumping sufficient topsoil in an area	48	48	48	48	48	48	48	48	48
Conduct soil analysis to determine fertilizer requirements.	85	85	85	85	85	85	85	85	85
Monitor stripping, stockpiling and replacement of topsoil by third party.	44	44	44	44	44	44	44	44	44
Do not overload trucks and ensure that topsoil is not lost. This is part of the management costs.	48	48	48	48	48	48	48	48	48
Shape area to as close as possible to the pre-mining topography.	2 973	2 973	2 973	2 973	2 973	2 973	2 973	2 973	2 973
Update the rehabilitation design annually	87	87	87	87	87	87	87	87	87
Limit disturbance to a minimum. Conduct concurrent rehabilitation and re-establish vegetation as soon as possible.	48	48	48	48	48	48	48	48	48
Develop alien vegetation management programme and remove alien vegetation accordingly.	58	97	58	35	97	58	35	97	58
Conserve wetland areas within 100 m of the centre of the streams and ensure connectivity.	48	48	48	48	48	48	48	48	48

Mitigation measure description (All amounts in R '000)	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17
In the areas where wetlands will be imapcted by the opencast mine, re-establish the wetlands, during ongoing rehabilitation	0			152					
Develop and implement a bio-diversity management plan.	0	0	0	0	58	0	0		
Conduct follow up investigations on rocky outcrop, wetland systems and grassland areas to continuously update the biodiversity of the area	0	75	0	0	0	75	0	0	75
Establish vegetation as soon as possible and conduct regular inspection to identify erosion. Conduct maintenance on erosion areas as soon as possible.	115	115	115	115	115	115	115	115	115
Develop and implement a land management plan.	59	59	59	59	59	59	59	59	59
Also monitor surface water quality.	42	42	42	42	42	42	42	42	42
Vacate everyone within 500 m of the proposed blast. All blasts need to be designed by a professional and seismographs located at the workshops, stores and offices. Use electronic blasting techniques to ensure that the impact is limited as far as possible.	80	80	80	80	80	80	80	80	80
Maintain all drains.	145	145	145	145	145	145	145	145	145
Conduct concurrent rehabilitation (backfilling of the mined out areas as mining continues), topsoil and seed as soon as possible.	519	519	519	519	519	519	519	519	519
Affected water in the pit will be collected in the sump and pumped to the pollution control dam.	181	181	181	181	181	181	181	181	181
Maintain pipeline and inspect regularly for pipeline leaks.	30	30	30	30	30	30	30	30	30
Monitor boreholes.	15	15	15	15	15	15	15	15	15
Underground	0								
Monitor methane gas in underground	39	39	39	39	39	39	39	39	39
Pump surplus water to pollution control dam	217	217	217	217	217	217	217	217	217
Disposal of coal discard	0								

Mitigation measure description (All amounts in R '000)	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17
Maintain drains around coal discard dump area.	145	145	145	145	145	145	145	145	145
Compact the discard to prevent spontaneous combustion during the operational shaping of the dump.	300	300	300	300	300	300	300	300	300
Measure compaction of coal discard quarterly	46	46	46	46	46	46	46	46	46
Ensure that shaping of discard dump is done according to the predesigned slopes	48	48	48	48	48	48	48	48	48
Topsoil and seed areas that reached the pre-designed slopes and elevations	1 121	1 121	1 121	1 121	1 121	1 121	1 121	1 121	1 121
Water Management	0								
Clean silt trap to ensure no silt is deposited in the pollution control dam	108	108	108	108	108	108	108	108	108
Re-use the water contained in the pollution control dam as source for the washing plant and for dust suppression	50	50	50	50	50	50	50	50	50
Maintain all drains.	300	300	300	300	300	300	300	300	300
Construct highwall drains as required	750	750	750	750	750	750	750	750	750
Conduct daily inspections.	48	48	48	48	48	48	48	48	48
Workshops, stores and offices	0								
Operate the sewage plant according to the operational and license requirements	74	74	74	74	74	74	74	74	74
Ensure that waste is managed according to the Umsimbithi waste management procedure	102	102	102	102	102	102	102	102	102
All hydro-carbon areas to be bunded.	56	56	56	56	56	56	56	56	56
Clean spills and dispose into hazardous waste bins.	50	50	50	50	50	50	50	50	50
Use drip trays during maintenance and services and conduct activities on concrete floor.	28	28	28	28	28	28	28	28	28
Decommissioning phase									
Opencast									

