ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT FOR THE PROPOSED HARWAR COLLIERY, CHRISSIESMEER

MSOBO COAL (PTY) LTD

DMR REFERENCE: MP 30/5/1/2/2/10061 MR

As required in terms of Regulation 50 of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002)

JUNE 2013

DRAFT FOR PUBLIC REVIEW

Digby Wells and Associates (South Africa) (Pty) Ltd (Subsidiary of Digby Wells & Associates (Pty) Ltd). Co. Reg. No. 2010/008577/07. Fern Isle, Section 10, 359 Pretoria Ave Randburg Private Bag X10046, Randburg, 2125, South Africa
Tel: +27 11 789 9495, Fax: +27 11 789 9498, info@digbywells.com, www.digbywells.com

Directors: A Sing*, AR Wilke, LF Koeslag, PD Tanner (British)*, AJ Reynolds (Chairman) (British)*, J Leaver*, GE Trusler (C.E.O)
*Non-Executive

This document has been prepared by **Digby Wells Environmental**.

Report Title: **EIA/EMPR REPORT FOR THE PROPOSED HARWAR COLLIERY, CHRISSIESMEER**

Project Number: **MSO1805**

Name	**Responsibility**	**Signature**	**Date**
Leon Ellis	Project Administrator		June 2013
Marcelle Radyn	Project Manager and 1st Review		June 2013
Andries Wilke	Project Sponsor and 2nd Review		June 2013
Michael Hennessy	Legal Review		June 2013

EXECUTIVE SUMMARY

A Mining Right Application (MRA) was lodged by Xstrata South Africa (Pty) Ltd[1]. (Xstrata SA), through its subsidiary Duiker Mining (Pty) Ltd. (Duiker Mining), with the DMR in November 2012 in respect of the properties discussed in this Report. The application was accepted by the Regional Manager and the acknowledgement letter (with reference number *MP/30/5/1/2/2/10061 MR*) was received on 30 January 2013 permitting Xstrata SA to proceed with the necessary environmental process. Xstrata SA, as the applicant, was directed to lodge an Environmental Management Programme report (EMPR) as contemplated in Regulation 48, 50, and 51 of the Mineral and Petroleum Resources Development Act, Act 28 of 2002 (MPRDA), by 29 July 2013. Subsequent to the MRA being submitted, the properties in question have been transferred and all rights in terms of the MPRDA have been ceded to Msobo Coal (Pty) Limited (Msobo Coal). This EMPR report has accordingly been prepared under the name of Msobo Coal which is the current holder of the Prospecting Rights, and which will ultimately become the holder of the Mining Right.

The proposed project area is located within the boundaries of the Albert Luthuli Local Municipality, under the jurisdiction of the Gert Sibande District Municipality, Mpumalanga Province. The project area falls entirely within Ward 21 of the Albert Luthuli Local Municipality. The project area is bordered by the Msukaligwa Local Municipality to the south. The proposed project area is located approximately 10 km north of the town Chrissiesmeer.

Notice was given by the Member of the Executive Council (MEC) to the Department of Economic Development, Environment and Tourism in Mpumalanga Province (DEDET) in terms of section 33 (1) of the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) (NEMPAA), as amended, of the intention to declare the Chrissiesmeer Protected Environment (CPE), in terms of Section 28 (1) of the NEMPAA on certain properties as indicated on a map filed with the Chief Executive Officer (CEO): Mpumalanga Tourism and Parks Agency (Provincial Gazette Extraordinary No. 2181, General Notice 209 of 2013).

Certain farm portions of the Harwar project area forms part of the proposed CPE.

The towns of Breyten and Carolina are also located within the vicinity of the proposed project area. The proposed Harwar Colliery proposes to mine bituminous coal in the B and C seams through the use of the opencast, truck and shovel roll-over method. The planned Life of Mine (LoM) is 15 years.

The area is characterised by agricultural activities including cropping and livestock farming. Commercial crops mainly consist of maize and soya on areas that are arable, typically the higher lying areas. Grazing is practiced on the remaining areas, typically the lower potential soils found in low lying and wetland areas. Tourism activities are also predominant within the

[1] Now Glencore Xstrata plc

larger Chrissiesmeer area, with the St. Louis Private Nature Reserve located to the north west of the project area. Sensitive areas include Tevrede se pan, other pans, grasslands and rocky ridges.

A comprehensive Public Participation Process (PPP) was conducted with Interested and Affected Parties (I&APs) to determine issues and concerns related to the proposed project and to establish a working relationship between the communities, mine and authorities as part of the Environmental Impact Assessment and Environmental Management Programme (EIA/EMPR) process. This process also served to introduce the project to I&APs.

A public information sharing meeting took place on 27 March 2013 for the scoping phase. All comments received to date have been included in the Comment and Response Report (CRR). To date, 254 stakeholders were registered through the PPP.

The proposed project is regarded by the consulted stakeholders and I&APs as highly sensitive, in terms of both the natural and the socio-economic environment.

The most significant concerns pertaining to the perceptions of stakeholders and I&APs are listed below. These concerns are focussed on the natural environment as well as the socio-economic environment. These concerns are raised by various stakeholders and I&APs, leading to a diverse nature of the concerns.

- Environmental concerns:
  - Negative visual impact;
  - Dust and noise pollution (impact on humans, animals and crops);
  - The intention to declare the area as a protected environment (Chrissiesmeer Protected Environment);
  - Impacts on Tevrede se Pan; and
  - Groundwater pollution/depletion.
- Socio-economic concerns:
  - Loss of land rights/ownership;
  - Loss of sense of place;
  - Property devaluation;
  - Influx of foreign workforce;
  - Impact on tourism development/potential of the greater Chrissiesmeer area;
  - Local employment opportunities should be maximised; and
  - Local communities must share in the economic benefits of the project.

The following studies have been conducted as part of the EIA/EMPR report:

- Air Quality Assessment;
- Topography and Visual Assessment;

- Surface Water Assessment;
- Interim Hydrogeological Assessment;
- Wetland Assessment;
- Aquatic Ecology Assessment;
- Soils, Land Use and Land Capability Assessment;
- Flora and Fauna Assessment;
- Noise Assessment;
- Archaeological and Heritage Assessment;
- Social Assessment;
- Traffic Assessment; and
- Conceptual Rehabilitation Plan.

At the time of completing the draft EIA/EMPR report the following studies have not been completed, however these will be included in the final EIA/EMPR for submission:

- Blasting Assessment; and
- Sustainable Development Assessment.

Knowledge gaps associated with the specialist investigations conducted as part of the EIA/EMPR are discussed below.

A wet season site identification of the flora and fauna on the project area has not yet been conducted. This will only be done during the months of November 2013 and February 2014. Currently only a desktop assessment of the flora and fauna that is expected to occur on the proposed project area was done. The hydrogeological assessment is only an interim assessment as the conceptual model will only be finalised once the percussion drilling programme is complete to assess the groundwater system. These investigations will be done given that access to the properties is granted. The aquatic assessment was only conducted for a single flow. A high flow assessment is recommended in order to identify temporal trends within the aquatic environment. Adequate dust fallout monitoring data was also not available at the time of the air quality assessment.

The knowledge gaps identified within this report are generally due to denial of access to certain farm portions of the project study which restricted proper field investigations by specialists.

Another knowledge gap is the fact that the location of ancillary infrastructure to be constructed on the proposed project area was not known at the time of completing the specialist investigations and the draft EIA/EMPR report. The conceptual rehabilitation plan is based on the information currently available.

The potential impacts of the proposed opencast mining activities of the proposed Harwar Colliery Project have been evaluated for both environmental and socio-economic aspects.

The proposed development of a coal mine will have a significant impact on the current land use and surrounding agricultural activities.

The results from the EIA phase indicate that the proposed development will generally result in Medium–high to High negative environmental impacts pre-mitigation.

Listed below are the environmental aspects identified which are highly likely to be negatively impacted upon:

- Degradation of water quality on aquatic biota within the Mpuluzi River as the water quality within this catchment is still of good quality and the expected presence of a near threatened species;
- Loss of flora and fauna habitat types, biodiversity and ecosystem function in terms of the remaining grasslands on the proposed project area and the area being classified as an Important Bird Area (IBA);
- Reduced agricultural potential and land capability on current land use practices due to disturbance of soil;
- Sedimentation of surface water resources and reducing surface water quality, specifically at Tevrede se Pan;
- Surface water quality impacts after mine closure due to possible decant of Acid Mine Drainage (AMD);
- Direct and indirect loss of hillslope seepage wetland habitats, loss of wetland integrity, and loss of wetland functionality;
- Ambient air quality impacts during the construction and operational phase as a result of increased dust emissions; and
- Groundwater quantity impacts due to dewatering; and
- Groundwater quality impacts due to possible AMD formation during the mine closure phase.

Mitigation and management measures will decrease or minimise the significance of the negative environmental impacts where possible and the impact post mitigation was also assessed. Certain environmental impacts currently don’t have site specific mitigation measures as a result of the knowledge gaps that exist.

In terms of the socio-economic environment, no significant negative or positive impacts are expected as a result of the proposed project. The possible negative impacts on the socio-economic environment are listed below:

- Safety Impacts;
- Increase social pathologies;
- Increased pressure on local services/resources such as water provision during construction and operational phase;

- Displacement during construction and operational phase;
- Impacts on tourism activities in the area;
- Loss of agricultural and tourism job opportunities; and
- Transport routes to be used by the mine.

The significance of the negative impacts on the socio-economic environment can be reduced by applying appropriate mitigation and management measures.

Another issue of concern is the fact that the provincial road (P117-1) connecting Chrissiessmeer with Carolina has a tonnage restriction of 10 tonnes (Provincial road sign). This road would require an upgrade should additional loads be placed on the road surface. The route going through Chrissiesmeer is not the preferred route of choice. Alternative route options will be investigated in order to bypass the town of Chrissiesmeer and joining the project area with the R542 directly and using this route to transport coal to the Spitzkop Colliery for processing.

The positive impacts expected on the socio-economic environment relate to possible job creation for locals and local skills development. The current situation with regards to employment is that existing workforce from Msobo Coal's other operations in the area, Spitzkop and Tselentis Collieries, will be employed at the proposed Harwar Colliery. However, employment opportunities for locals will also be created. Applying appropriate mitigation measures, the positive impacts associated with the proposed project could be enhanced.

An Environmental Management Programme has been developed in order to manage and mitigate the key issues that have the potential to result in significant impacts. The Management Programme should be implemented during the LoM to ensure that the potential impacts are monitored and prevented, if possible. The Management Programme includes the methods to be implemented to monitor the potential impacts as well as recommendations, frequencies and the responsible persons to oversee that the Management Programme is implemented. Recommendations to enhance the positive and reduce the negative impacts on the socio-economic environment have also been made.

Final rehabilitation of the area during the decommissioning and post-closure phase is critical in restoring the natural environment as close as possible to pre-mining conditions. To achieve this, concurrent rehabilitation efforts during the operational phase should be conducted according to the rehabilitation plan and appropriate soil handling management measures should be implemented. The current rehabilitation plan is only a conceptual plan based on the current information available.

Tevrede se Pan is a unique feature within the landscape and the Pan system is not entirely understood, and until such time, no mining should take place within the catchment of the Tevrede se Pan.

The remaining mining opencast areas cover a combination of wetland, grassland and agricultural fields. The baseline of these areas will only be fully understood upon completion of the two wet season surveys, a per the MTPA minimum requirements, which will be done in November 2013 and February 2014. It is recommended by the fauna and flora specialist that a decision on the remainder of the mining plan only be taken once these studies have been completed.

The hydrogeological model, geochemical assessment and a high flow survey also needs to be completed before the full impacts can be understood.

It must be stressed that access to the following properties is required for the specialist studies:

- Portion 3 of the farm Fairview 62 IT (Mr. Johan Aubrey De Jager);
- Portion 3 of the farm Florence 78 IT (Baltimore Familie Trust - Mr. Chris Nel);
- Remaining Extent of the farm Harwar 58 IT (Johan Botha Trust – Mr. Hannes Botha)
- Portion 1 of the farm Harwar 58 IT (Fanie Nel Testamentary Trust – Mr. Chris Nel);
- Remaining Extent of the farm Leliefontein 79 IT (Mr. Jacobus Stephanus Nel);
- Portion 6 of the farm Leliefontein 79 IT (Mr. Hannes Botha);
- Portion 4 of the farm Lusthof 60 IT (Johan Botha Trust – Mr. Hannes Botha);
- Portion 6 of the farm Lusthof 60 IT (Hannes Botha Trust – Mr. Hannes Botha);
- Portion 8 of the farm Tevreden 56 IT (Johan Botha Trust – Mr. Hannes Botha);
- Remaining Extent of the farm Vryheid 59 IT (Mr. Hannes Botha);
- Remaining Extent of Haarlem 39 IT (Worldwide Coal Carolina (Pty) Ltd.); and
- Portion 5 of Iona 77 IT (Mr. Koos Davel).

Not providing access will not result in an automatic rejection of the application, but will result in this investigation not being complete and thus unnecessarily increasing the risk to the environment.

Bridging the current knowledge gaps and having access to all properties concerned for proper field investigations would enable the decision making authority to make a more informed decision on the proposed project.

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AMD	Acid Mine Drainage
CARA	Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)
CITES	Convention on International Trade in Endangered Species
CPE	Chrissiesmeer Protected Area
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DWA	Department of Water Affairs
ECO	Environmental Control Officer
EIA/EMP	Environmental Impact Assessment and Environmental Management Plan
EMF	Environmental Management Framework
EMPR	Environmental Management Programme
EWT	Endangered Wildlife Trust
GIS	Geographical Information System
HDSA	Historically Disadvantaged South Africans
HIA	Heritage Impact Assessment
I&AP	Interested and Affected Party
IBA	Important Bird Area
IDP	Integrated Development Plan
IUCN	International Union for the Conservation of Nature
LED	Local Economic Development
LoM	Life of Mine
M&HCV	Medium and Heavy Commercial Vehicle
MAE	Mean Annual Evaporation
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
MBCP	Mpumalanga Biodiversity Conservation Plan
MLD	Mpumalanga Lakes District
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002)
MRA	Mining Right Application
MTPA	Mpumalanga Tourism and Parks Agency

NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEMBA	National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)
NEMPAA	National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003)
NFEPA	National Freshwater Ecosystem Priority Areas
NHRA	National Heritage Resources Act, 1999 (Act No. 25 of 1999)
PCD	Pollution Control Dam
PPP	Public Participation Process
QDS	Quarter Degree Square
RHP	The River Health Programme
RoM	Run of Mine
SABIF	South African Biodiversity Information Facility
SAHRA	South African Heritage Resources Agency
SANBI	South African National Biodiversity Institute
SANRAL	South African National Roads Agency Limited
SANS	South African National Standards
SIA	Social Impact Assessment
SLP	Social and Labour Plan
SMME	Small, Medium and Micro-Sized Enterprises
WISH	Windows Interpretation System for Hydrogeologists
WMA	Water Management Area
WRC	Water Research Commission
WULA	Water Use Licence Application

SECTION 1: ENVIRONMENTAL IMPACT ASSESSMENT

1 THE BASELINE ENVIRONMENT (REGULATION 50 (A))

1.1 Description of the current environment

For the purpose of this document the proposed project will be referred to as the Harwar Colliery Project. All Plans associated with and referred to in this Report are included in Appendix A.

The proposed Harwar Colliery Project Area (hereafter referred to as “project area”) is located within the boundaries of the Albert Luthuli Local Municipality, under the jurisdiction of the Gert Sibande District Municipality in the Mpumalanga Province. The project area falls entirely within Ward 21 of the Albert Luthuli Local Municipality. The proposed project area is bordered by the Msukaligwa Local Municipality to the south. The Regional Setting of the project area is depicted in Plan 1. The project area covers various portions of the farms Harwar 58 IT, De Goedeverwachting 57 IT, Vryheid 59 IT, Tevreden 56 IT and Mooifontein 35 IT. The Local Setting and Land Tenure of the project area are depicted in Plan 2 and Plan 3 respectively.

The Harwar Mining Right Application (MRA) area covers a total area of approximately 3, 389 hectares (ha). The table below gives a summary of the extent of the area affected by the Harwar MRA area. Refer to Plan 3 indicating the MRA area and the affected farm portions.

Table 1-1: Farm Sizes of the Harwar MRA Area (Directly Affected Farms)

Harwar MRA Area		
Farm Name	**Portion (Ptn)**	**Extent (ha)**
De Goedeverwachting 57 IT	MA/1 on Ptn 5	53.2
	MA/2 on Ptn 10	112.1
	Ptn 6	70.5
Harwar 58 IT	MA/1 on Remaining Extent	242.4
Vryheid 59 IT	Farm	612.6
Tevreden 56 IT	Ptn 4 (of Ptn 1)	856.5
	Ptn 6 (of Ptn 1)	234.9
	Ptn 9 (of Ptn 5)	428.3
Mooifontein 35 IT	Ptn 2	778.3
	TOTAL:	**3,388.8**

The closest towns to the proposed project area are indicated in Table 1-2 indicating the distance and direction relative to the project site.

Table 1-2: Distance and Direction to Towns surrounding the Project Area (Measured from Tevrede se Pan to the town centre)

Name of Town	Distance (km)	Direction
Chrissiesmeer	10	S
Carolina	17	NW
Breyten	25	NSW

The project area is located within the Mpumalanga Lakes District (MLD). The MLD is marked by an unusually dense cluster of pans located around Lake Chrissie which is the largest of the pans. The MLD is a unique geomorphic entity within the South African landscapes. In contrast to the pans in the west of the country, those of the MLD are mainly perennial. Several major river systems arise around the fringes of the pan field, namely the Vaal River, the Komati River (via the Boesmanspruit), the Mpuluzi River and the Usutu River.

The MLD consists of approximately 320 pans, of which less than 3% are classified as reed pans (de Klerk et al, 2012). The Tevrede se Pan Peatland complex is made up of Tevrede se Pan (300 ha) and a smaller perennial pan (50 ha) located south east of Tevrede se Pan. Tevrede se Pan is by far the biggest pan, which is covered by a dense growth of *Phragmites* reeds (emergent) with a narrow outer ring of open water.

The project area spans two separate Water Management Areas (WMAs), namely the Inkomati (WMA 5) and the Usutu to Mhlatuze (WMA 6). Based on the layout of the project area the affected aquatic ecosystems are located in two separate quaternary catchments namely X11B and W55A. Quaternary catchment X12A is located north of the project area. Four freshwater endorheic pans exist within the project area and a number of pans are located within the immediate surrounding landscape.

Part of the project area is situated within the proposed Chrissiesmeer Biodiversity Site. In March 2011, the Minister of Mineral Resources announced her intention to declare the Chrissiesmeer Lake District as an area in which no new reconnaissance permission, prospecting right, mining right or mining permit could be granted after the announcement date for the next three years (Government Gazette No. 169). Subsequent to the Minister making her intention clear, no further action was taken and the proposed project area was never officially declared a protected area.

In 2010, the Mpumalanga Tourism and Parks Agency (MTPA), together with landowners within the area and various NGOs such as the Endangered Wildlife Trust (EWT) and Birdlife South Africa (Birdlife SA), has been involved in a process to have the Chrissiesmeer Protected Environment (CPE) established (Morris; MTPA 2013). The gazette notice was published on the 21st of June 2013 (Provincial Gazette Extraordinary No. 2181, General Notice 209 of 2013). The proposal for this declaration has been made in terms of Section 28(1) of the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of

2003) (NEMPAA). The proposed CPE will qualify to be registered as a Wetland of International Significance in terms of the RAMSAR Convention (Morris; MTPA, 2013) if it receives protection under the NEMPAA.

The key economic activities surrounding the project area are those of agriculture, tourism and coal mining. Residential activities also occur within the area and consist of small towns such as Breyten, Chrissiesmeer and Carolina. Local farmers and their farm workers also stay in homesteads on farms in and around the project area. The nearest operational mining activities are located ±13 km NNW from the project area. The mining activities are associated with coal and clay mines. Most of the mines surrounding the project area are opencast mines. The current and proposed mines (mines under application), within a 50 km radius of the project area are indicated in Table 1-3, below. Plan 4 depicts the mines surrounding the project area.