Mitigation measure description (All amounts in R '000)	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17
Load all topsoil from the stockpiles and place on leveled areas. Prevent mixing of topsoil groups and placement should be done according to soil type.								621	
Conduct soil analysis to determine fertilizer requirements. Apply fertilizer and seed as per recommendation.								99	
Conduct regular inspections and re-vegetate areas as required. Repair erosion areas as soon as possible. Conduct maintenance on all rehabilitated areas	1 114	1 114	1 114	1 114	1 114	1 114	1 114	1 114	1 114
Conduct the final rehabilitation according to the rehabilitation plan, including closing the final voids and ramps.							588		
Cumulative									
Construct an access road at the D383.									
Vehicles will be road worthy and regular inspections will be done.	80	80	80	80	80	80	80	80	80
After rehabilitation the land can be used for agricultural purposes, mainly grazing but some sections would not have been disturbed and it can be used as arable land again.									
Limit disturbance to a minimum and allow agriculture on areas not disturbed as soon as possible	48	48	48	48	48	48	48	48	48
Heritage									
Historical structures need to be investigated by historical architect and need to acquire a permit from SAHRA prior to any of the structures been affected.									
Graveyards need to be conserved with a brick wall and fences. A buffer zone of 20 m is required.	1 095						1 095		
Total	32 753	31 771	31 658	31 847	31 815	33 356	34 942	35 288	33 429

Mitigation measure description (All amounts in R '000)	Y18	Y19	Y20	Y21	Y22	Y23	Y24	Y25	Y26
Operational Phase									
All activities									
Use water for dust suppression during construction. It is recommended that 0.118 ℓ/m2/h be applied.	438	328	328	328	328	328			
Monitor dust monthly at the monitoring points.	37	37	37	37	37	37			
Maintenance on dust a side type roads	5 628	5 628	5 628	5 628	5 628	5 628			
Maintain vehicles according to the manufactures maintenance schedule to ensure that noise levels are maintained within the specified levels and emissions are also within the specifications.	4 320	4 320	4 320	4 320	4 320	4 320			
Clean spills as soon as possible to prevent the contamination of water and soils.	50	50	50	50	50	50			
Roads	0								
Clean spillages as per the Umsimbithi procedure daily.	50	50	50	50	50	50			
Opencast	0								
Strip all available topsoil and place in consolidated blocks as per the post mining landcapability map.	9 731	9 731	9 731	9 731	9 731	9 731			
Limit levelling of topsoil to a once-off operation by planning and dumping sufficient topsoil in an area	48	48	48	48	48	48			
Conduct soil analysis to determine fertilizer requirements.	85	85	85	85	85	85			
Monitor stripping, stockpiling and replacement of topsoil by third party.	44	44	44	44	44	44			
Do not overload trucks and ensure that topsoil is not lost. This is part of the management costs.	48	48	48	48	48	48			