Table 1-3: Mines within a 50km radius of the project area (Measured from the Tevrede se Pan to the Mine)

Mine	Distance (km)	Direction
Proposed Lusthoff Colliery (under application)	Adjacent	SE
Droogvallei Colliery	13	NNW
Mimosa Colliery	14	W
Tselentis Colliery (MR area borders the Harwar MRA area)	15	SW
Paardeplaats Colliery	16	N
Spitzkop Colliery	27	SW
Umlabu Colliery	28	SW
Brickfab	36	SW
Goedehoop Stene	37	NW
Marlin-Prairie Granite	40	N
Strathrae Colliery	41	NW
Ermelo Stene	42	SSW
Klippan Colliery	46	NW
Kobra Mining-Usutu West	47	SSW
Penumbra Coal Mining	49	SSW

1.1.1 Climate

1.1.1.1 Regional Climate

Ambient air quality in this region of South Africa is strongly influenced by regional atmospheric movements, together with local climatic and meteorological conditions. The most important of these atmospheric movement routes are the direct transport towards the Indian Ocean and the recirculation over the sub-continents.

Mpumalanga Province experiences a wide range of both natural and anthropogenic sources of air pollution ranging from power generation to veld fires, mining activities, industrial processes, agriculture, paper and pulp processing, vehicle use and domestic use of fossil fuels. Different pollutants are associated with each of the above activities, ranging from volatile organic compounds to heavy metals to particulate matter, dust and odours. Mpumalanga experiences distinct weather patterns in summer and winter that affect the dispersal of pollutants in the atmosphere. In summer, unstable atmospheric conditions result in mixing of the atmosphere and rapid dispersion of pollutants. In contrast, winter is characterised by atmospheric stability caused by a persistent high pressure system over South Africa. This dominant high pressure system results in subsidence, causing clear skies and a pronounced temperature inversion over the Highveld central plateau area. This inversion layer traps the pollutants in the lower atmosphere, which results in reduced dispersion and a poorer ambient air quality. Preston-Whyte and Tyson (1988) describe the atmospheric conditions in the winter months as highly unfavourable for the dispersion of atmospheric pollutants.

1.1.1.2 Wind Direction and Wind Speed

Wind roses comprise 16 spokes which represent the directions from which winds blew during the period. The colours reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories.

Wind class frequency distribution per sector is given in Figure 1–1.

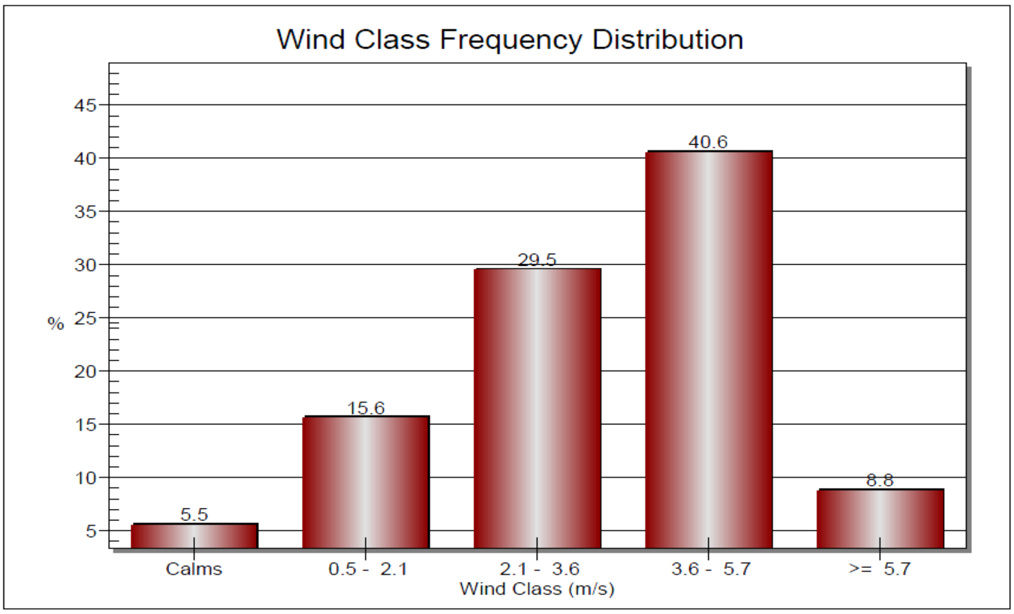

Figure 1–1: Wind Class Frequency Distribution for Msobo Coal modelled data, 01 January 2010 – 31 December 2012

The spatial and annual variability in the wind field for the Msobo Coal modelled data is clearly evident in Figure 1–2. The predominant wind direction over the three year period is from the north-east (14% frequency), east-north-east (10%) and west-north-west (10%), with frequent winds also occurring from the east and north-west. Less frequent winds (under 3% of the time) were coming from the south-south-west and south. Calm conditions (wind speeds < 0.5 m/s) occurred for 6% of the time.

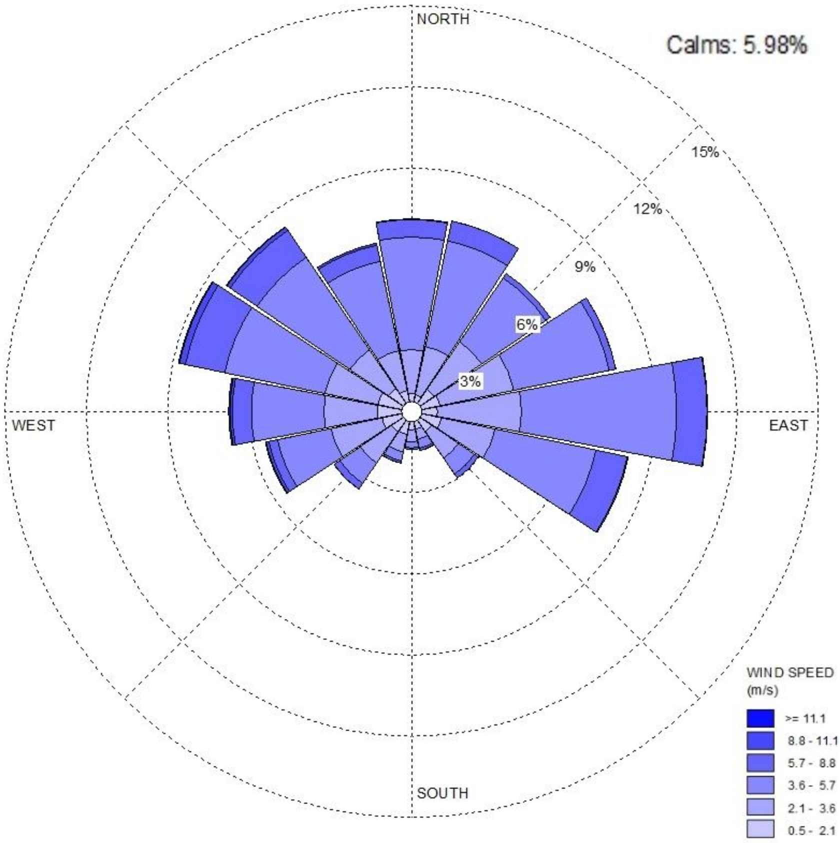

Figure 1–2: Period surface wind rose for Msobo Coal modelled data, 01 January 2010 – 31 December 2012

There are variations in the wind direction throughout the day. In the morning, the main wind direction is from the north-west, with secondary component from the east and east-south-east. In the afternoon period, the main wind direction is from west-north-west, west, east and east-south-east. Throughout the evening the predominant wind direction is east, with secondary component from the north-north-east, north-east and east-south-east respectively. Less frequent winds (under 2% of the time) were coming from the south. Throughout the night, the dominant winds came from the north with north-north-east and north-north-east components. More calm (wind speeds < 0.5 m/s) winds were experienced during the afternoon with the least calm period during the evening.

The windroses depicting the diurnal variation of winds between night time, morning, afternoon and evening are given in the Air Quality Assessment Report (Appendix B).

Seasonal changes bring about changes in wind direction and speed. In spring, maximum wind speed is between 8.8 - 11 m/s. Predominant wind direction was from the north-west, west-north-west, north and north-north-east. In summer, the main wind direction was from the east with the main wind speed between 3.6 - 5.7 m/s and highest wind speed experienced was 5.7 – 8.8 m/s. In autumn, predominant wind direction was from the east and west-north-west. Highest calm winds (wind speeds < 0.5 m/s) were experienced in autumn. In winter, predominant wind direction was west and east. Highest wind speeds exceeding 11 m/s were experienced during this season. Less frequent winds (under 2% of the time) were coming from the south.

The windroses depicting the seasonal variation of winds in spring, summer, autumn and winter are given in the Air Quality Assessment Report (Appendix B).

1.1.1.3 Mean Monthly and Maximum Temperatures

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the plume and the ambient air, the higher the plume is able to rise), and determining the development of the mixing and inversion layers.

South African Weather Service does not have an Automatic Weather Station (AWS) within the reasonable distance from the proposed Msobo Coal mine site that would give representative and accurate climate data, so the use was made of modelled data and trends were observed analysing the three years available (2010-2012).

The average monthly maximum temperatures range from 19.2°C in February to 7.6°C in June, with monthly minima ranging from 18.2°C in January to 6.5°C in July. Annual mean temperature for Msobo is given as 13.5°C.

1.1.1.4 Relative Humidity

The annual maximum, minimum and mean relative humidity over the three year period is given as 76%, 71% and 74% respectively. The monthly maximum relative humidity remains above 70% for the whole year and ranges from 82% in winter (July) to 71% in spring (November). The monthly minimum relative humidity on the other hand is above than 65% throughout the year, with the highest minimum (74%) occurring in summer (January and February) and the lowest (67%) occurring in winter and spring (August and October respectively).

1.1.1.5 Precipitation and Evaporation

The Mean annual evaporation (MAE) for the area is given in WR2005 as 1400 mm. Evaporation, in terms of spatial variation, is fairly constant over the area. Limited long term evaporation records are available and the one at Morgenstond Dam is the longest and has a long term average slightly higher than that referred to above.

The surface water attributes of the affected catchments namely Mean Annual Runoff (MAR), Mean Annual Precipitation (MAP) and Mean Annual Evaporation (MAE) are summarised in Table 1-4 (WRC, 2005), indicating that the ratio of Precipitation: evaporation is 0.55 and 0.51 for the W55A and X11B quaternary catchments respectively.

Table 1-4: Summary of the surface water attributes of the two quaternary catchments

Quaternary Catchment	Rainfall Zone	MAP (mm)	MAR (mm)	MAR $m^3 * 10^6$	Evaporation Zone	MAE (mm)
W55A	W5E	767	32.4	22.3	13A	1400

Quaternary Catchment	Rainfall Zone	MAP (mm)	MAR (mm)	MAR $m^3 * 10^6$	Evaporation Zone	MAE (mm)
X11B	X1A	716	45.2	27.1	5A	1402

1.1.2 Air Quality

An Air Quality Assessment Report is attached as Appendix B.

1.1.2.1 Measured Background Ambient Air Quality

1.1.2.1.1 __Assessment of dust fallout rates__

Dust monitoring locations have been selected and the sites will be commissioned during June 2013. Refer to Plan 5 for the location of the dust monitoring points. This will be used to appraise the pre-mining air quality for the area. The standard procedure accepted internationally is adopted by the South African National Standard (SANS 1137:2012) "Standard Test Method for Collection and Measurement of Dustfall" (Settleable Particulates Matter). This method uses a passive wet dust collector, which comprises of a vertical pole of ~2 meters above the ground, a 5 litre bucket with a surface area of 227 cm^2 (Lewis, 1983; Lodge 1988). Each bucket contains 4 litre of distilled water to which was added Copper Sulphate - $CuSO_4$ (25 mg-1 solution). The presence of $CuSO_4$ in solution prevents algae growth (Krah et al., 2004).

1.1.2.1.2 __Ambient air quality__

As site specific information for the criteria gaseous pollutants are not available, data from the Hendrina Ambient Air Quality Monitoring Station was used. Although, the pollutant of interest for the proposed project is particulate matter, the levels of gaseous criteria pollutants are appraised using data from Department of Environmental Affairs (DEA). DEA operates an Ambient Air Quality monitoring station at the residential area of Kwazamokuhle just north east of the Hendrina, which is a part of the Highveld Priority Area.

The daily average PM_{10} and $PM_{2.5}$ ambient concentrations, as well as diurnal profiles at Hendrina Ambient Air Quality Monitoring Station for the period August 2008 to February 2013 are presented in the Air Quality Baseline Assessment.

This data was used to establish baseline ground level concentrations for the above mentioned pollutants in the vicinity of proposed project. The distance from the operation to the AQM station is approximately 40km, but is deemed representative of existing air quality in the area.

1.1.3 Geology

1.1.3.1 Regional Geology

The proposed project area is situated in the Ermelo Coal Field. The coal field is underlain by pre-Karoo rocks which were subject to glaciation that resulted in the deposition of the Dwyka tillite. The Dwyka Formation consists of a variety of glacial to peri-glacial sediments. These include logment tills, terrestrial moraine, glaci-lacustrine and fluvio-glacial conglomerate, sandstone and mudrock, as wells as submarine to sub-aerial outwash diamictite. These glacial deposits are easily recognised in boreholes cores and form an excellent marker below which coal is not found.

The Ecca Group, which contains the coal-bearing Vryheid Formation, rests disconformably on the Dwyka Formation. The Vryheid formation consists of feldspathic sandstone, shale, mudstone and coal (Wilson & Anhauesser, 1998). The Vryheid Formation contains five bituminous coal seams, named A, B, C, D and E; with A at the top and E being at the bottom, and are separated by mainly arenaceous sediments. The coal seams are generally flat with a regional shallow south-westerly dip.

The E-seam, where developed, averages 0.5 m in thickness. The E-seam is overlain by a persistent shale member, followed by sandstone. The D-seam may be made up of four members locally, but usually has two leaves (term used when a coal seam 'splits') separated by a thin parting. The seam, although laterally continuous, seldom exceeds 0.5 m in thickness. The D-seam is overlain by sandstone followed by a persistent shale layer, followed by further sandstone and another persistent shale layer. The C-seam, which averages 1.8 m in thickness, is usually composed of a C-Upper (CU), C-Interburden (CUCLIB) and C-Lower (CL) seam, separated by a parting of variable lithological compositions. Locally the CU-seam may split into two recognisable leaves. It is overlain by a sandstone layer of variable thickness and in some instances a thin band of carbonaceous shale is present above the C-upper seam.

The B-seam group, which is also an average of 1.8 m thick, is generally represented by two seams, termed B and BL1; separated by a sandstone parting. Locally the B-seam may include the thin BX-seam lying above the B-seam. The B-seam is overlain by sandstone which in turn is overlain by a persistent shale member. Thereafter there is an alternating sequence of sandstone and shale developments.

The C and B-seams commonly comprise several coal horizons with shale partings; hence they have been termed seam groups. A series of shale and sandstone layers overlie the coal zone with the uppermost layer invariably being sandstone. Soils, weathered sandstone and ferricrete overlie this uppermost layer. The proposed Harwar project will target the C and B-seams.

The A-seam is seldom preserved as it has been removed by erosion. It is usually overlain by a glauconitic sandstone layer.

Dolerite intrusions in the form of sills and dykes are present over the entire Ermelo Coal Field. These sills displace the seams and cause structural complications. Sills may cause devolatilisation[2] of the coal.

[2] Coal devolatilization is a process in which coal is transformed at elevated temperatures to produce gasses, tar and char.

1.1.3.2 Local Geology

The coal present on the project area is associated with the B and C-seam of the Vryheid Formation. The specific geology of the project area is discussed below.

The Mooifontein portion of the proposed project area has been divided into two parts by a northeast-southwest trending faults which has thrown the sediments down on the southern side by approximately 8 m (Digby Wells, 1996). Over the rest of the area the sediments dip gently in a south to south-westerly direction. There is a dolerite sill approximately 6 m thick over a large part of the area just below the weathered zone at the level of the CL-seam. A dolerite outcrop can be seen at the proposed mining area at Mooifontein. Refer to Plan 6 depicting the Local Geology of the project area. The BX-seam ranges from 0.3 to 0.8 m in thickness and occurs at a maximum depth of 25 mbgl. It is separated from the B and BL-seams by 0.5 to 1 m of shale. The BL2 and CU-seams are separated by a parting of inter-bedded arenaceous and argillaceous sediments of 0.3 to 0.7 m in thickness. The interburden between the B and C-seams is predominantly sandstone with inter-bedded layers of shale and siltstone. The CL-seams is separated from the CU by a sandstone parting of 3.5 to 6.5 m in thickness.

In the Tevreden area, a northwest to southeast trending fault has displaced all the seams, dividing the minable area into a northern and southern part (Digby Wells, 1996). This fault has an average throw of 15 m to the northeast. The B and BL-seams are formed at a maximum depth of 27 mbgl with shale/siltstone forming the immediate roof lithology. All the seams are gently undulating with a gentle north-easterly dip. The CU-seam is separated from the B-seam by 3 to 7.5m of inter-bedded shale and siltstone. Shale and siltstone form the floor lithology of the seam. The CL-seam occurs 1 to 7 m below the CU-seam in the area where the CU-seam has not, but would have been deposited. Sandstone forms the seam floor lithology and shale and siltstone the immediate roof. The D and E-seams occur in this area, but are considered insignificant from a mining perspective. The coal floor contours indicate a general dip of the seams from north to south at the Mooifontein area and from south to north at the Tevreden area. The B and C-Seams' floor contours are depicted in Figure 1–3 and Figure 1–4 respectively; these contours are interpolated from the exploration data and do not show the subsequent erosion or weathering of the coal seams within the lower lying areas.

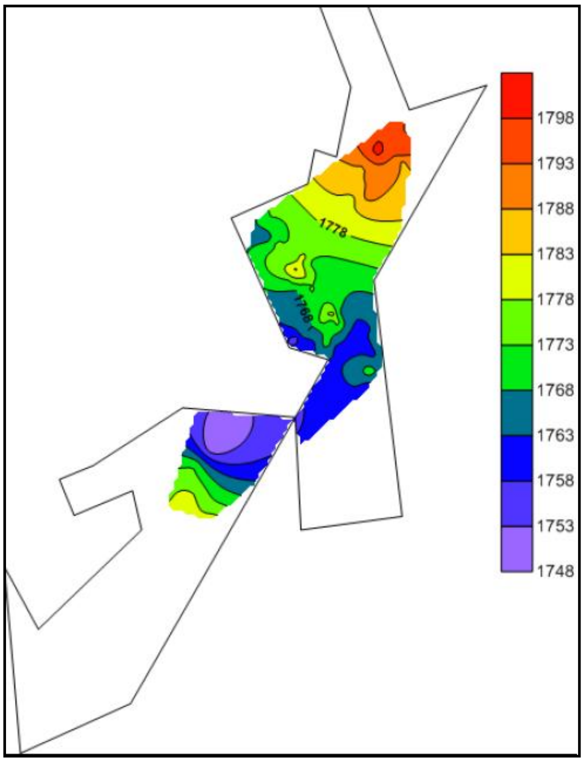

Figure 1–3: B-seam floor contours

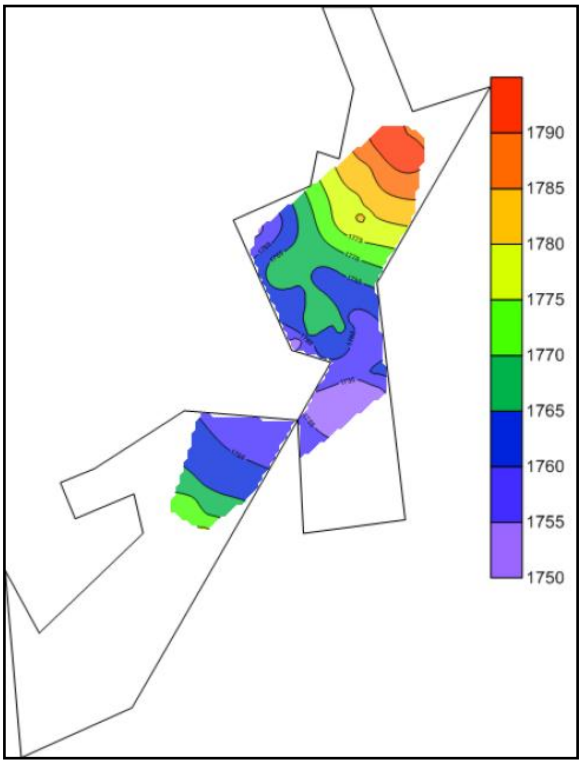

Figure 1–4: C-seam floor contours

The low lying areas across the study area are typically associated with the deposition of quaternary sediments. These quaternary sediments typically include alluvial sands and sediments along river and stream beds and ferricrete within the study area.

The ferricrete layer varies in thickness and forms isolated lenses (near surface) throughout the project area. This ferricrete layer provides a local barrier to the downward flow of groundwater and is at its greatest along the higher ground and becomes thinner towards the pans.

1.1.4 Topography

A detailed Topography and Visual Assessment Report has been attached as Appendix C and the relevant topographical information has been extracted from this report and is discussed below.

The study area is typical of the South African Highveld with gradual rolling grasslands dominating the landscape. As mentioned previously, the proposed project area is located within the MLD. Several major river systems arise around the fringes of the pan field, namely the Vaal River, the Komati River (via the Boesmanspruit), the Mpuluzi River and the Usutu River. Thus, the pan field represents a local plateau of elevated ground, amongst the highest in the Highveld region. The above mentioned features combine to form the MLD which is a unique geomorphic entity within the South African landscapes.

The project area's elevation varies from 1852 m.a.m.s.l near the northern project boundary, to 1732 m.a.m.s.l near Tevrede se Pan, and 1786 m.a.m.s.l near the southern boundary. Slopes are generally flat to gentle, however, moderate to steep slopes occur around Tevrede se Pan and areas where rocky ridges are situated. The elevated area forms a ridge which runs the length of the project area in a north-east south-west direction. This ridge forms a major watershed between two WMAs, namely, the Inkomati WMA and the Usutu to Mhlatuze WMA.

A number of rivers take their source from the project area. To the west and north, tributaries of the Boesmanspruit, Swartspruit and Buffelspruit drain the project site and eventually flow into the Komati River system. To the east, tributaries such as The Pearl Stream and Blouwaterspruit drain the project site towards Swaziland finding their way into the Mpuluzi and Great Usutu Rivers. The numerous rivers in the area have carved a number of valleys over millennia which have given rise to an undulating topography.

Refer to Plan 7 depicting the site specific topography, proposed opencast areas and associated opencast area numbers.

Figure 1–5: A photograph taken near the R33 looking south-east over the project area. The ridge on which the proposed project is situated can be seen in the background

The proposed opencasts are located on high lying areas across the project area (approximately 1740 – 1790 m.a.m.s.l). The majority of the opencast areas are positioned on slopes of between 0^0 - 6^0, however, a number of these opencast areas are proposed on slopes of 6^0 - 11^0 which can be considered gentle slopes. These include opencast areas 1, 2, 3, 4 and 5. Slightly steeper slopes of 11^0 - 18^0 occur in the vicinity of opencast area 2. The aspect model created for the project site indicated that opencast areas 1, 2 and 4 are mostly located on south and south-westerly facing slopes, while opencast area 3 and 5 are mostly located on north and north-easterly facing slopes. Opencast areas 6 and 7 are located on a mixture of different facing slopes.

1.1.5 Surface Water

The following objectives were considered in establishing findings:

- Understanding the baseline characteristics (quantitative and qualitative);
- An assessment of literature; and
- Establishing the drivers/processes of the hydrological conditions for the surface water.

A Surface Water Assessment Report is attached as Appendix G.

1.1.5.1 Catchment Description

The project area is located over two Water Management Areas (WMAs) namely the Usuthu to Mahlatuze (WMA 06) and the Inkomati (WMA 05). The affected quaternary catchments are the W55A and X11B for the WMA 06 and WMA 05 respectively. Refer to Plan 8 depicting the quaternary catchments.

There are numerous streams and pans within and around the proposed project area. Within the X11B catchment, there are a number of tributaries of the Boesmanspruit that drains the site in a north westerly direction; while the tributaries of the Impuluzi River within the W55A catchment, drain the site in an easterly direction. The X12B catchment is located to the north of the project area and is associated with the Buffeslspruit River system. The project area does however not fall within this catchment.

The MLD is unique due to the high density of pans, several of which are permanently saturated / perennial. These pans form part of the eastern extent of the pan belt in the Highveld. The pans range in size from less than a hectare to over a thousand hectares (Lake Chrissie). Run-off from the immediate catchments are locally important for each pan as classic sedimentation and nutrient input take place from the surrounding landscape (McCarthy et al., 2007). This makes the water quantity and quality issues important in the area.

Table 1-5 is a summary of the percentage catchment area that is occupied by the proposed project area (WRC, 2005). The proposed project area occupies 2.4% and 2.9% of the W55A and X11B quaternary catchments respectively.

Table 1-5: Summary of the percentage catchment area occupied by the project site

Quaternary Catchment	Total Catchment Area (km^2)	Project Area in Catchment (km^2)	% of Catchment occupied by project area
W55A	689	17.2	2.4
X11B	599	17.2	2.9

1.1.5.2 Climatic Conditions

The Mean Annual Runoff (MAR), Mean Annual Precipitation (MAP) and Mean Annual Evaporation (MAR) are discussed in section 1.1.1.5.

1.1.5.3 Surface Water Quantity

1.1.5.3.1 <u>Stream Flow</u>

There are Department of Water Affairs (DWA) stream flow gauges within the X11B catchment that are located downstream of the proposed project area. Within W55A catchment, there were no stream DWA gauges identified and no stream flow gauges are located within a 5 km radius from the project site. Refer to the Surface Water Assessment Report.

1.1.5.3.2 Estimated Design Rainfall

The rainfall data from the stations closest to the project site was used to calculate the 24 hour design rainfall depth for the 1: 50 and 1: 100 years (Table 1-6) using Design Rainfall Estimation (DRE) in South Africa (Smithers and Schulze, 2003).

Table 1-6: Calculated 24 hour design rainfall depth for 1: 50 and 1: 100 years

Station Name	Station Number	Rainfall Record Period (years)	24 Hr. Design Rainfall (mm)	
			1:50	1:100
Chrissiesmeer – Pol	0480377 3	91	141	158
Carolina - ARS	0480184_A	90	139	155

1.1.5.3.3 Estimated Peak Flow

Due to the location of the proposed opencast areas flooding is not expected to be a major concern for the project. It must be mentioned that appropriate methods for calculating the flood peak flows would need to consider the volumes of water resulting from the peak rainfall events.

1.1.5.4 Surface Water Uses

The predominant land and surface water use in the region is agricultural (livestock watering and crop irrigation) and urban supply (from local dams). Approximately 32% of the project area surveyed is under irrigation. Mining activities are also located within the vicinity of the proposed project area especially within the X11B catchment.

The upper Boesmanspruit has had its flow regime modified by government water scheme which transfers water from the Vaal river basin at Camden into the upper reaches of the Boesmanspruit. The water flows into Nooitgedacht dam from where it is pumped to a number of ESKOM power stations south of Middelburg.

The WARMS database indicates the following water sources for the respective quaternary catchments.

Table 1-7: WARMS Database Activities (Water Source)

Water Source	Quaternary Catchment	
	X11B	W55A
Boreholes	17	8
Dam	10	6
River/Stream	13	25
Spring/eye	2	4
Wetland	0	1

Refer to Plan 9 indicating the various registered water uses within the X11B and W55A cathments. From this plan it can also be seen that certain water uses are not registered within the X11B and W55B catchments. No registered water uses according to the DWA WARMS database are located within the proposed project area.

The nearest registered water uses surrounding the project area in the W55A catchment is for irrigation purposes and is located approximately 3 km east from the eastern boundary of the project area. The nearest registered water use to the project area in the X11B catchment is for livestock agriculture and is located approximately 5 km north-west from the western boundary of the project area.

1.1.5.5 Surface Water Quality

The importance of establishing the baseline condition ensures a comparative index to monitor any changes in the water quality resulting from mining activities.

The regional surface water quality can be described as follows:

- The lower regions of the Komati river system, into which the Boesmanspruit and Buffelspruit flow indicates that coal mining operations, have been taking place in the region for a number of years, some as early as 1934. From the information available, it can be said that the baseline conditions today indicate that regional water quality has already been impacted upon by mining related and other anthropogenic activities.
- The surface water in the W55A catchment is of a high quality with low concentrations in cations and anions. These exact locations can be sourced in the Lustof report, but the general results indicate dominance of sodium and/or calcium/magnesium.

Surface water sampling was undertaken by Digby Wells on 02 April 2013, where the streams and pans, were identified for establishing a comprehensive indication of the water quality. However, due to limited site access and streams being dry, only five samples were taken. Plan 10 indicates the sampling locations.

The water quality analysis of these samples (HMF, and HSW01 – HSW04) is presented in Table 1-8, where the parameters were compared against the SANS water quality, Class I (Aesthetic) and Class II (Drinking water) standards. The following interpretation may be established:

- HSW02, HSW03, HSW04 and HMF had Class 1 water quality;
- The water quantity at HSW02 was sampled from the stream with low flow, which indicates the potential source may be a spring. This however could not be confirmed as access to the property was denied; and
- HSW01 sampled at the perimeter of Tevrede se Pan indicated Class II TDS and EC (representing increased salts), while Cl and Na exceeded Class II. This data is representative of pan water quality particularly since the samples were collected in the dry season where salt concentrations will increase due to evaporative losses. On-going monthly monitoring should be implemented to determine the seasonal trend of the data.

Surface water quality was further established from previous studies undertaken within the project area. Consolidating historic and Digby Wells sampling results provides for a more extensive water quality baseline index for the area that could be impacted from the mining activities. The analytical results of the historic sampling are included in the Surface Water Assessment Report. The historic surface water sampling was extracted from the Shell South Africa EMP report for Project Caroline (Digby Wells, 1996) and the Lusthoff Colliery Project Scoping Report and plan of study (JMA Consulting, 2013).

Based on the water quality results presented in the table contained in the Surface Water Assessment Report (Historic and Digby Wells samples), it is evident that the general quality within the project area and surrounding areas is of a good standard (with exception of the higher TDS concentrations in the pan), when compared against the SANS water quality Class I (Aesthetic) and Class II (Drinking water) standards. The trend is consistent with the three sampling sets which have been performed over the years 1995 (Digby Wells), 2010 (JMA Consulting Hydrocensus date) and current Digby Wells (2013), respectively. It must be emphasised however, that the number of samples and locations undertaken in this current study should be increased in order to establish a more comprehensive assessment over the project area. Assessment of the topography indicates no activities that are likely to impact on water quality within the project area and surroundings. This will confirm the relatively good water quality standard of the results as indicated in the table.

Table 1-8: Surface Water Quality Results

Sample ID			Total Dissolved Solids	Nitrate NO_3 as N	Chlorides as Cl	Total Alkalinity as $CaCO_3$	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Iron as Fe	Manganese as Mn	Conductivity at 25° C in mS/m	pH-Value at 25° C	Aluminium as Al	Free and Saline Ammonia as N	Fluoride as F
Class I	**(Aesthetic Recommended)**		<1200	<10	<300	N/S	<250	<150	<70	<200	<50	<0.3	<0.1	<170	5-9.5	<0.3	<1.5	<1
Class II	**(Drinking water Max. Allowable)**		2400	11	600	N/S	500	300	100	400	100	2	0.5	370	4-5 or 9.5-10	0.5	2	1.5
	Duration (years)		70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs	70yrs
HSW02		2013/05/08	18	0.17	0.6	4	8.7	2.0	1.8	0.0	2.11	0.00	0.00	6.8	6.90	0.00	0.12	0.11
HSW03		2013/05/08	103	0.12	11.9	58	18.1	20.6	7.9	7.8	1.45	0.00	0.00	22.6	7.39	0.00	0.17	0.28
HSW04		2013/05/08	2	0.35	-1.0	-1	1.1	0.4	0.4	0.0	-1.00	0.00	0.00	3.5	6.92	0.00	0.07	0.09
HSW01		2013/05/08	1423	0.14	725.0	296	0.0	22.3	35.4	451.0	11.00	0.00	0.00	256.0	8.75	0.00	0.06	0.78
HMF		2013/05/08	11	0.24	0.0	10	0.0	0.9	1.5	0.0	2.39	0.00	0.00	5.6	6.93	0.00	0.09	0.00

<dl: below detection limit

1.1.6 Groundwater (Hydrogeology)

The objective of the Interim Hydrogeological Baseline Assessment is to provide a reference point (current conditions) against which potential mining impacts on the groundwater system can be identified and measured. The baseline description will focus on the groundwater flow system and the main processes that influence system behaviour.

The Interim Hydrogeological Assessment Report is attached as Appendix L.

1.1.6.1 Conceptual Hydrogeological Model

1.1.6.1.1 Groundwater Occurrence

The occurrence and movement of groundwater, as well as the groundwater quality, are functions of the geological formations in which the groundwater occurs, including the alteration thereof as a result of human activities, such as mining. The natural groundwater system within the Ermelo Coal Field consists of two superimposed aquifers namely an upper weathered aquifer and a fractured Karoo aquifer (Hodgson & Krantz, 1998). Based on geochemical evolution, Russell (2008) concluded that there are three types of groundwater systems in the MLD, namely perched aquifers, the deeper weathered and fractured aquifers and the pan influence groundwater systems. The aquifers within the proposed Harwar project area are conceptualised in terms of a combination of the Hodgson & Krantz model and the Russell model.

Preferential groundwater flow zones are usually associated with highly weathered or fractured formations, as well as along fault zones or intrusive features. The current drilling programme at Harwar will assist with the classification of the aquifer systems within the project area and an update of this conceptual model will be done upon completion of the intrusive tasks and laboratory analysis.

1.1.6.1.2 Perched Aquifer

Perched aquifers are developed in the MLD, from which springs exude on the ground above pans. The presence of a ferricrete layer within the soil profile provides the necessary aquitard[3] for such an aquifer[4] to develop; essentially inhibiting the movement of water through this impermeable layer. Such perched aquifers are located around 1770 mamsl, inferred from the elevation of the surveyed springs. Geochemical analysis showed that spring samples, obtained from the perched aquifer, evolve directly from rainwater. Once seepage of the perched groundwater occurs on the banks of the pan through springs, mixing of these waters with surface runoff and direct rainfall will occur. The water in the pans, subject to evaporation, evolves and becomes more saline.

[3] A bed of low permeability along an aquifer

[4] An aquifer is an underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, or silt) from which groundwater can be extracted

1.1.6.1.3 Shallow Weathered and deep Fractured Aquifers

The generally accepted two aquifer units in the Ermelo Coal Field (Hodgson & Krantz, 1998) include:

- An upper, weathered aquifer; and
- The deep fractured Karoo (sandstone, siltstone, shale, coal) aquifer.

These aquifers have typical low yields (less than 1 L/s), but considered to be a vital water resources for domestic and stock watering. The groundwater in these aquifers generally has a greater salt load due to the longer residence time compared to springs samples (Russell, 2008).

The first 5 to 15 m in the project area consists mostly of highly weathered coarse-grained sandstone, with shale and siltstone in some areas. The upper aquifer is associated with this weathered horizon. In places, a thick dolerite sill is present close to surface. The sustainability of the shallow weathered aquifer is dependent on seasonal recharge from rainfall. The weathered zone is generally low yielding (less than 0.1 L/s) because of its insignificant thickness.

The shallow weathered aquifer seem to be the predominant aquifer type in the project area and will generally store and transport the bulk of the groundwater in the area. These aquifers are typically unconfined to semi-confined aquifer systems and therefore susceptible to any surface activities or impacts.

The deeper sandstone, siltstone and shale aquifers below the weathered zone do not yield significant quantities of water either. Although there are a number of fractures in the sandstone, a low yield; usually less that 0.5 L/s could be expected. The pores in the sediments are too tight to allow water transmission. All groundwater movement is therefore along secondary structures such as fractures, dykes, faults, cracks and joints in the rock. Dolerite sills and dykes are generally impermeable to water movement, except in the weathered state. The contact of these intrusive features and their host rock generally yield low to medium groundwater yields due to their fractured nature.

There are no high yielding aquifers in the project area based on the general aquifer description of the Ermelo Coal Field and also the information collected during the 2013 hydrocensus. The fractured Karoo and dolerite aquifers typically yield 1 to 2 L/s. These aquifers are dependent on rainfall recharge for a sustained yield.

The literature review indicated that the average borehole yield within the area varies between 0.5 and 2.0 L/s. The 1:500 000 Hydrogeological Map for the area indicate that the probability of drilling a borehole yielding more than 0.1 L/s is 60%, and for drilling a borehole yielding more than 2.0 L/s is 10% to 20%. The groundwater recharge in the project area is estimated to be between 7% and 10% of the Mean Annual Precipitation.

Based on the South African Aquifer Classification (Department of Water Affairs, 1995) the shallow weathered aquifers within the project area will be classified as Minor Aquifer Systems. This is because of their low permeability and low yields and subsequent limited use for large scale abstraction. The aquifer extent may be limited and the water quality variable. They are however important aquifer systems for local supply and in terms of their contribution to base flow.

1.1.6.1.4 <u>Pan Influenced Groundwater</u>

Each pan has its own local catchment. In certain areas along the banks of the pan, the sandstone bedrock is exposed as the weathered rock and soil material are eroded away. Russell (2008) classified groundwater samples with high salinities along the evolution trend as pan influenced groundwater. The boreholes that have pan signatures are located close to pan boundaries suggesting that the pans are most likely releasing water into the groundwater environment and recharging them. This may be in response to gravity driven flow or salinity gradients that exist between the surface and the groundwater. The abstraction of groundwater from boreholes may result in deep water level drawdown and depletion of groundwater resources, causing pan water to seep towards the deeper groundwater level.

A theory was also presented (McCarthy, 2007) that there might be seepage from one pan to another via the unconsolidated sand formations found along the eastern boundaries of some of the pans, but it has not been confirmed to date. The water quality of the pans are in general very good (low TDS), even considering the fact that most of the water entering the pan is lost via evaporation. In closed systems this would lead to an increase in the salt load in the pan over time. This could possibly support the theory that these pans might be losing water through seepage into the aquifers underlying the pans.

1.1.6.2 Field investigations

1.1.6.2.1 <u>Hydrocensus</u>

A hydrocensus covering the project area and adjacent farms was conducted from 22 April 2013 to 3 May 2013. The following information was collected for each site:

- Borehole coordinates were recorded on a handheld Garmin GPS, in the Geographic (Latitude/Longitude) WGS 84 coordinate system;
- The status of the borehole and equipment installed;
- Access at each borehole for the dip meter was determined and the groundwater level was measured if possible; and
- Current borehole use.

A total 28 boreholes, 4 springs, 1 dam and 4 pans were identified within the study area. Most of the springs in the area are used primarily for stock watering. Table 1-9 provides a summary of all identified sites and the information collected for each. The Hydrocensus borehole localities are depicted on Plan 11.

Of the 28 boreholes, 12 were in use, with 3 equipped with wind pumps and 9 with submersible pumps. Fourteen of the remaining boreholes were either not in use or destroyed. Two dry boreholes were found. The depths of these dry boreholes are unknown. Water levels were measured from ten boreholes. Groundwater levels could not be measured from the remaining 19 boreholes due to the installed equipment blocking access or due to the borehole being closed or collapsed.

Six water samples were sent for inorganic and metal analysis to Aquatico Laboratories, a South African National Accreditation System (SANAS) accredited laboratory based in Pretoria. The water samples were collected using single valve, decontaminated bailers and from pumps or taps in the case of boreholes which were equipped and in use. The groundwater quality will be discussed in section 1.1.6.5.