Mitigation measure description (All amounts in R '000)	Y18	Y19	Y20	Y21	Y22	Y23	Y24	Y25	Y26
Shape area to as close as possible to the pre-mining topography.	2 973	2 973	2 973	2 973	2 973	2 973			
Update the rehabilitation design annually	87	87	87	87	87	87			
Limit disturbance to a minimum. Conduct concurrent rehabilitation and re-establish vegetation as soon as possible.	48	48	48	48	48	48			
Develop alien vegetation management programme and remove alien vegetation accordingly.	35	97	58	35	97	58			
Conserve wetland areas within 100 m of the centre of the streams and ensure connectivity.	48	48	48	48	48	48			
In the areas where wetlands will be imapcted by the opencast mine, re-establish the wetlands, during ongoing rehabilitation	0								
Develop and implement a bio-diversity management plan.	0			58					
Conduct follow up investigations on rocky outcrop, wetland systems and grassland areas to continuously update the biodiversity of the area	0		75			75			
Establish vegetation as soon as possible and conduct regular inspection to identify erosion. Conduct maintenance on erosion areas as soon as possible.	115	115	115	115	115	115			
Develop and implement a land management plan.	59	59	59	59	59	59			
Also monitor surface water quality.	42	42	42	42	42	42			
Vacate everyone within 500 m of the proposed blast. All blasts need to be designed by a professional and seismographs located at the workshops, stores and offices. Use electronic blasting techniques to ensure that the impact is limited as far as possible.	80	80	80	80	80	80			
Maintain all drains.	145	145	145	145	145	145			
Conduct concurrent rehabilitation (backfilling of the mined out areas as mining continues), topsoil and seed as soon as possible.	519	519	519	519	519	519			

Mitigation measure description (All amounts in R '000)	Y18	Y19	Y20	Y21	Y22	Y23	Y24	Y25	Y26
Affected water in the pit will be collected in the sump and pumped to the pollution control dam.	181	181	181	181	181	181			
Maintain pipeline and inspect regularly for pipeline leaks.	30	30	30	30	30	30			
Monitor boreholes.	15	15	15	15	15	15			
Underground	0								
Monitor methane gas in underground	39	39	39	39	39	39			
Pump surplus water to pollution control dam	217	217	217	217	217	217			
Disposal of coal discard	0								
Maintain drains around coal discard dump area.	145	145	145	145	145	145			
Compact the discard to prevent spontaneous combustion during the operational shaping of the dump.	300	300	300	300	300	300			
Measure compaction of coal discard quarterly	46	46	46	46	46	46			
Ensure that shaping of discard dump is done according to the predesigned slopes	48	48	48	48	48	48			
Topsoil and seed areas that reached the pre-designed slopes and elevations	1 121	1 121	1 121	1 121	1 121	1 121			
Water Management	0								
Clean silt trap to ensure no silt is deposited in the pollution control dam	108	108	108	108	108	108			
Re-use the water contained in the pollution control dam as source for the washing plant and for dust suppression	50	50	50	50	50	50			
Maintain all drains.	300	300	300	300	300	300			
Construct highwall drains as required	750	750	750	750	750	750			
Conduct daily inspections.	48	48	48	48	48	48			
Workshops, stores and offices	0								
Operate the sewage plant according to the operational and license requirements	74	74	74	74	74	74			

Mitigation measure description (All amounts in R '000)	Y18	Y19	Y20	Y21	Y22	Y23	Y24	Y25	Y26
Ensure that waste is managed according to the Umsimbithi waste management procedure	102	102	102	102	102	102			
All hydro-carbon areas to be bunded.	56	56	56	56	56	56			
Clean spills and dispose into hazardous waste bins.	50	50	50	50	50	50			
Use drip trays during maintenance and services and conduct activities on concrete floor.	28	28	28	28	28	28			
Decommissioning phase									
Maintain vehicles according to the manufactures maintenance schedule.						1 728	1 728	1 728	1 728
Maintain berm until very last minute, Remove, level and seed.									145
Use water for dust suppression. It is recommended that 0.118 ℓ/m2/h be applied. Continue with dust monitoring during the decommissioning phase.						127	106	84	74
Access roads									
Attempt to conduct decommissioning during the dry season. Rip the roads and cover it with topsoil. Establish vegetation as soon as possible.									714
Maintain monitoring programme.						37	37	37	37
Opencast									
Load all topsoil from the stockpiles and place on leveled areas. Prevent mixing of topsoil groups and placement should be done according to soil type.							499		
Conduct soil analysis to determine fertilizer requirements. Apply fertilizer and seed as per recommendation.							80		
Conduct regular inspections and re-vegetate areas as required. Repair erosion areas as soon as possible. Conduct maintenance on all rehabilitated areas	1 114	1 114	1 114	1 114	1 114	1 114	1 114	743	371