Table 1-9: Summary of hydrocensus results

Site ID	Old Site ID	Latitude	Longitude	Elevation (mamsl)	Type	Farm	Sampled	WL	WL (mbgl)	Status	Primary use	Equipment
BB01		-26.1346	30.2502	1746	BH	Appeldoorn 38 IT Ptn 8	Yes	No	N/A	In use	Domestic and gardening	Submersible
BBF01		-26.1393	30.2485	1756	SP	Appeldoorn 38 IT Ptn 8	Yes	Yes	0	Not in use	Stock watering	Not equipped
DGV01		-26.1594	30.1974		BH	De Goedeverwachting 57 IT Ptn 9	Yes	No	N/A	In use	Domestic and gardening	Submersible
DGV02	MBH3	-26.1580	30.2016		BH	De Goedeverwachting 57 IT Ptn 5	Yes	No	N/A	In use	Domestic and gardening	Submersible
DGV03		-26.1606	30.2028	1800	BH	De Goedeverwachting 57 IT Ptn 5	Yes	Yes	28.08	In use	Stock watering	Submersible
DGV04		-26.1389	30.1762	1726	BH	De Goedeverwachting 57 IT Ptn 8	Yes	Yes	35	In use	Domestic and gardening	Submersible
DGV05		-26.1385	30.1756	1727	BH	De Goedeverwachting 57 IT Ptn 8	No	Yes	18	Not in use	Domestic and gardening	Wind pump
DGV06		-26.1379	30.1753	1729	BH	De Goedeverwachting 57 IT Ptn 8	No	No	N/A	Not in use	Irrigation	Wind pump
DGV07		-26.1373	30.1753	1729	BH	De Goedeverwachting 57 IT Ptn 8	No	No	N/A	Not in use	Irrigation	Wind pump
DGV08		-26.1348	30.1791		BH	De Goedeverwachting 57 IT Ptn 8	Dry	Dry	N/A	Dry	Stock watering	Not equipped
DGV09		-26.1333	30.1794	1742	BH	De Goedeverwachting 57 IT Ptn 8	No	No	N/A	Not in use	Stock watering	Wind pump
DGV10		-26.1315	30.1786	1731	BH	De Goedeverwachting 57 IT Ptn 7	Yes	Yes	3.5	Not in use	Stock watering	Not equipped
DGV11		-26.1312	30.1841	1740	BH	De Goedeverwachting 57 IT Ptn 7	No	No	N/A	Not in use	Stock watering	Not equipped

Site ID	Old Site ID	Latitude	Longitude	Elevation (mamsl)	Type	Farm	Sampled	WL	WL (mbgl)	Status	Primary use	Equipment
DGV12		-26.1309	30.1841	1738	BH	De Goedeverwachting 57 IT Ptn 7	No	No	N/A	Not in use	Stock watering	Not equipped
DGV13		-26.1200	30.1831	1742	BH	De Goedeverwachting 57 IT Ptn 3	Yes	No	N/A	In use	Stock watering	Wind pump
HAR01		-26.1743	30.2064		BH	Hawar 58 IT Ptn R	Dry	Dry	N/A	Dry	Irrigation	Not equipped
MF01		-26.1485	30.2744	1756	BH	Mooifontein 35 IT Ptn 4	Yes	Yes	N/A	In use	Irrigation	Submersible
MF02		-26.1462	30.2758	1742	BH	Mooifontein 35 IT Ptn 4	Yes	Yes	7.2	Not in use	Irrigation	Not equipped
MF03		-26.1479	30.2743	1748	BH	Mooifontein 35 IT Ptn 4	Yes	Yes	16	Not in use	Irrigation	Not equipped
MF04		-26.1499	30.2733	1757	Dam	Mooifontein 35 IT Ptn 4	Yes	No	0	In use	Domestic and gardening	Submersible
MF05		-26.1443	30.2773	1736	BH	Mooifontein 35 IT Ptn 4	Yes	Yes	3.5	Not in use	Irrigation	Not equipped
MF06	MWM1	-26.1648	30.2220	1803	BH	Mooifontein 35 IT Ptn 5	Yes	Yes	6.21	Not in use	Stock watering	Wind pump
MFF01		-26.1626	30.2163	1808	SP	Mooifontein 35 IT Ptn 5	Yes	Yes	0	In use	Stock watering	Not equipped
TVR01		-26.2147	30.1800		BH	Tevreden 56 IT Ptn 9	No	No	N/A	Not in use	Stock watering	Not equipped
TVR02	TS3	-26.2158	30.1782	1785	BH	Tevreden 56 IT Ptn 9	Yes	No	N/A	In use	Domestic and gardening	Submersible
TVR03		-26.2018	30.1760		BH	Tevreden 56 IT Ptn 1	No	No	N/A	Not in use	Stock watering	Not equipped
TVR04		-26.2259	30.1927	1783	BH	Leliefontein 79 IT Ptn R	Yes	Yes	24	In use	Irrigation	Submersible
TVR05		-26.2615	30.1999		BH	Leliefontein 79 IT Ptn 4	Yes	No	N/A	Not in use	Stock watering	Not equipped
TVR06	TS4	-26.2163	30.1890		BH	Tevreden 56 IT Ptn 4	Yes	No	N/A	In use	Domestic and gardening	Submersible
TVR07		-26.2394	30.1877		BH	Leliefontein 79 IT Ptn 2	Yes	No	N/A	In use	Stock watering	Wind pump
TVR08		-26.2609	30.1825	1742	BH	Simonsdal 88 IT Ptn R	No	No	N/A	Not in use	Domestic and gardening	Not equipped
TVR09		-26.2536	30.1468	1776	BH	Goedeverwachting 81 IT Ptn 16	Yes	Yes	1.76	In use	Stock watering	Wind pump
TVRF01	TS2	-26.2074	30.1770	1777	SP	Tevreden 56 IT Ptn 9	Yes	Yes	0	In use	Stock watering	Not equipped

Site ID	Old Site ID	Latitude	Longitude	Elevation (mamsl)	Type	Farm	Sampled	WL	WL (mbgl)	Status	Primary use	Equipment
TVRF02		-26.1994	30.1893	1735	SP	Tevreden 56 IT Ptn 9	No	Yes	0	In use	Stock watering	Not equipped
TVRP01	HSW01	-26.2009	30.1974	1740	Pan	Tevreden 56 IT Ptn 9	Yes	No	0	In use	Stock watering	Not equipped

WL: Groundwater Level

BH: Borehole

SP: Spring

N/A: Not Accessible

Coordinate System: Geographic (Latitude/Longitude) WGS84

1.1.6.2.2 Geophysical Survey

A surface geophysical survey was conducted during May 2013 on the farms Mooifontein and Tevreden.

Geophysical data were recorded on two lines, namely Line 1 and Line 2 on the farm Mooifontein 35 IT and on five lines on the farm Tevreden. A handheld GPS was used to record the location of each data station. The station spacing for the survey was set at ten meters to ensure that possible sub-horizontal features could be detected. An inter-coil spacing of 20 m was used for the EM survey in the project area. This separation allows investigation to depths of 20 to 30 m below surface, depending on the conductivities of the earth materials. These depths of investigation were deemed adequate for the detection of near surface faults that could act as preferential pathways for groundwater. Cultural effects that would generate false anomalies were recorded during the survey. These included position of overhead power lines, fences and presence of cars, relative to the survey direction. The geophysical results are presented in the following sections.

1.1.6.2.3 Farm Mooifontein

1.1.6.2.4 Line 1

Line 1 was surveyed at Mooifontein 35 IT, Portion 5. A SE-NW dolerite sill outcrop occurs 200 m from station zero. The magnetic results (Figure 1–6) show an increasing magnetic response trend depicting movement over a dolerite sill. A zone of higher apparent conductivities occurs between station zero and 30 m, but systematically reduces towards the end of the traverse. Station zero and 30 m is also associated with the lowest magnetic intensities. These results suggest the depth of the dolerite sill varies and becomes shallower as you move in a northerly direction. A proposed drilling position has been sited at station 20 m to investigate the groundwater bearing properties within this area and associated with the sill.

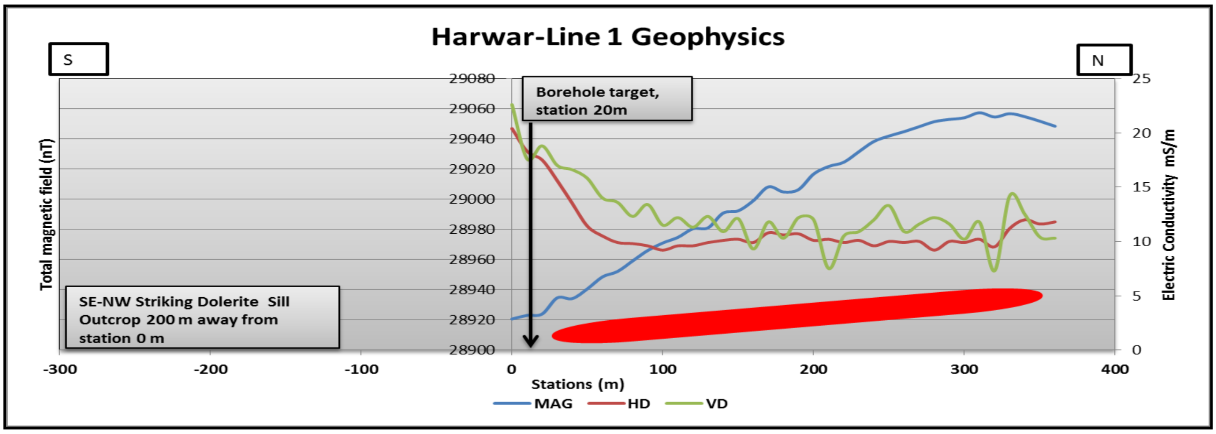

Figure 1–6: Mooifontein Line 1

1.1.6.2.5 Line 2

Line 2 was surveyed at Mooifontein 35 IT Portion 2. The magnetic results (Figure 1–7) indicate various anomalies between station zero and 160 m. This is indicative of a shallow dolerite sill potentially stopping around station 160 m. The VD anomaly at station 160 m couples with the end of the erratic magnetic anomaly, which suggests the edge of the sill. A proposed drilling position has been sited at station 160 m to investigate the groundwater bearing properties at the edge of the sill.

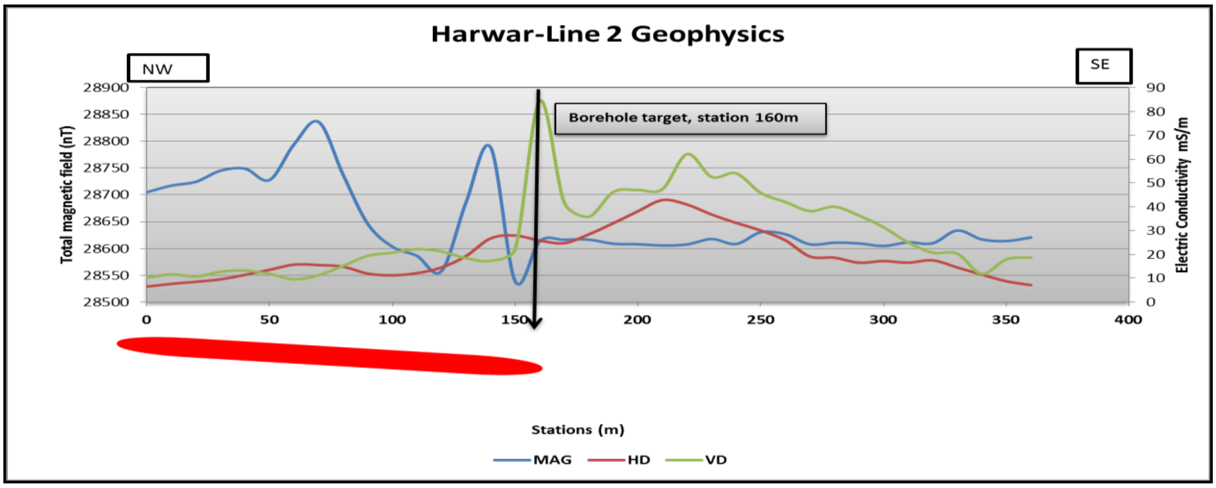

Figure 1–7: Mooifontein Line 2

1.1.6.2.6 Farm Tevreden

1.1.6.2.7 Lines 1 to 5

Five magnetic survey lines were surveyed on the farm Tevreden to investigate a potential linear geological structure or alternatively the edge of a sill traversing the area. Five lines were surveyed in close proximity to each other to assess the possible strike and extent of the feature.

Clear magnetic anomalies were identified on each of the lines (Figure 1–8) and a preliminary conclusion was made that it represents the edge of the dolerite sill present in the area. A drilling position was proposed for Line 3, station 120 m to confirm the feature and assess its water bearing potential and flow characteristics.

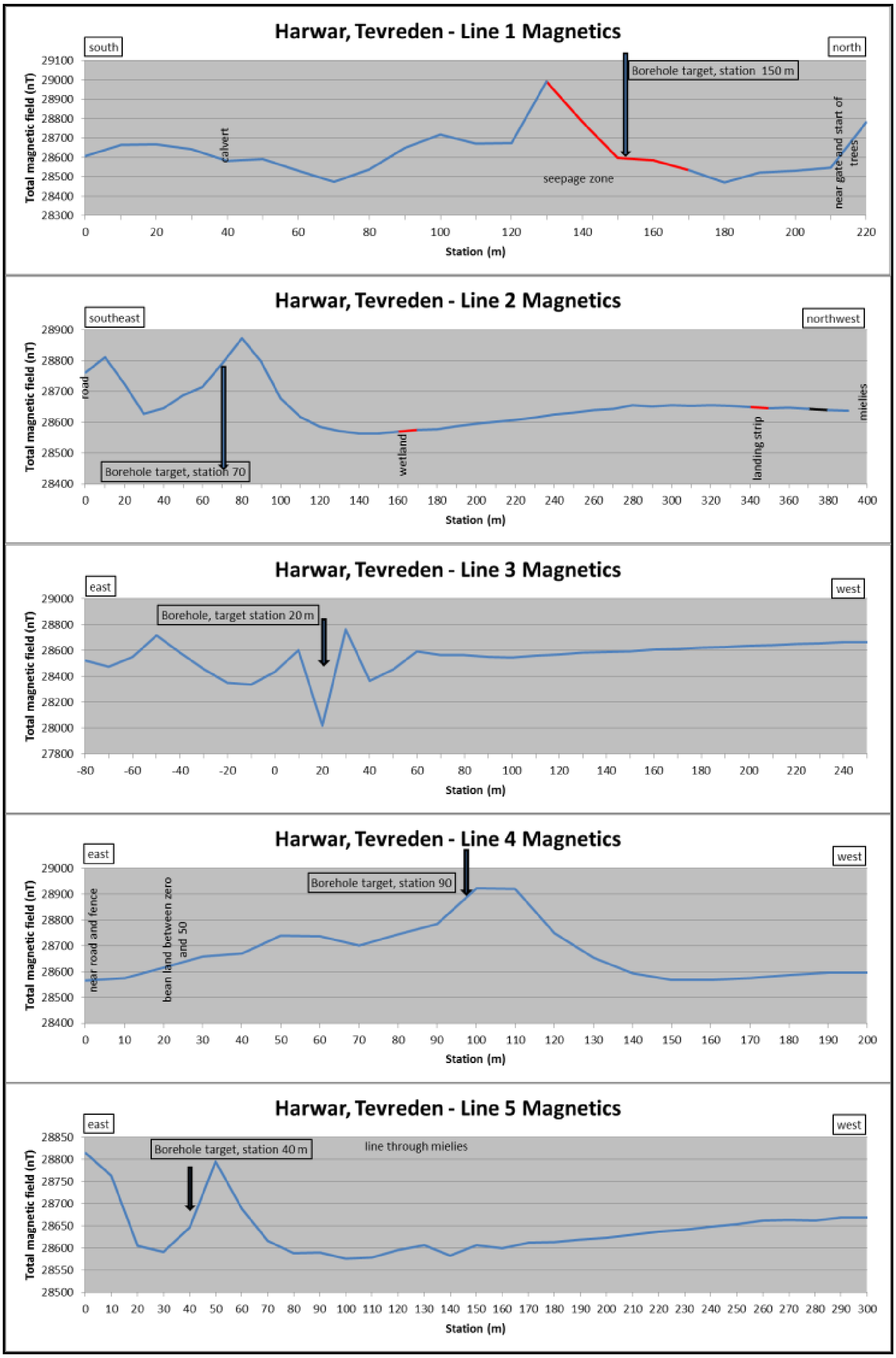

Figure 1–8: Tevreden Line 1 to 5

1.1.6.2.8 Drilling Programme

Percussion and core drilling programmes have been proposed for the Harwar project area. Six percussion boreholes and six core holes have been proposed and have been positioned across the project area (refer to Plan 11). All percussion boreholes will be drilled to a depth of 60 m and the core holes to a depth of 40 m. The core drilling programme is to enable the collection of representative geological samples from the project area for geochemical assessment. It is important (for metal leaching and contamination assessments) to assess the acid generating or neutralisation potential, as well as metal leaching potential for the over-burden, coal seams and under-burden.

The drilling programme started on 3 June 2013, but was not completed at the time of writing this report. This report will be updated upon completion of the drilling, aquifer testing, and geochemical assessment tasks.

1.1.6.2.9 Aquifer Testing

The aquifer testing task has not been initiated at the time of writing this report due to the fact that the drilling programme has not been completed. It is imperative that the most strategic and successful boreholes drilled during this investigation be aquifer tested to determine aquifer responses and to calculate the parameters presenting the aquifer hydro-dynamics underlying the investigation area. All boreholes will be subjected to constant discharge and recovery tests.

1.1.6.2.10 Geochemical Assessment

The core drilling programme will enable the specialist to fill the data gaps in terms of the potential for the host formation and the coal seams to generate contaminants – high salt load; high metal concentrations or potential acid mine drainage in the project area.

Geochemical analysis of the overburden, coal seams and under-burden will be conducted to assess the mineralogical composition, contamination potential and trace metal concentration of the leachate under distilled, as well as acid rain conditions. Static and kinetic testing is proposed.

1.1.6.3 Groundwater Levels

The current groundwater levels in the proposed project area range from 0 to 35 meters below ground level (mbgl); based on measurements obtained from ten hydrocensus boreholes and four springs (Figure 1–9). The deeper groundwater levels (15 to 35 mbgl) at boreholes DGV03, DGV04, DGV05, MF03 and TVR04 can possibly be related to groundwater abstraction for domestic and agricultural use or different aquifer characteristics and recharge resulting in different water levels.

An elevated ridge (boundary between the two WMAs) runs the entire length of the project area in a northeast-southwest direction. Surface elevation varies from 1852 mamsl near the northern project boundary, to 1715 mamsl near Tevrede se Pan, and 1786 mamsl near the southern boundary.

The groundwater table in the project area generally follows the local topography, mirroring the local surface drainage pattern. Given the weathered nature of the soil environment, a shallow perched groundwater level exist in certain high-lying areas, as described in section 1.1.6.1.2, which discharge as springs on hill slopes areas for a period of time (sometimes months) after the summer rainfall.

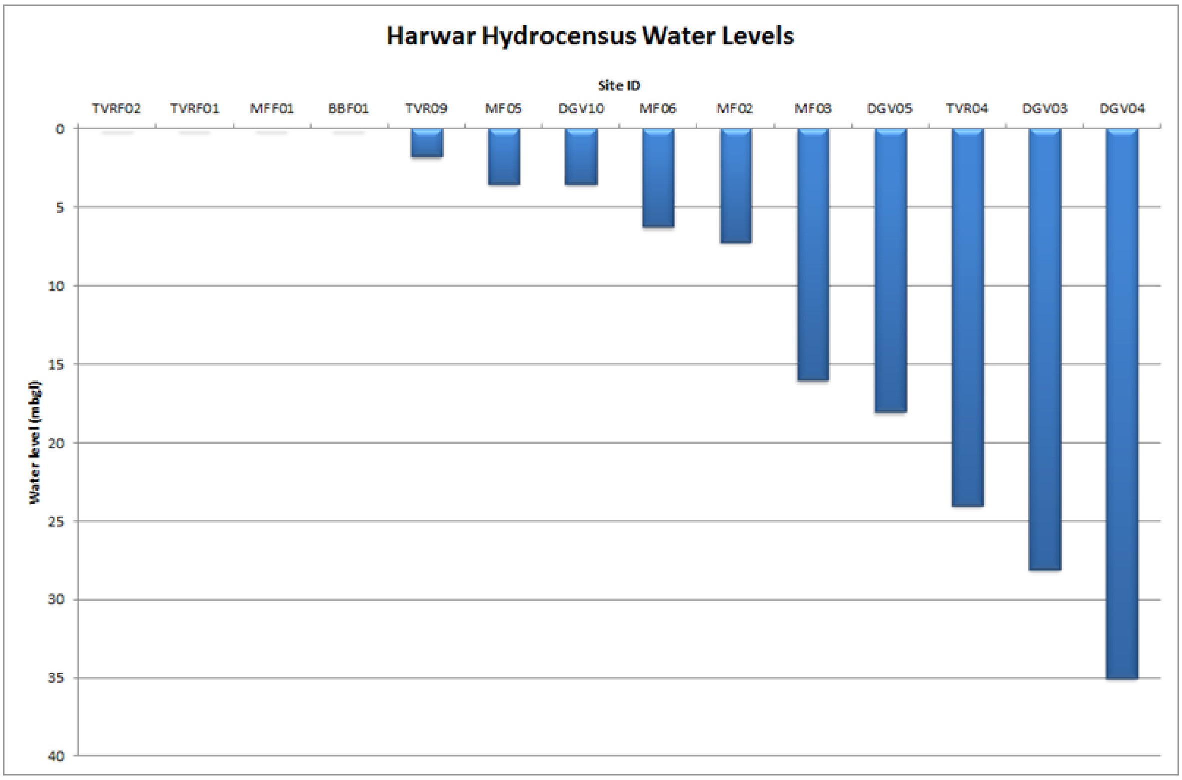

Figure 1–9: Groundwater levels

On a regional scale it is assumed that the groundwater flow will be in a north-westerly, as well as south-easterly direction, from the watershed dividing the project area. Localised, smaller variations can be expected within the project area and especially within the Tevrede se Pan area where groundwater might flow from all directions towards the pan. The current drilling programme does include a profile on the farm Tevreden, Portion 9 to investigate the groundwater gradient from the higher lying areas towards the pan. Seasonal monitoring of these boreholes will assist with an assessment of the groundwater level fluctuation and gradient in close proximity to the pan and also attempt to assess whether the pan is currently a losing or gaining pan; i.e. whether it is fed by groundwater or whether it loses water to a deeper lying groundwater table.

1.1.6.4 Pan / Groundwater Interactions

The water in the pans are influenced to a greater extend by the shallow, perched and weathered zone groundwater flow and spring discharge than the deeper fractured groundwater systems. The deeper groundwater flow is probably only a minor contributor the pan recharge, but will be assessed during this hydrogeological investigation. The perched aquifers with the addition of surface runoff and direct precipitation form the dilute inflow from which the pans potentially evolve. The mixture of predominantly perched water and rainwater makes up the dilute inflow that evolves into the saline, high alkalinity waters found in the pans of the MLD. As the dilute waters move through the weathered zone within the soil towards the pan, the solution becomes saturated with respect to calcite. Calcium and carbonate are continuously concentrated in solution through the dissolution of feldspars such as plagioclase and carbonate cement, as well as through subsequent evaporation of dilute waters. The influence of deeper groundwater is most likely very minimal. The deeper fractured aquifer may therefore have very little inflow into the pans, but may be recharged by pan water. The drilling of three profile boreholes in the Tevrede se Pan catchment will shed more light in understanding the full effect of this hypothesis, as well as conceptualising the actual movement of the water to and from the pan.

1.1.6.5 Groundwater Quality

Water samples were collected and the results reported below are not based on regularly monitoring of the same monitoring stations, but instead a once off analysis done by Digby Wells and previous investigators, such as Russell (2008). The water quality results from the 2013 hydrocensus are presented in Appendix A of the Interim Hydrogeological Assessment report. Russell (2008) sampled Tevrede se Pan at the end of the wet season and during the dry season. These results have been compared with the recent Tevrede se Pan sample and analysis.

A summary of the results (Digby Wells and previous investigators) are presented in the Interim Hydrogeological Assessment report and referenced against South African National Standards (SANS) 241:2005 guidelines for domestic use. The following conclusions are drawn:

- The spring pH-values range between 6.1 and 7. The low salinity of the spring water is due to the leached nature of the weathered zone situated above the aquitard (ferricrete), as well as rainfall recharge characteristics of this area, and no apparent contamination of the shallow groundwater zone;
- The pH in the groundwater varies between 6.7 (DGV01) to 7.6 (TVR06). For most of the major ions evaluated, this deeper water indicates concentrations greater than those of the spring samples. This is indicative of longer residence times of groundwater in the Vryheid formation;
- The results show a high fluoride content (2.27 mg/L) in borehole DVG01. The fluoride occurs naturally in the groundwater systems and formations of the project area. At concentrations between 3 and 6 mg/L individuals can experience skeletal fluorosis, particular with high water consumption. The groundwater in DVG01 is not fit for human consumption based on the SANS classification standards for human consumption;

- Tevrede se Pan shows an increase in pH during the wet season. The pan shows an increase in TDS, as well as a loss of Ca over Na through the precipitation of calcium carbonate;
- Tevrede se Pan is deficient in sulphate, which may be related to the presence of the reed beds, where microbial activity and sulphate reduction may occur; and
- All metal concentrations, including aluminium, manganese, cobalt, copper, iron, lead and nickel in the pan, groundwater and springs are currently below detection limit.

Piper diagrams, where the relative concentrations of water species are displayed, are useful in understanding the hydro-chemical character of aquifers. The piper diagram is depicted in the Interim Hydrogeological Assessment report. There are two distinct water types, which correspond to groundwater, spring water and pan water:

- The pan water plots in the evaporation dominated region. The groundwater samples plot in the formation dominated region and the spring samples plot in the precipitation (rainfall) dominated region;
- The pan water chemistry is affected by evaporation, as this is the main loss of water in these systems;
- The spring samples are assumed to represent the perched aquifer, which is located above the groundwater level. The fact that they show precipitation (rainfall) dominance may confirm this as they have less formation influence and a larger precipitation influence compared to the groundwater samples;
- The grouping may indicate the difference between a deep aquifer and a perched aquifer. The residence time for water in the perched aquifer would be significantly less than deeper groundwater, hence the different water chemistry; and
- The borehole samples show two distinct rock interactions. The groundwater in DGV01 and TVR02 may represent water flowing through dolerite due to magnesium enrichment. The groundwater in MF06 and TVR06 is more influenced by recent recharge from rainfall hence the calcium enrichment.

McCarthy (2007) reported that the shallow weathered formations and soils in the MLD is highly leached and subsequently contains very little minerals and salts; typically low TDS values. For this reason the groundwater quality presents a very low TDS.

A study conducted by De Klerk (2012) indicated that Tevrede se Pan has relatively high conductivity values when compared to the other pans in the area. Most of the pans in the area showed a typical Mg and Na/K cation dominance, as well as a SO_4 / Cl anion dominance; indicating saline conditions. The preliminary conceptual interpretation of the groundwater and pan system in the proposed mining area is depicted in Figure 1–10.

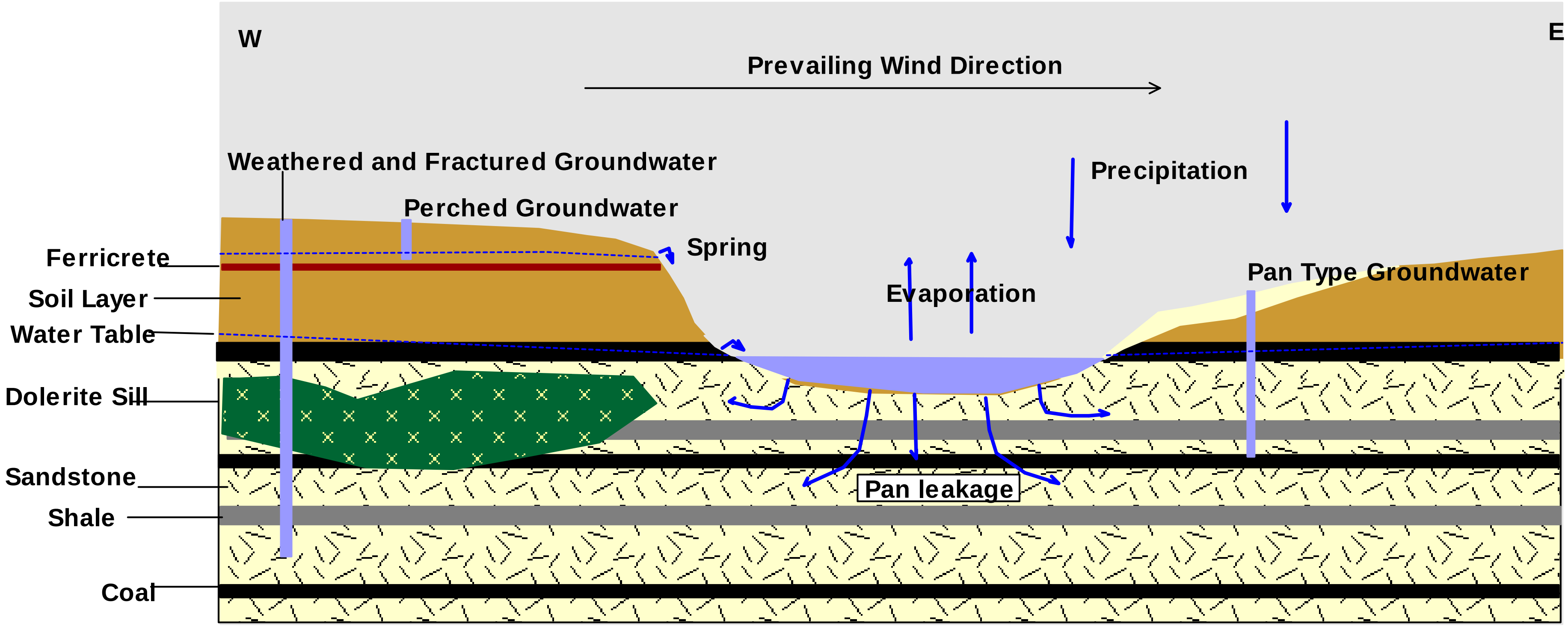

Figure 1–10: Preliminary baseline hydrogeological conceptual model for Harwar study area

1.1.7 Wetland Areas

The aim of the Wetland Baseline Assessment is to describe the wetlands within the proposed project area.

The Wetland Assessment Report is attached as Appendix K.

According to Mitsch and Gosselink, (1993) wetlands are highly susceptible to the degradation of quality and a reduction in quantity as a result of anthropogenic resource use activities, land-surface-development and landscape-management practices that alter their hydrological regime impacting these systems.

The MLD is marked by an unusually dense cluster of pans located around the Lake Chrissie which is the largest of the pans. The MLD support large numbers of Lesser Flamingo (*Phoeniconaias*) minor and Greater Flamingo (*Phoenicopterus ruber*). The system is probably also an important refuge for the small floating population of Wattled Crane (*Bugeranus carunculatus*) remaining in Mpumalanga. Other species present in large numbers include Crowned Crane (*Balearica regulorum*), Chestnutbanded Plover (*Charadrius pallidus*) and African Marsh Harrier (*Circus ranivorus*). When inundated with water, these wetlands also support large numbers of Great Crested Grebe (*Podiceps cristatus*), Yellowbilled Duck (*Anas undulata*), Cape Shoveller (*A. smithii*), Southern Pochard (*Netta erythrophthalma*), Egyptian Goose (*Alopochen aegyptiacus*), Spurwinged Goose (*Plectropterus gambensis*), Redknobbed Coot (*Fulica cristata*), Little Stint (*Calidris minuta*), Whitewinged Tern (*Chlidonias leucopterus*) and Avocet (*Recurvirostra avosetta*). When completely inundated the total number of birds regularly exceed 20 000 (Barnes, K., 1998).

The MLD is an important area for all three South African crane species. Grey Crowned Cranes (*Balearica regulorum*) are especially abundant and use the wetlands and pans to breed and forage. The Endangered Wildlife Trust (EWT) is currently involved in two biodiversity conservation projects for the area, which are directed by the MTPA. This is the application for the Chrissiesmeer Lake District to be declared a Wetland of International Importance through the RAMSAR Convention and secondly to use biodiversity stewardship to legally protect the land in the area.

In contrast to the pans in the west of the country, those of the MLD are in the main perennial; although some non-perennial pans do exist in the area. Moreover, the water in the pans is generally fresh. One of the most important factors contributing to the perennial nature of the pans is the favourable water balance (i.e. the difference between rainfall and evaporation) of the region. In the MLD, rainfall is 800 mm per annum, and evaporation is 1600 mm per annum. In contrast, in the Kenhard district, rainfall is less than 100 mm per annum, and evaporation is 2700 mm per annum.

The MLD consists of approximately 320 pans, of which less than 3% are classified as reed pans (de Klerk et al, 2012). The Tevrede se Pan Peatland complex is made up of Tevrede se Pan (300 ha) and a smaller perennial pan (50 ha) located south east of the main pan. Tevrede se Pan is by far the biggest pan, which is covered by a dense growth of Phragmites reeds (emergent) with a narrow outer ring of open water. According to Grundling et al, (2007), Tevrede se Pan Peatland complex consist of diverse flora characterised by *P. australis* which forms a dense extensive reedbed covering across the larger part of the pan basin. A stranded floating reedbed with a submerged peat body below the surface was identified by Grundling et al, (2007). The floating mat comprised of peat consisting of an upper fibrous layer (H1 on the Von Post humification scale: 0-60 cm depth), a less fibrous middle layer (H4 : 60–80 cm depth), and a bottom fine peat layer (H9 : 80 –100 cm depth).

1.1.7.1 National Freshwater Ecosystems Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) strategic spatial priorities for conserving the country's freshwater ecosystems and supporting sustainable use of water resources were considered to evaluate the importance of the wetland areas located within the proposed project area (Nel et al., 2011).

As shown in Plan 12 the wetland areas that occur within the project area are classified as depressions (pans), seeps and flats. The identified wetland areas play important functions such as enhancement of water quality, attenuation of floods and biodiversity support.

The NFEPA wetlands have been ranked in terms of importance in the conservation of biodiversity. According to Plan 13, only two wetland types were identified within the project area, namely pans (Depressions) and hillslope seepage wetland. The pans are ranked (Rank 2) and the hillslope seepage wetlands are ranked (Rank 4).

The wetland areas that occur within the project areas are ranked as follows:

- Depressions (pans) – Ranked 2;
- Flats – Ranked 2; and
- Seeps – Ranked 4.

This indicates the high importance and high integrity of the wetland areas located within the project area in the maintenance of biodiversity. Rank 2 indicates wetland areas that support threatened fauna such as birds and frogs. Rank 4 indicates wetlands areas with a Present Ecological State (PES) category A (natural) or B (largely natural).

1.1.7.2 Wetland Unit Identification

The wetlands in the study area are linked to both perched groundwater and surface water. A total of four different Hydro-geomorphic (HGM) types of natural wetland systems were identified within the project area (Table 1-10). The delineated wetland areas within the project area as well as their respective 100 m and 500 m buffer zones are depicted in Plan 13.

Table 1-10: Total Wetland Area within the project area

Wetland HGM Units	Total area (ha)	% of Project Area
Pans	63.61	3.734
Hillslope Seepage	333.68	19.77
Valley Bottom without a channel	12.67	0.75
Valley Bottom with a channel	6.19	0.36
Total	416.15	24.66

1.1.7.3 Ecological Health

The wetland areas within the project area have been impacted by agricultural activities, alien plant species and local and provincial road networks. The abovementioned activities are regarded as the principal courses of wetland degradation within the project area.

The health assessment of the identified Hydro-geomorphic units made use of the indicators hydrology, geomorphology and vegetation. The findings of the WET-Health assessment for the three indicators are presented in the Wetland Assessment Report.

1.1.7.4 Ecological Functionality

The general features of each wetland unit were assessed in terms of functioning and the overall importance of the Hydro-geomorphic unit was then determined at a landscape level. Figure 1–11 presents the percentage of the five respective ecological services classes for the respective wetland systems.

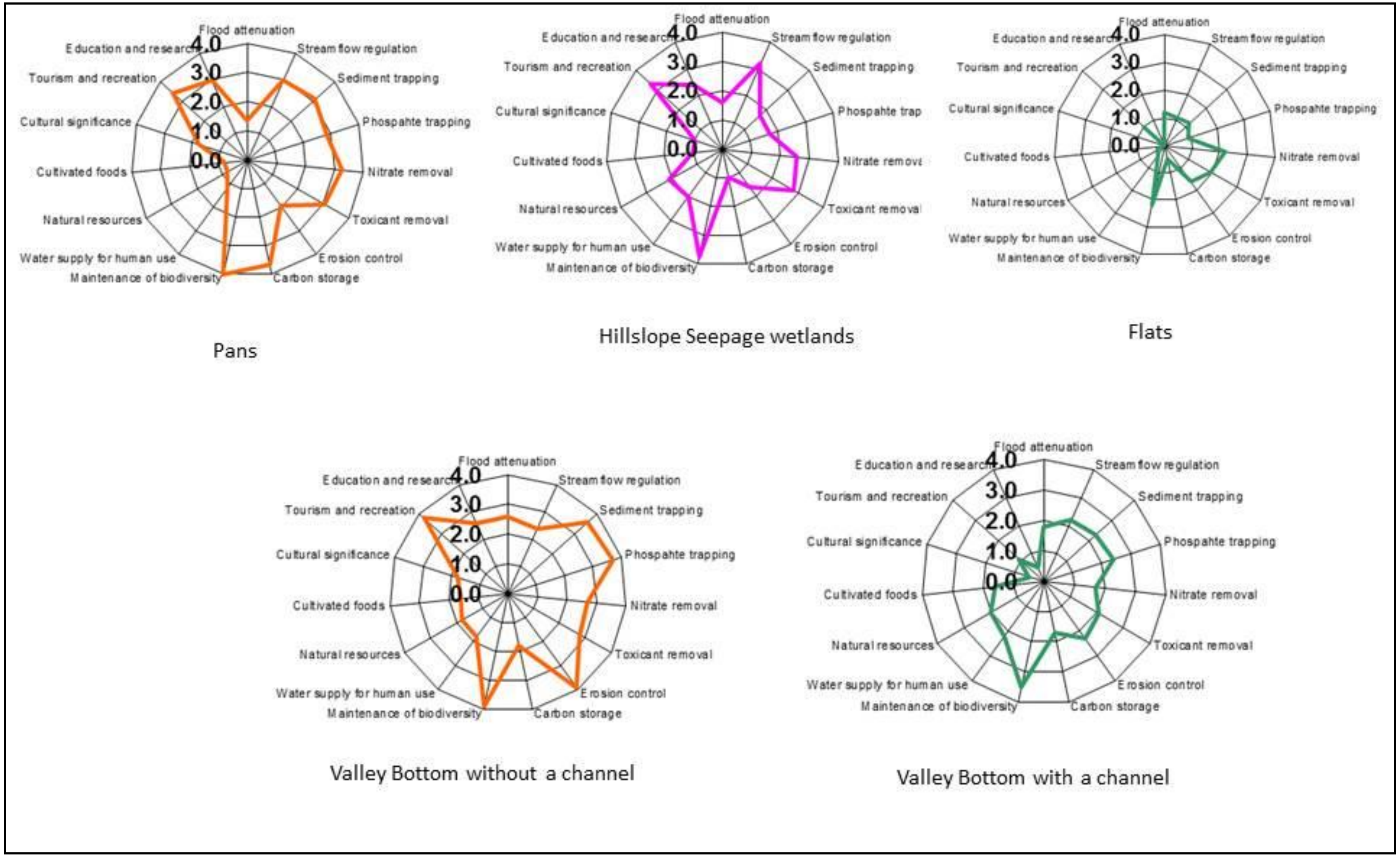

Figure 1–11: Preliminery baseline hydrogeological conceptual model for Harwar study area

Table 1-11: Lists the percentage of each importance class for the provided services

Ecological Services Importance	Pans	Hillslope Seepage wetlands	Valley Bottom without a channel	Valley Bottom with a channel
Low	0%	0%	0%	13%
Moderately low	27%	20%	0%	7%
Intermediate	20%	47%	40%	73%
Moderately high	40%	26%	27%	0%
High	13%	7%	33%	7%

The importance of services provided by the wetland areas within the project area range from; low importance to high importance. The valley bottom without a channel, wetland areas were found to perform the services of highest importance. These services are associated with water quality enhancement (33%). The valley bottom with a channel wetland was found to perform the highest percentage of services of low importance. The reduction in the importance of services performed by the valley bottom with a channel wetland is due to the reduction in the integrity of such systems.