Mitigation measure description (All amounts in R '000)	Y18	Y19	Y20	Y21	Y22	Y23	Y24	Y25	Y26
Conduct the final rehabilitation according to the rehabilitation plan, including closing the final voids and ramps.							215		
Underground									
Close the adits with concrete plugs. (Voids will be closed as part of the opencast rehabilitation.)						4 560	4 560	4 560	4 560
Monitor the topography for development of subsidence						144	144	144	144
Disposal of coal discard									
Complete the final shaping of the dump							1 627		
Cap, topsoil and seed the dump							2 290	6 869	
Ensure that all cut-off drains are well maintained and operational							0	0	0
Ensure that clean water runoff is diverted into the streams							0	0	0
Water Management									
Remove all coal from the stockpiles and dispose into opencast void, topsoil and seed.							250		
The basin of the evaporation facilities at the various opencast pits will be developed as part of the backfill concurrent rehabilitation process. The floor of the voids need to be shaped to the elevations as determined, 3 m below the decant elevations. Side slopes of the facility will be constructed during this phase.							4 811		
Construct a desalination plant that will be able to treat 1.5 Mℓ/day.							9 000	21 000	30 000
Construct northern subsurface water management plan							8 483	16 967	
Grout pillar between Pit 6 and the gravel road							7 500		
Workshops, stores and offices									
Demolish infrastructure and dispose rubble into opencast void, topsoil and seed.							145		
Post closure phase									

Mitigation measure description (All amounts in R '000)	Y18	Y19	Y20	Y21	Y22	Y23	Y24	Y25	Y26
Manage and operate desalination treatment plant									2 300
Cumulative									
Construct an access road at the D383.									
Vehicles will be road worthy and regular inspections will be done.	80	80	80	80	80	80			
After rehabilitation the land can be used for agricultural purposes, mainly grazing but some sections would not have been disturbed and it can be used as arable land again.									
Limit disturbance to a minimum and allow agriculture on areas not disturbed as soon as possible	48	48	48	48	48	48			
Total	29 579	29 532	29 568	29 528	29 532	36 163	42 589	52 132	40 073

5 CONCLUSION

This EMP amendment serves to quantify and qualify the impacts that the new proposed mining plan will have on the environment. It also states clear objectives and measures how to either modify, remediate, control or stop any actions, activities and processes leading to, or causing pollution or degradation.

Key aspects that were indentified during the EIA phase of the project is the direct impact the proposed activity will have on the community residing in the nearby surroundings or currently still living on one of the properties associated for the project. Negotiations are still ongoing with some of the relevant communities.

Another key aspect is the potential pollution of the Wonderfontein Mine during the operational and post closure phases of the project. Separation of clean and affected water during the operational phase will be implemented to prevent contaminated water from entering any of the surface water resources in the area (including the pans). This will be strictly monitored by checking the quality of the nearby surface water resources on a monthly basis as well as the quality of the affected water from the pits and the pollution control dam once in operation. During the operational and decommissioning phases of the project evaporation facilities will be finalized, the northern subsurface decant water management plan will be implemented, water treatment plant will be constructed as well as the creation of a vertical barrier between Pit 6 and the gravel road. Monitoring holes will be drilled to measure the effectiveness of these measures.

Monitoring holes will also be drilled into the underground mine workings to monitor the methane levels and also to measure when the underground mine workings is flooded.

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