The hillslope seepage wetland and the valley bottom without a channel, wetland areas are regarded as extremely important due to the water quality enhancement capacities. Furthermore the Tevrede se Pan is regarded as important as a unique wetland system as well as the capacity to maintain biodiversity.

Pans within the project area are located in close proximity to agricultural lands. The land use activities have resulted in the reduction in the capacity to perform important wetland functions. The services of highest importance (13%) that are performed by the pans within the project area are associated with the storage of carbon especially due to extensive peat associated with Tevrede se Pan and biodiversity support. Tevrede se Pan is a unique pan system that supports important waterfowl due to the permanent source of water. Services of moderately high importance that were found to be performed by the pan systems include trapping of sediment and nutrients due to the enclosed nature and the size of the pans.

1.1.8 Aquatic Ecology

The aim of the Aquatic Baseline Assessment is to establish the current ecological integrity of the aquatic ecosystems.

The Aquatic Ecology Assessment Report is attached as Appendix F.

As indicated earlier, the directly affected aquatic ecosystems are located in two separate quaternary catchments namely X11B and W55A. Refer to Plan 8 indicating the quaternary catchments. The layout of the effected river systems includes the Boesmanspruit in quaternary catchment X11B and the Mpuluzi River in quaternary catchment W55A. As part of the Aquatic Ecology Assessment the quaternary catchment X12A which include the Buffelspruit River was also included as it borders the project area to the north.

The aquatic ecology study focus on the river systems only and a specialist study for the pans will be conducted. This is as a result of differnet study techniques being applied to flowing and stagnant systems.

A total of seven sampling points (HAR1 – HAR7) were selected for the aquatic ecology study. These sampling points are located on tributaries and main stems of the Mpuluzi River, Boesmanspruit and Buffelspruit. An illustration of the locations of the sampling sites in relation to the Harwar MRA area is depicted in Plan 14.

The two directly affected river systems are divided up into the Mpuluzi River system and the Boesmanspruit system. The Buffelspruit system situated to the north of the proposed project area is also discussed below.

1.1.8.1 Water Quality

The *in situ* water quality associated with the project area is in a good state with no expected negative effects on the aquatic biota (DWAF, 1996). The water quality in the Mpuluzi River system, the Boesmanspruit system and the Buffelspruit system is discussed below. This is represented by sampling points HAR1 – HAR7.

1.1.8.1.1 <u>The Mpuluzi River system</u>

Table 1-12 presents the *in situ* variables measured within sampling points associated with the Mpuluzi River system during the 2013 low flow survey.

Table 1-12: *In situ* water quality results for the Mpuluzi River system

Constituent	Range	HAR1	HAR2	HAR3
pH	6.5 – 9	6.60	6.89	7.11
Temperature (°C)	5 – 30	12.3	10.4	16
Conductivity (µS/cm)	< 700	174.7	51.1	53.1
DO (mg/l)	> 5	6.32	6.7	6.9
DO (% saturation)	80 - 120	83	91	92

Based on the *in situ* water quality analyses the water quality of the upper reaches of the Mpuluzi River system is of good quality and within the desired ranges.

1.1.8.1.2 <u>The Boesmanspruit system</u>

Table 1-13 presents the *in situ* variables measured within sampling points associated with the Boesmanspruit system during the 2013 low flow survey.

Table 1-13: *In situ* water quality results for the Boesmanspruit system

Constituent	Range	HAR4	HAR5	HAR6
pH	6.5 – 9	6.88	6.76	6.95
Temperature (°C)	5 – 30	13.8	15.7	16.4
Conductivity (µS/cm)	< 700	73.8	185.6	108.6
DO (mg/l)	> 5	7.25	6.38	7.5
DO (% saturation)	80 - 120	86	84	90

The *in situ* water quality for the sampling points on the Boesmanspruit system indicate water quality that is of a good condition with no parameters measured that may negatively affect the aquatic biota.

1.1.8.1.3 The Buffelspruit system

Table 1-14 presents the *in situ* variables measured within sampling points associated with the Buffelspruit system during the 2013 low flow survey.

Table 1-14: *In situ* water quality results for the Buffelspruit system

Constituent	Range	HAR7
pH	6.5 – 9	7.20
Temperature (°C)	5 – 30	14.6
Conductivity (µS/cm)	< 700	54.1
DO (mg/l)	> 5	7.9
DO (% saturation)	80 - 120	89

The *in situ* water quality within the upper reaches of the Buffelspruit is seen to be within a good state and is therefore not expected to negatively affect the local aquatic biota.

1.1.8.2 Habitat

The Index of Habitat Integrity (IHI) assesses the number and severity of anthropogenic impacts and the damage they potentially inflict on the habitat integrity of aquatic ecosystems. Throughout each quaternary catchment, livestock agriculture is present, presence of impoundments such as dams are evident and extensive pine and blue gum plantations exist.

Based on the findings of the Index of Habitat Integrity analysis of the three associated river systems the instream habitat was found to be in a natural/largely natural state. The natural state of the instream habitat allows for the support of diverse aquatic biota. The current land use of the affected quaternary catchments is impacting on the riparian vegetation with the main impacts being livestock agriculture, forestry encroachment and the creation of small impoundments. This has resulted in the riparian vegetation being moderately modified.

1.1.8.3 Fish Assessment

The use of fish as a means to determine ecological disturbance has many advantages (Zhou et al., 2008). Fish are long living, respond to environmental modification, continuously exposed to aquatic conditions, often migratory and fulfil higher niches in the aquatic food web. Therefore fish can effectively give an indication into the degree of modification of the aquatic environment. The River Health Programme (RHP) uses fish in the biotic index Fish Response Assessment Index (FRAI). The Fish Response Assessment Index is based upon the preferences of various fish species as well the frequencies of occurrence in which the species occur.

Based on the Fish Response Assessment Index assessment the communities associated with the project area are in a modified state with the exception of the Mpuluzi River. This modified community structure is a result of the loss of specific habitat groups. Reference conditions and expected species were aligned with an environment that has high flow velocities and varied depths. The alteration of the flow-depth scenarios of the affected water courses has resulted in the alteration of the species composition in the associated river systems, however, although the fish species present are considered to be modified it should be noted that sensitive species such as *Amphilus uranoscopus* and *Chiloglanis pretoraie* were present. The presence of these sensitive fish species indicates that the systems are still somewhat natural with high flows and un-modified water quality.

1.1.8.4 Macroinvertebrate Assessment

As a result of aquatic macroinvertebrates integrating the effects of physical and chemical changes in the aquatic ecosystems, they are good, short-term indicators of ecological integrity. Integration of biological indicators (like aquatic invertebrates) with chemical and physical indicators will ultimately provide information on the ecological status of the river (RHP, 2001).

Due to the lack of reference data in the 11.04 Highveld ecoregion the Macroinvertebrate Response Assessment Index (MIRAI) was not available for sites HAR1, HAR2, HAR3 and HAR7. The Boesmanspruit system falls within the 11.02 Highveld ecoregion and therefore

Macroinvertebrate Response Assessment Index reference data was available. The Macroinvertebrate Response Assessment Index was implemented for each of the sampled sites for the Boesmanspruit collectively based on a reach of the rivers sampled.

Based on the Macroinvertebrate Response Assessment Index, the macroinvertebrate communities associated with the study sites within the Boesmanspruit are moderately modified. The moderately modified state of the macroinvertebrate community is primarily due to alterations in flow. For a total of the 18 species present in the reference conditions that are adapted to moderately modified water quality, only 5 are present. Additionally, out of the 6 species adapted to high water quality in the reference conditions only 2 are present. Organisms adapted to low water quality and organisms with no preference to water quality are present at 11 out of 19 and 9 out of 14 respectively. The community structure present when compared to reference conditions indicates that sensitive species are no longer present thus negatively influencing the Macroinvertebrate Response Assessment Index result.

Several species adapted to high flow velocities and flows between 0.1 m/s – 0.3 m/s were also absent from the current low flow survey. The results are out of the 11 species with specific requirements for high flow velocities (>0.6 m/s) only 5 were present. Out of the 11 species adapted to flows between 0.1 m/s - 0.3 m/s only 4 were present.

These missing species indicate that conditions within the Boesmanspruit are modified, however, it should be noted that only a single survey was conducted during the low flow period, therefore, temporal trends were not included. It is assumed that during the high flow period species adapted to higher flows (> 0.6 m/s and 0.1m/s – 0.3 m/s) will return to the specific sites.

In conclusion, the macroinvertebrate communities associated with the project area vary from tolerant species in the Boesmanspruit to sensitive species in the Mpuluzi River. The invertebrate communities within these associated and affected river systems have now been established for the low flow period.

The sensitive nature of the macroinvertebrates found within the Mpuluzi River system should be noted as alterations in either water quality or quantity will result in the potential loss of these sensitive species. The macroinvertebrate communities associated with the Boesmanspruit are in a modified condition.

1.1.9 Soils, Land Use and Land Capability

The Soil Baseline Assessment was to obtain existing baseline soil, land capability and land use information for the project area through a field soil survey.

The Soil Assessment Report is attached as Appendix D.

1.1.9.1 Soils

Existing Land Type data was used to obtain generalised soil patterns and terrain types for the project area. Land Type data exists in the form of published 1:250 000 maps. These maps indicate delineated areas of similar terrain types, pedosystems (uniform terrain and soil pattern) and climate (Land Type Survey Staff, 1989).

The soils found on the farms are contained within the Ba 57, Bb 39 and Bb 15 land types of the 2630 Mbabane land type map (Land Type Survey Staff, 1989). This land type indicates the underlying geology to consist mainly of shale, shaly sandstone, grit, sandstone and conglomerate of the Ecca Group, tillite and shale of the Dwyka formation in the Karoo sequence.

Plateaus and crests are generally occupied by shallow soils of the Glenrosa, Mispah, Glencoe and Dresden soil forms. Shallow topsoil is underlain by hard plinthite (ferricrete) and or sandstone parent material in these landscape positions.

The upper to lower mid-slope positions contain large pockets of yellow brown, apedal, medium textured soils of the Avalon, Glencoe and Clovelly soil forms. Soils are generally sandy with low clay content.

The footslope and valley bottom positions are dominated by wetter soil types although some pockets of well-drained soil are also present that include shallow soil at times.

The dominating soil types form an integral part of a hydrological topo-sequence in the landscape of the proposed project area, depicted in Figure 1–12. The crest areas contain well-drained deep soil intermixed with shallow soil representing the Mispah, Clovelly and Hutton soil forms. The midslope and some footslope positions are occupied by well drained soils as well as waterlogged soils such as Longlands and Kroonstad soil forms. The lower landscape positions are occupied by permanent wet soil present in wetlands or pans.

The large pans in the proposed project area in the valley bottom positions dominate large areas of the proposed project landscape. The hydrological processes responsible for the recharge of the pans are determined by the soil types and soil hydrological properties. Therefore, the soil hydrological properties in relation to the presence of the pans need to be understood. Soil can be divided into three categories using their hydrological responses as guidance. The three hydrological groups are recharge, interflow and responsive soils.

Figure 1–12: Topo-sequence of soil types, soils occuring from high to low landscape positions namely Mispah, Clovelly, Longlands and Katspruit soils

In the proposed project area crest landscape positions are indicated as 1, midslope positions as 3, while footslope and valley bottom positions are indicated as the 4 and 5 landscape positions respectively.

1.1.9.1.1 <u>Dominant Soils present in Land Type Ba 57</u>

Crests as depicted by landscape position 1 and illustrated in Figure 1–13, are generally dominated by deep red and yellow Hutton (50 %) and Glencoe soils (10 %) respectively, but shallow Mispah soil is also present in some instances in the crest positions (15 %).

The upper to lower midslope 3 positions are dominated by Hutton (30 %) and yellow such as Glencoe (15 %) and Avalon (15 %) soils underlain by hard and soft plinthite in the subsoils respectively. Shallow Mispah soil also occurs in 10 % of the cases.

The footslope positions in the landscape position 4 are dominated by Hutton (10 %), Glencoe (10 %) and shallow Mispah soils.

The valley bottom landscape position in this landscape is occupied by permanent wet Katspruit soils.

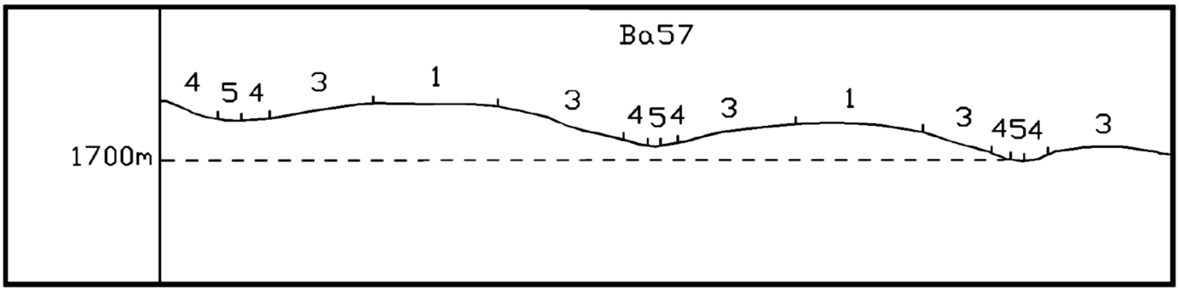

Figure 1–13: Terrain form sketch of the Ba 57 land type present in the Harwar Project area

1.1.9.1.2 <u>Dominant Soil Types present in land type Bb 15</u>

Crests as depicted by the landscape position 1 are generally dominated by shallow Mispah (25 %) and deeper Glencoe soil (25 %) soil, illustrated in Figure 1–14.

The upper to lower midslope 3 positions are dominated by yellow soil such as deeper Avalon (15 %) and shallow soil such as Mispah (25 %).

The footslope positions in landscape position 4 are dominated by Avalon (20 %), and shallow Mispah (10 %) and Wasbank (10 %) soils.

The valley bottom landscape position in this landscape is dominated by a mixture of wet Longlands (30 %) and Kroonstad (20 %) soils, but yellow Avalon (20 %) soil also occurs.

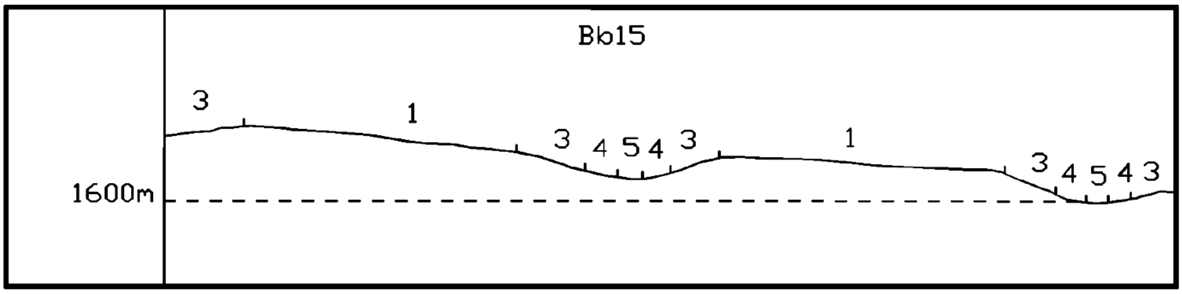

Figure 1–14: Terrain form sketch of the Bb 15 land type present in the Harwar Project area

1.1.9.1.3 <u>Dominant Soil Types present in Land Type Bb 39</u>

Crests as depicted by the landscape position 1 are generally dominated by shallow Mispah (30 %) and Wasbank (15 %) soils, and deeper Glencoe soil (30 %) soil.

The upper to lower midslope 3 positions – including the footslope positions – are dominated by soils similar to soils occupying the crest landscape positions in this land type.

The valley bottom landscape positions in this land type are dominated by the presence of pans, see Figure 1–15.

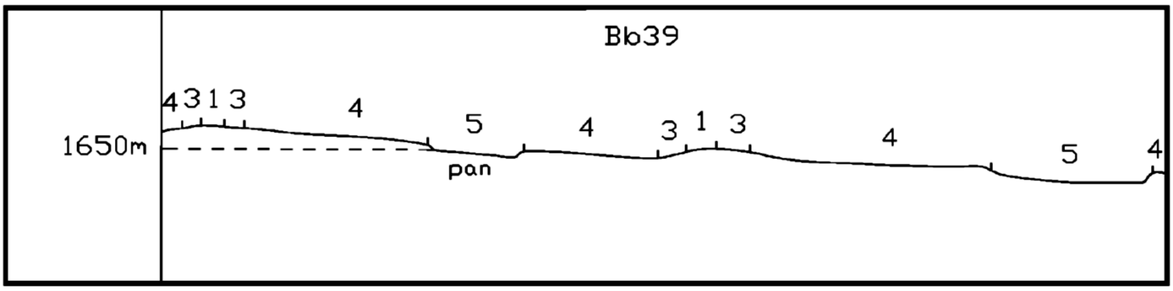

Figure 1–15: Terrain form sketch of the Bb 39 land type present in the Harwar Project area

1.1.9.1.4 Major Soil Types

The soil delineations are depicted in Plan 15. The contribution of the various soil types towards the sustainability of the pans in the project area can be interpreted by evaluating their importance in the hydrological soil landscape.

The major soil types present in the project area are:

- shallow soils underlain by weathered parent material such as Glenrosa soil;
- un-weathered rock such as Mispah soil;
- hard plinthite such as the Dresden soil form;
- recharged soils which are deep, such as Clovelly soil form; and
- interflow soils such as Longlands and Fernwood forms.

The shallow soil types (Glenrosa, Mispah and Dresden) represent approximately 508 ha or 20% of the surveyed area. Rainwater may accumulate and run off from the shallow Mispah (responsive) soil underlain by rock. The runoff water then infiltrate into the cracks present in the Glenrosa and Dresden (recharge) soils.

In addition, rainwater infiltrates into the Clovelly (recharge) soil which covers 786 ha or 31%. The infiltrated water then becomes part of the water contained in the soil profile. Excess water (due to high rainfall) moves through the soil profile into underlying rock through cracks present in the parent material and move towards the pans in the lower lying landscape positions.

Interflow soils – soils where lateral flow within the profile takes place - occupy approximately 850 ha or 34 % of the area surveyed. The interflow soils are represented by the Longlands and Fernwood soil forms. These soils play an important role in the supply of water to the pans in the area.

Disturbing the natural sequence of the soil profiles through opencast mining will affect the quantity and quality of the needed water supply for the pans. A sustainable water supply is needed for the health of the pans.

Table 1-15 lists the soil forms and areas occupied by the various soil forms. This is limited to the areas where access to the property was granted.

Table 1-15: Soil Types, and Area of Soils located on Site.

Soil types	Area (ha)	Percentage (%)
Avalon (Av)	80.87	3.34
Clovelly (Cv)	785.89	32.45
Fernwood/Longlands (Fw/Lo)	849.53	35.08
Glencoe (Gc)	3.25	0.13
Hutton (Hu)	16.58	0.68
Mispah/Glenrosa/Dresden (Ms/Gs/Dr)	507.99	20.98
Oakleaf (Oa)	9.1	0.38
Pan	12.46	0.51
Pinedene (Pn)	27.73	1.14
Rensburg (Rg)	13.54	0.56
Sepane (Se)	15.22	0.63
Wet	99.71	4.12
Total	**2421.87**	**100**

1.1.9.2 Fertility

The project area is occupied and dominated by yellow sandy and medium textured soils as well as dark wet soils. Generally the yellow coloured soils occupy the higher landscape positions. Wet soils generally occupy the midslope and footslope landscape positions.

The yellow soils are used for arable crop production while the darker wet soils are used to graze animals on. The Soil Assessment Report contains the analytical soil data obtained through soil analysis.

The pH of soil in the root zone is an important soil parameter because nutrient availability is controlled by the soil pH. The pH properties of analysed soil samples are generally within suggested optimum pH levels except for three topsoil samples as indicated by the shaded areas, these low soil pH was found to be less than pH 4.5. The grazed areas exhibit low soil pH. This is to be expected due to the high rainfall and sandy character of the soils present. Soil bases are leached out leading to natural decrease in soil pH. The pH of the cultivated topsoil however is within the guideline limit due to the addition of lime by the farmers. The measured soil pH is compared to an optimum suggested crop productive soil pH. These optimum levels are accepted as average soil content, in other words non-crop specific, but provide a good guideline to evaluate general soil chemical properties.

Ca, Mg and K are considered as macro nutrients required by vegetation in large quantities. The soil Ca, Mg and K content in the topsoil samples vary and no trend is clear when comparing cultivated and uncultivated soil. Once again the shaded cells indicate lower Ca, Mg and K content than the guidelines suggest. Sandy soil do not retain nutrients well and when sandy soil is found in combination with a high rainfall climate the conditions allow leaching of plant nutrients thereby depleting the soil of nutrients.

Large quantities of Phosphorus (P) are required to produce optimal growth in agricultural crops and yields. P can be compared to nitrogen (N), because like N, P is also an essential component of the photosynthesis process. Uncultivated soils generally lack large quantities of P and should be managed through the addition of fertilisers to the soil during the cultivation process to optimise agricultural production. The P status is generally low in all the topsoil samples except one soil sample.

1.1.9.3 Land Capability

Land capability is defined as the specific occurrence of a combination of soil, terrain and climatic features. Land capability is also defined by the most intensive long-term sustainable use of land under rain-fed conditions. Simultaneously an indication is provided considering permanent limitations associated with different land use classes (Schoeman et al, 2000).

Presently, the project area is occupied by arable, grazing, wetland and wilderness areas. Refer to Plan 16 depicting the Land Capability of the project area. These land capability classes occupy 823 ha, 787 ha, 546 ha and 381 ha respectively. The arable areas are mainly associated with the high lying areas and the slopes associated with grazing. Wilderness areas are generally located in between and on the edges of these areas. The low lying areas are characterised by the pans and wetlands.

The proposed opencast areas will affect approximately 255 ha (31%) of the arable land. Approximately 44 ha (6%) of grazing land will be affected by the opencast areas with 33 ha (6%) of the wetland areas and 91 ha (24%) of the wilderness areas being affected.

1.1.9.4 Land Use

The proposed project area is intensively used for commercial agriculture as depicted in Plan 17. The agriculture practised mainly includes grazing and arable farming. At present, an estimated 779 ha is utilised for commercial arable farming, while 2597 ha is grazed. The arable soils are predominantly of moderate to high agricultural potential. Intensive grazing is practised due to a high potential carrying capacity of 5 – 8 ha per large stock unit (cattle) of the project area (Agricultural Information System (AgIS)). As the land capability description indicated, the high lying areas are currently used for arable farming practices and the slope areas for grazing.

Wetland areas and pans are present in lower lying landscape positions and form part of grazed fields because the soils occupying these sites are normally too wet for arable farming practises. It is clear that the project area is dominated by grazing land.

1.1.10 Flora (Vegetation)

The Flora and Fauna Assessment serves to undertake a basic ecological assessment of the local flora and fauna communities associated with the Harwar study area in order to determine the current state of these components. In order to achieve the aim of describing the study site and determining potential impacts of the proposed mine, the following objectives were considered:

- To delineate the various vegetation/habitat types present within the study area, and describe their sensitivity; and
- To determine the flora and fauna communities present, the state of these communities, identification of possible species of special concern.

This study was done on a largely desktop scale, with one site visit to groundtruth the land use described in the satellite imagery. A dry season survey is not appropriate within this largely grassland area. The wet season field survey will be conducted during the months of November and February to achieve more accurate baseline information and meet the requirements of the MTPA.

The Flora and Fauna Assessment Report is attached as Appendix E.

1.1.10.1 Chrissiesmeer Panveld

The project area falls on the north-western boundary of the Chrissiesmeer Panveld.

The Chrissiesmeer Panveld comprises of over 320 pans on private land and boasts the largest inland freshwater lake in South Africa, Lake Chrissie. The primary area of pans runs from Tevrede se Pan in the north to Burgerspan in the South and from Goedverwachtingspan in the west to Lake Banagher in the east. The Chrissie system supports a spectrum of pans, including three (3) main types; reed, sedge and saline (Birdlife, 1998). Reed pans are mostly permanent, usually retaining water throughout the year. They have a diverse flora, characterised by Common Reed (*Phragmites australis*), which forms a dense extensive reed bed covering most of the pan basin. The narrow, peripheral ring of open water is usually underlain with submerged species such as Oxygen Weed (*Lagarosiphon muscoides*), *Potamogeton thunbergii* and *Potamogeton pectinatus*. Shoreline species, which are restricted to reed pans, include *Cyperus difformis*, *Juncus effuses* and *Chenopodium glaucum*.

Sedge pans are semi-permanent, usually drying up during the winter and/or dry spells, when they are almost devoid of vegetation. Water is shallow, and the substratum consists of shallow soil or exposed bedrock. The vegetation of sedge pans is particularly profuse and diverse, covering both shoreline and basin. Creeping Spike-rush (*Eleocharis palustris*) and tall emergent stands of *Schoenoplectus corymbosus* usually dominate these pans. Areas of open water hold submergents such as Oxygen Weed (*Lagarosiphon muscoides*), *Potamogeton thunbergii* and *Potamogeton pectinatus*. The following species are exclusive to and characteristic of sedge pans, *Hemarthria altissima*, *Cyperus denudatus*, *Polygonum salicifolium*, Floating Hearts (*Nymphoides thunbergiana*) and the much localised

Odontelytrum abyssinicum. Saline pans are characterised by their glaring white basins when dry and have extremely saline substrata and water. The basins of these pans usually lack vegetation, except for Swamp Grass (*Diplachne fusca*), a grass that can colonise very shallow or waterlogged basins. Other species exclusive to saline pans are Large Silver Grass (*Andropogon eucomus*), Swamp Couch Grass (*Cynodon dactylon*), *Puccinellia sp*., *Cyperus laevigatus*, *Schoenoplectus triqueter* and African Clover (*Trifolium africanum*). There is also considerable overlap in the common plants between the three pan types. *Echinochloa jubata* (Rice Grass), *Leersia hexandra*, *Agrostis eriantha*, *Cyperus longus*, *C. rigidifolius*, *Mariscus congestus*, *Isolepis costata* and *Juncus exsertus* are common to all pan types, and several plants are common to two of the three pan types. The pans, and their functioning, remain intact desopencast areae existing in a matrix that consists almost exclusively of maize (80%), interspersed with small fragmented patches of natural grassland (20%).

The plant *Odontelytrum abyssinicum* is a highly localised grass species which is expected to occur within the Chrissiesmeer Panveld. This species is known as a threatened pan specialist.

1.1.10.2 Vegetation Types

Mucina and Rutherford (2006) describe two different vegetation types as occurring in the Harwar project area. These include Eastern Highveld Grassland and Eastern Temperate Freshwater Wetlands. The vegetation types are described below.

Eastern Highveld Grassland occurs in Mpumalanga and Gauteng Provinces; extending south east from Johannesburg towards Ermelo at an altitude of 1520 – 1780m's (Mucina & Rutherford, 2006). These are slightly undulating plains including some low hills and pan depressions. The vegetation is short dense grassland dominated by the usual Highveld grass composition with small, scattered, rocky outcrops with wiry sour grasses and some woody species. The rainfall is strongly seasonal (Mean Annual Precipitation: 650 – 900mm) with very dry winters. The vegetation type is endangered, with only very small fractions conserved statutorily. Some 44% of the vegetation has been transformed by cultivation, plantations, mines, urbanisation and dams. On the project area the majority of the area with the exception of the pans is classified as the Eastern Highveld Grassland.

Three pans exist on the project area and are classified as part of the Eastern Temperate Freshwater Wetlands. This vegetation type occur in flat or shallow depressions filled with water which supports zoned systems of aquatic and hygrophilous vegetation of temporarily flooded grasslands and ephemeral herblands. The vleis form where flow of water is impeded by impermeable soils and by erosion resistant features such as dolerite intrusions. Many vleis and pans of this type of freshwater wetlands are inundated only during summer rainfall season and for some months after this into the middle of the dry winter season, but they may remain saturated all year round. Surface water inundation may be present at any point while the wetland is saturated and some plant species may only be present only under inundated conditions, or under permanently saturated conditions. The presence of standing water should not be taken as a sign of permanent wet conditions. This vegetation type occurs in exclusively summer rainfall regions. Biogeographicly important taxon included Rorippa fluviatilis var caledonica which is a highveld endemic species. The threatened ecosystems are depicted on Plan 18.

1.1.10.3 Preliminary Vegetation Assessment

Much of the site has been transformed for farming practices (27%), and there are some areas that have stands of alien invasive plant species (5.8%), however, much of the land cannot be used for agriculture, and is left as natural grassland (44.3%) with grazing. There are isolated rocky ridges (2%) forming niche habitats for plants and animals, as well as an extensive wetland system (20%), both of which are extremely ecologically sensitive. The vegetation delineation map is presented in Plan 19.

1.1.10.4 Flora

The South African Biodiversity Information Facility (SABIF) list was obtained from the South African National Biodiversity Institute (SANBI) which lists all the plant species officially recorded by SANBI for Quarter Degree Square (QDS) grids 2630AA and 2630AC. This list is not a comprehensive list representing only those species that may occur in these grids, but rather a guideline as to what is likely to occur here.

In addition, the species lists supplied by Mucina and Rutherford (2006) for each vegetation type found in the study area were used to add to the list of expected species for the study area. This resulted in a comprehensive expected species list of flowering plants for the study site. In total, there are 610 species with the potential to occur within the study site; these are listed in Appendix B of the Flora and Fauna Report. The list of species confirmed in the study area will be drawn up on completion of the site surveys, which will take place in the wet season (November and February).

Of the 610 species that could potentially be found on site, the well-represented of the families is the grass family (*Poaceae*) with 94 species, followed by the daisy family (*Asteraceae*) with 51 species and then the *cyperus* family (*Cyperaceae*) with 37 species. These plant families are indicative of the vegetation types that can be found within the study area, i.e. grassland and pan vegetation.

The family distribution is provided in the Flora and Fauna Assessment Report.

1.1.10.5 Expected Flora Species of Special Concern

Sixty (60) Species of Special Concern (SSC) have the potential to occur within the study area as well as being described as expected species which occur within the vegetation types occurring in the study area according to Mucina and Rutherford (2006).

The species listed occur on the Mpumalanga Nature Conservation Act Schedule 11, as well as the South African Red Data List and the Convention on International Trade in Endangered Species (CITES) list. The majority (50 species) are found on the Mpumalanga Nature Conservation Act Schedule, primarily due to the schedule assigning whole families or general protected status. In terms of the law for the Mpumalanga Conservation Act, permits must be obtained for the destruction of any of the species listed in Schedule 11.

Eleven (11) of the species occur on the South African Red Data list. Of these, five (5) are Declining, two (2) are Vulnerable, three (3) are Endangered and one (1) is Data Deficient for taxonomic reasons. None of the species expected to occur in the study area occur on the International IUCN Red Data List. Nine (9) species occur on CITES Appendix II.

In terms of family numbers; most well-represented family in the Protected Species of Special Concern (PSSC) are the *Orchidaceae* with nineteen (19) species, followed by the *Iridaceae* with ten (10) species, the *Amaryllidaceae* with nine (9) species and the *Asphodelaceae* with eight (8) species. Other families have four (4) or less species on the list.

Refer to the full breakdown of the family composition in Appendix B of the the Flora and Fauna Report.

1.1.10.6 Alien Invasive Species

An initial brief site visit indicated the presence of some alien invasive species (Table 1-16). This list will be finalized and likely added to, on completion of the required two growing season sampling periods in November and February when the field work for the study site is conducted.

Table 1-16: Alien invasive species recorded on site from an initial screening survey

Species	Common Name	CARA	NEMBA
Acacia mearnsii	Black Wattle	Category 2	Category 2
Bidens bipinnata	Blackjack	-	-
Bidens formosa	Cosmos	-	-
Cyperus esculentus	Yellow Nut Sedge	-	-
Eucalyptus camaldulensis	Red River Gum	Category 2	Category 2
Gomphocarpus fruticosus	Milkweed	-	-
Persicaria lapathifolia	Spotted Knotweed	-	-
Pinus pinaster	Pine	Category 2	Category 2
Tagetes minuta	Tall Khaki Weed	-	-

Species from the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA) Schedule 2 are found in the study site.

1.1.10.6.1 Category 2: Declared Invader Plants

These plants have a commercial or utility value but can become invasive, they are only allowed in designated areas under controlled conditions (Bromilow 2010). There are three category two plants recorded from the study area; *Acacia mearnsii*, *Eucalyptus camaldulensis* and *Pinus pinaster*.

1.1.11 Fauna

The faunal assemblages are expected to be typical of the grasslands biome. Fauna expected to occur on site include assemblages within terrestrial ecosystems, they are mammals, birds, reptiles, amphibians and invertebrates. Each of these species occurs within unique habitats, the ecological state of these habitats directly relates to the number of species found within them. According to Carruthers (2007), the main habitats occurring in the region are grassland plains, rivers and pans, with little altitudinal variation. The study area can be described as varying between natural, arable and grazing to wilderness and wetland. It is therefore expected that agriculturally disturbed areas do exist on site, which would have a negative effect on the available natural habitat for natural occurring animal species. All desktop data obtained was for the grids 2630AA and 2630AC from the SANBI SIBIS: SABIF lists.

1.1.11.1 Faunal Habitats

There are several different faunal habitats in the Harwar study area, as determined by a preliminary site investigation. These are depicted on Plan 21.

The importance of habitat to animal species in the form of shelter and food is very high. The quality and quantity of the habitat present in the general study area and beyond determines the assemblages of animal species to occur here. Threats to animal species will also have a detrimental effect, and will play a role in conjunction with habitat qualities in determining animals that prefer the area of concern. The main habitat types are described below as they were encountered during a short screening site visit.

1.1.11.1.1 Grasslands

The Grassland habitat type was found extensively across the project site, and accounts for a preferred habitat for many birds, mammals, invertebrates, reptiles and frogs. The effects of the anthropogenic activities, however, in the form of declining and fragmented habitat, are a major threat to this grassland habitat in area. The grassland was encountered on relatively flat rolling hill slopes, with the majority of the very flat and agriculturally suitable areas used for maize farming.

1.1.11.1.2 Ridges

Rocky outcrops are a sensitive landscape as determined by the MTPA, as per the minimum requirements set forth by Parks Board. Reasons for the protection of these outcrops are that they provide habitat for plant and animal species that is not impacted on by agriculture due to the unsuitable rocky nature of these outcrops for ploughing. Small localities of ridges were identified either through desktop evaluations of areal images and ground truthing.

1.1.11.1.3 Transformed/Cultivation

Areas that were found to be under current cultivation, accounts a relatively large part of the study area, the majority of these are maize fields. The anthropogenic pressure that reduced the grassland has resulted in increased areas under current cultivation.

Areas of current cultivation were encountered on the areas with the least gradient, but also on the hill slopes where the gradient was no too aggressive. These areas can provide habitat for animals such as birds, mammals (rodents), reptiles (snakes, lizards) and amphibians.

1.1.11.1.4 Pans

Four pans (three perennial and one non-perennial) were identified to occur within the study area, creating specialised habitat for bird, mammal and amphibian species.

1.1.11.1.5 __Wetlands__

The wetland and riparian habitat type occurred throughout the study site. Multiple small wetland systems were identified and are indicated on the habitat delineation map. These areas were dominated by riparian vegetation that grows in seasonally to permanent wet soil. These areas create habitat for birds, mammals, reptiles and amphibians.

1.1.11.1.6 __Alien vegetation__

Relatively small but prominent collections of alien invasive and exotic tree species were encountered throughout the project footprint. These tree species were either planted as windbreaks by local farmers, as is the case with Pine and Eucalyptus, or they were transported to the area via waterways such as Populus spp. The alien vegetation habitat type was further encountered on the hill slopes of rolling hills and flat areas between these hills. These areas create a different micro habitat where tall tree cover provides shade to grassy areas.

1.1.11.2 Mammals

Mammal species that could potentially occur in the study area include twenty-two (22) species and are indicated in Table 1-17. Of these, the most well represented family is the shrew family (Soricidae), with six (6) expected species. Other important families include the Ungulate family (Bovidae), mole family (Chrysochloridae), mongoose family (Herpestidae) and otter family (Mustelidae) with two (2) species each.

The potential for a mammal species to occur in the project area has been evaluated through the presence of threats, preferred habitat and food availability. With a species scoring high if threats are not present, preferred habitat is present and food supply is present. A medium probability will mean threats are not present and preferred habitat and food supply is both or only one present. A low probability indicates that threats are present; there is no preferred habitat and no food resource.

In total, seven (7) of the species have a high probability of occurrence, six (6) have a medium probability of occurrence and nine (9) have a low probability of occurrence. The table below indicates the species with a medium to high probability of occurring within the study area.

Table 1-17: Mammal Species Expected in the Study Area

Family	Species	Common Name	Probability of Occurrence
Bovidae	*Raphicerus campestris*	Steenbok	High
Chrysochloridae	*Amblysomus septentrionalis*	Highveld golden mole	High
	Chrysospalax villosus	Rough haired Golden Mole	Medium
Erinaceidae	*Atelerix frontalis*	Southern African hedgehog	Medium
Felidae	*Leptailurus serval*	Serval	High
Herpestidae	*Atilax paludinosus*	Water mongoose	Medium
	Cynictis penicillata	Yellow mongoose	High
Hyaenidae	*Proteles cristata*	Aardwolf	Medium
Muridae	*Otomys laminatus*	Laminate Vlei Rat	Medium
Mustelidae	*Aonyx capensis*	African clawless otter	High
	Poecilogale albinucha	African Striped Weasel	High
Nesomyidae	*Mystromys albicaudatus*	White-tailed mouse	Medium
Procaviidae	*Procavia capensis*	Rock hyrax	High

1.1.11.2.1 <u>Expected Mammal Species of Special Concern</u>

The expected species lists of animals that can be expected in the Harwar study area was cross referenced with Provincial, National and International lists of species of special concern. These lists are the following:

- Mpumalanga Nature Conservation Act of 1998 (MNCA, Act No.10 of 1998), Schedule 1: Specially Protected Game (Section 4 (1)(a), and Schedule 2: Protected Game (Section 4 (1)(b));
- National Environmental Management Biodiversity Act of 2004 (NEMBA, Act No. 10 of 2004), including the 2013 version;
- South African National Red List;
- IUCN Red List; and
- The Fauna and Flora CITES list.

The Roughhaired Golden Mole (*Chrysospalax villosus*) may occur within the area. This species is listed as Vulnerable according to the IUCN which means this species is at high risk of endangerment in the wild. Furthermore the White-tailed mouse (*Mystromys albicaudatus*) listed as endangered according to the IUCN, can also be expected. Blesbok (*Damaliscus pygargus*), Serval (*Leptailurus serval*) and Aardvark (*Orycteropus afer*), are all protected by NEMBA 2013 and Mpumalange Nature Conservation Act 10.

Mammals determined as Protected Species of Special Concern are presented in Table 3-7 of the Flora and Faunal Impact Assessment Report attached to this report as Appendix E.

1.1.11.3 Birds

Birds are viewed as good ecological indicators, since their presence or absence tends to represent conditions pertaining to the proper functioning of an ecosystem. Bird communities and ecological condition are linked to land cover. As the land cover of an area changes, so do the types of birds in that area (The Bird Community Index, 2007). Land cover is directly linked to habitats within the study area. The diversity of these habitats should give rise to many different species.

According to SABAP 2, approximately two hundred and sixteen (216) species of birds have been identified in the area. All birds that could be present within QDS 2630AA and 2630AC, according to the SABAP 2, are listed in Appendix C of the Flora and Fauna Report. General and protected species as listed by SIBIS: SABIF, for the relevant grid squares are listed below these species, 11 have been assigned a protected status. Due to the transient nature of the listed bird species that have been recorded in the area of interest and beyond previously, it is assumed that if preferred habitat is present, within or outside the project area boundaries that these species could occur on site.

Mining, agriculture and other anthropogenic activities have been identified as threats.

1.1.11.3.1 Expected Bird Species of Special Concern

Eleven of the birds expected to occur within the study site are listed as Red Data according to the IUCN.

Eight species are protected under NEMBA, and six species appear on the CITES Appendix II. Secretarybird (*Sagittarius serpentarius*), Blue Crane (*Anthropooides paradiseus*) and Southern Bald Ibis (*Geronticus calvus*) is Vulnerable which means that these species are at high risk of endangerment in the wild. Grey Crowned Crane (*Balearica regulorum*) is listed as Endangered which means this species is at high risk of extinction in the wild. Lesser Flamingo (*Phoenicopterus minor*), Blue Korhaan (*Eupodotis caerulescens*) Denham's Bustard (*Neotis denhami*) is listed as Near threatened which means that it is likely that this species may become endangered in the near future (Table 1-18).

Table 1-18: Possible Bird Species of Special Concern that may occur within the Study Site

Family	Species	Common Name	Mpumalanga Nature Conservation Act No. 10 of 1998 Schedule 11	NEMBA	IUCN Red List	CITES	NEMBA 2013
Acciopencast atearidae	*Acciopencast areaer melanoleucus*	Black Sparrow hawk	Protected	-	-	II	-
	Circus ranivorus	African Marsh-Harrier	Protected	Protected	-	-	-
	Sagittarius serpentarius	Secretary bird	Protected	-	VU	-	-
Charadriidae	*Charadrius pallidus*	Chestnut-banded Plover	Protected	-	NT	-	-
	Vanellus melanopterus	Black-winged Plover	Protected	-	-	-	-
Falconidae	*Falco peregrinus*	Peregrine Falcon	Protected	Vulnerable	-	-	-
	Falco naumanni	Lesser Kestrel	Protected	Vulnerable	VU	II	-
Glareolidae	*Glareola nordmanni*	Black-winged Pratincole	Protected	-	NT	-	-
Gruidae	*Anthropooides paradiseus*	Blue Crane	Protected	Endangered	VU	-	-
	Balearica regulorum	Grey Crowned Crane	Protected	Endangered	EN	II	Vulnerable
	Bugeranus carunculatus	Wattled Crane	Protected	Critically endangered	VU	II	-
Muscicapidae	*Campicoloides bifasciatus*	Buff-streaked Chat	Protected	-	-	-	-
Otididae	*Eupodotis caerulescens*	Blue Korhaan	Protected	Vulnerable	NT	II	-
	Neotis denhami	Denham's Bustard	Protected	Protected	NT	II	Vulnerable
	Eupodotis senegalensis	White-bellied Korhaan	Protected	-	VU	-	-
Phoenicopteridae	*Phoenicopterus minor*	Lesser Flamingo	Protected	-	NT	-	-
	Phoenicopterus roseus	Greater Flamingo	Protected	-	NT	II	-
Threskiornithidae	*Geronticus calvus*	Southern Bald Ibis	Protected	Vulnerable	VU	II	Vulnerable
Tytonidae	*Tyto capensis*	African Grass-Owl	Protected	Vulnerable	-	II	-

1.1.11.4 Reptiles

Reptiles are ectothermic (cold-blooded) meaning they are organisms that control body temperature through external means. As a result reptiles are dependent on environmental heat sources (Savage, 2005). Due to this many reptiles regulate their body temperature by basking in the sun, or in warmer areas. According to Carruthers (2007) substrate is an important factor determining which habitats are suitable for which species of reptile. The presence of and limited availability of rocky out crops within the study area may indicate that only a few reptile species are present.

Reptiles recorded previously from the QDS in which the study site occurs and are thus expected to occur on site are listed in Table 1-19. This is by no means a complete list of all the reptile species that may be found on site, and it may be likely that additional species be found on the completion of the field surveys. Species expected to occur on site include six (6) families, each with one species except for the girdled lizard family (Cordylidae), for which two species are expected.

Table 1-19: Reptiles that have been recorded from the Study Area previously (SANBI SIBIS: SABIF)

Family	Species	Common Name
Agamidae	*Agama aculeata*	Ground agama
Colubridae	*Psammophylax tritaeniatus*	Three-lined Grass Snake
Cordylidae	*Cordylus giganteus*	Giant Girdled Lizard
	Pseudocordylus melanotus	Drakensberg crag lizard
Gekkonidae	*Lygodactylus ocellatus*	Spotted dwarf gecko
Scincidae	*Acontias gracilicauda*	Slendertail lance skink
Typhlopidae	*Typhlops bibronii*	Bibron's blind snake

1.1.11.4.1 <u>Expected Reptile Species of Special Concern</u>

One (1) of the reptiles expected to occur within the study area is listed as Red Data according to the IUCN. The Giant Girdled Lizard (Cordylus giganteus) is known from the vicinity and may occur within the area. This species is listed as Vulnerable which means it is at high risk of endangerment in the wild.

1.1.11.5 Amphibians

Amphibians are viewed to be good indicators of changes to the whole ecosystem because they are sensitive to changes in the aquatic and terrestrial environments (Waddle, 2006). Most species of amphibians are dependent on the aquatic environment for reproduction (Duellman and Trueb 1986). Additionally, amphibians are sensitive to water quality and UV radiation because of their permeable skin (Gerlanc and Kaufman 2005, Taylor et al. 2005). Activities such as feeding and dispersal are spent in terrestrial environments (Waddle, 2006). According to Carruthers (2001), a number of factors influence the distribution of amphibians, but because amphibians have porous skin they generally prosper in warm and damp habitats. The presence of suitable habitat within the study area should provide a number of different species of amphibians.

According to Carruthers (2001), frogs occur throughout southern Africa. A number of factors influence their distribution, and they are generally restricted to the habitat type they prefer, especially in their choice of breeding site. The choices available of these habitats coincide with different biomes, these biomes in turn, are distinguished by means of biotic and abiotic features prevalent within them. Therefore a collection of amphibians associated with the Grassland biome will all choose to breed under the prevailing biotic and abiotic features present. All the species of frogs associated with the study area are listed in Table 1-20. Within the study area further niche differentiation is encountered by means of geographic location, this differentiation includes, banks of pans, open water, inundated grasses, reed beds, trees, rivers and open ground.

Table 1-20: Amphibians that have been recorded from the study area previously (SANBI SIBIS:SABIF)

Family	Species	Common Name
Bufonidae	*Amietophrynus gutturalis*	African common toad
	Amietophrynus regularis	African common toad
	Schismaderma carens	African split-skin toad
Hyperoliidae	*Hyperolius marmoratus*	Painted reed frog
	Kassina senegalensis	Bubling Kasina
	Semnodactylus wealii	Rattling frog
Pipidae	*Xenopusa laevis*	Common platanna
Pyxicephalidae	*Amietia angolensis*	Common river frog
	Amietia fuscigula	Cape river frog
	Cacosternum boettgeri	Common Caco
	Strongylopus fasciatus	Striped stream frog
	Strongylopus grayii	Clicking stream frog
	Strongylopus wageri	Plain stream frog
	Tomopterna cryptotis	Tremelo sand frog
	Tomopterna natalensis	Natal sand frog
Ranidae	*Hyperolius sp.*	-
	Ptychadena porosissima	Striped grass frog
	Rana angolense	Common river frog
	Rana fasciatus	-
	Rana sp.	-

1.1.11.5.1 Expected Amphibian Species of Special Concern

No Red Data amphibian species are expected to occur on site.

1.1.11.6 Invertebrates

Insects are vital to the functioning of the earth's ecosystems in their present form. Virtually every aspect of ecosystem functioning is dependent on insects in some way, which are the main non-plant drivers of ecosystem dynamics. (Afribugs.com). A list of the expected invertebrate species is included in Appendix D of the Flora and Fauna Assessment Report.

1.1.12 Biodiversity and Conservation

1.1.12.1 Biodiversity Value Assessment

The biodiversity value or sensitivity assessment takes into account all of the plans mentioned in Section 1.1.12.2 to Section 1.1.12.6, as well as the field data gathered on the preliminary site visit. This forms an assessment of the perceived biodiversity value. The outcomes of this assessment are two sensitivity maps, one for Flora / Vegetation and the other for Fauna. These are presented in Plan 20 and Plan 21 respectively.

The preliminary Flora assessment determined that the wetland areas, as well as the rocky ridges have a very high biodiversity value, with remaining natural vegetation a high biodiversity value. Transformed areas and areas of alien vegetation have a low biodiversity value.

In terms of the faunal sensitivity map, wetlands and rocky ridges form vital habitats, with alien tree stands providing nesting sites for birds. These areas have been assigned a high biodiversity value. The transformed areas have been assigned a medium biodiversity value as these agricultural areas provide a valuable food source for birds and small mammals.

When the ecosystem function/services is taken into account, and considering the overall high biodiversity of the site (both flora and fauna) and the high biodiversity value of the entire site, it is clear that the entire area is, as the updated Mpumalanga Conservation Plan (C-plan) indicates, irreplaceable.

Ecosystem services are the benefits that people derive from nature. Some benefits, such as crops, fish, and freshwater (provisioning services), are tangible. Others such as pollination, erosion regulation, climate regulation (regulating services) and aesthetic and spiritual fulfilment (cultural services) are less tangible. All, however, directly or indirectly underpin human economies and livelihoods.

1.1.12.2 Mpumalanga Conservation Plan

The Mpumalanga C-plan has categorised the entire province in terms of sensitivity. The criteria which are used to categorize various areas within the Mpumalanga landscape are described in the Table 1-21 below. This was used to get a broad understanding of the sensitivity of the area.

Table 1-21: Mpumalanga C-Plan criteria for various categories

Rating	Cover	Description	Comment
Protected Areas	14.8%	Formally protected both State and Privately. All are managed for biodiversity conservation and sustainable use. Such use includes commercial based Some irreplaceable sites may already be managed carefully and sustainably by land owners but there is currently no compelling legal or public pressure for this to be so.	High conservation Categories. These areas are to be managed for biodiversity conservation
Irreplaceable	2.4%	Irreplaceable areas are those of highest biodiversity value outside the formal protected areas. These areas support unique biodiversity features such as endangered species or rare habitat patches that don't occur anywhere else in the province. These features have already been so reduced by loss of natural habitat that one hundred per cent of what remains must be protected in order to achieve biodiversity targets. All development is strictly controlled in line with biodiversity conservation targets.	
Highly Significant	12.3%	Areas where biodiversity has been heavily compromised and very few options remain to meet biodiversity targets. Natural vegetation cover in these areas should be maintained and restored. Any significant habitat loss may cause these areas to become irreplaceable. Approved developments or changes in land use must be compatible with conservation objectives.	
Important and Necessary	9.5%	Biodiversity in this Category is relatively intact. It represents the areas which most efficiently contribute to meeting biodiversity targets and minimise land use conflicts. If biodiversity is lost from these areas larger areas will be required elsewhere for targets to be met. This category allows some flexibility and there area options for development.	
Least Concern	25.2%	Is an IUCN category assigned to extant species or lower taxa which have been evaluated but do not qualify for any other category. As such they do not qualify as threatened, Near Threatened, or (prior to 2001) Conservation Dependen	61% of the province is available for development following EIA

Rating	Cover	Description	Comment
No Natural Habitat Remaining	35.8%	This category has already lost most of its biodiversity and its ecological functioning too. In the remnants of natural habitat that occur between cultivated lands and along riverlines ad ridges, residual biodiversity features and ecological processes do survive. But these disconnected remnants are biologically impoverished, highly vulnerable to damage abd have limited likelihood of being able to persist. The more transformed a landscape becomes; the more value is placed on these remnants of natural habitat.	procedures

The original Mpumalanga C-plan (2007) rated the remaining natural areas within the Harwar study site as Highly Significant. This indicated that any remaining natural areas needed to be maintained and restored to meet biodiversity targets.

The updating of the Mpumalanga C-plan has allowed for more detailed mapping of the area. It should be noted that there is clear expansion of the transformed areas compared to the original Mpumalanga C-plan (2007). The updated Mpumalanga C-plan has taken cognisance of this, with the remaining natural areas becoming even more vital to meet conservation targets. Just about all the natural areas within the project area are identified as Irreplaceable Critical Biodiversity Areas in terms of the Mpumalanga Biodiversity Sector Plan (replacing the Mpumalanga Biodiversity Conservation Plan). A comparison of the two plans can be seen in Plan 22.

1.1.12.3 St. Louis Private Nature Reserve

The St. Louis Private Nature Reserve is situated north-west of the project area (adjacent), and is formally protected by the State and Privately. All protected areas are managed for biodiversity conservation and sustainable use. Such use includes commercial based tourism etc.

1.1.12.4 Important Bird Areas

An Important Bird Area (IBA) is an area recognized as being globally important habitat for the conservation of bird populations. Currently there are about 10,000 IBAs worldwide. At present, South Africa has 124 IBAs, covering over 14 million hecatres of habitat for our threatened, endemic and congregatory birds. Yet only a million hecatres of the total land surface covered by our IBA's legally protected. The BirdLife SA IBA programme continues a programme of stewardship which will ultimately achieve formal protection (Birdlife, 2013).

These areas are identified by BirdLife International. These sites are small enough to be entirely conserved and differ in their character, habitat or ornithological importance from the surrounding habitat. Often IBAs form part of a country's existing protected area network, and so are protected under national legislation. There is no formal National IBA Conservation Strategy for this area within South Africa. (Birdlife International, 2012)

According to Birdlife International, the Chrissiesmeer Panveld IBA is rated as A1, A4i, ii, iii Criteria. Criterion A1 means that the site holds significant numbers of globally threatened species, or other species of global conservation concern, as well as holding populations of IUCN listed species. Criterion A4 means that the sites holds equal or more than 1% of a biogeographic population of water bird species, or holds, on a regular basis, populations equal or more than 20 000 waterbirds (Barnes, K., 1998).

The area was reviewed in terms of bird sensitivity and importance through consideration of the Important Bird Areas atlas of South Africa (Plan 23).

1.1.12.5 Nationally Threatened Ecosystems

According to the National List of Threatened Ecosystems (NEMBA, Act 10 of 2004) the project area overlaps the following ecosystems (Plan 18) and these are regarded as threatened ecosystems:

- Eastern Highveld Grassland; and
- Chrissiesmeer Panveld.

1.1.12.6 National Protected Areas Expansion Strategy (NPAES)

The NPAES sites are areas designated for future incorporation into existing protected areas (both National and Informal protected areas). These areas are large, mostly intact, required to meet biodiversity targets, and suitable for protection. They may not necessarily be proclaimed as protected areas in the future and are a broad scale planning tool allowing for better development and conservation planning. The joining of the NPAES area to the north, with the Chrissiesmeer Panveld area, will greatly enhance the size of the conserved area.

1.1.13 Visual Aspects

The relevant visual aspects have been extracted from the Topography and Visual Baseline Assessment and are discussed below.

1.1.13.1 Identified Visual Receptors

Visual receptors were identified from aerial photography within the visible areas of the study area (Plan 24). These included farm and workers houses, protected areas (St. Louis Private Nature Reserve), a guest house, the R33 and N17 arterial / national roads, and urban built-up areas such as Chrissiesmeer, KwaChibikhulu, Carolina and Silobela.

1.1.13.2 Sense of Place and Scenic Quality

According to Lynch (1992), sense of place “is the extent to which a person can recognise or recall a place as being distinct from other places – as having a vivid, unique, or at least particular, character of its own”.

The study area is typical of the South African Highveld with gradual rolling grasslands dominating the landscape. Views over the natural pans which occur in the region make the landscape unique. Maize farming is dominant within the study area. The limited infrastructure development in the area gives one the impression of being in a truly rural setting especially around Tevrede se Pan. The rich cultural history of the MLD further contributes to the uniqueness of the region.

Landscapes with greater diversity or containing "distinctive" features are classified as having a higher scenic value than landscapes with low diversity, few distinctive features, or more “common" elements. Generally, the greater the diversity of form, line, texture, and colour in a landscape unit or area, the greater the potential for high scenic value. Scenic quality classifications are:

- High - distinctive landscape, often with a strong sense of place;
- Moderate - common landscape; and
- Low - minimal landscape, often with a weak sense of place.

As discussed above, the study area can be classified as having a strong sense of place and can therefore be classified as having high scenic quality. It should however be noted that this is subjective to personal opinion.

1.1.13.3 Visibility, Visual Exposure and Visual Absorbtion Capacity (VAC)

The visibility of a project is the geographic area from which a project is visible (Oberholzer, 2005). The visibility of the proposed project is shown in Plan 24, and can be taken as a worst case scenario, as vegetation and man-made structures as well as climatic conditions were not considered in the viewshed analysis model. The proposed mine is shown to be visible on the periphery of the two major urban areas being Carolina and Chrissiesmeer. Other mining activities occur in the immediate vicinity of Carolina. Further there are a number of mining activities which occur to the west and south-west of the study area which will impact directly on visual receptors in this vicinity. Major visual impacts are expected on high lying areas around Tevrede se Pan as well as to the south-east of the project near the town of Chrissiesmeer. The viewshed analysis model indicated that the proposed mine could potentially be seen from the Florence Guest Farm, located 4 km to the east of Chrissiesmeer. The proposed mine is likely to be visible from the St Louis Private Nature Reserve, located directly north-west of the proposed project, and the R33 and N17 roads in the area. The visibility of the proposed project is subject to the location of mining activities at a certain stage during the mining process.

The visual exposure is the relative visibility of a project or feature in the landscape (Oberholzer, 2005). The visual exposure of objects decreases exponentially as the distance between the receptor and the object of visual concern increases. Martin (2010) argues that the visual significance of objects decreases so rapidly that at a distance further than 10 km away, the exposure becomes negligible. Atmospheric haze, lighting and other weather conditions can vary greatly from area to area or even from day to day (Malm, 1999), and can greatly influence the visual exposure. During the site visit, atmospheric haze was evident on the far horizon. The site visit was conducted during May when conditions were fairly dry therefore dust and atmospheric pollution may be the cause of the haze. It is expected that visual receptors within a distance of 3 km of the proposed project will have a high visual exposure, while those located at a distance between 3 km and 6 km will experience moderate exposure, and those between 6 km and 12 km can be considered moderate to low.

The Visual Absorbtion Capacity is the potential of the landscape to conceal the proposed project as a result of topography, vegetation or synthetic features (Oberholzer, 2005). The primary vegetation in the region is grassland and the main land use is maize and livestock production. The Visual Absorbtion Capacity of grassland and maize in the area can be considered low, however, the undulating topography of the region can be considered as having a moderate to high Visual Absorbtion Capacity. Overall the Visual Absorbtion Capacity of the landscape can be considered moderate in concealing the proposed project.

1.1.14 Noise

The objective of the Noise Baseline Assessment is to assess what the current ambient noise levels in the area are.The baseline noise measurements will establish the soundscape of the area surrounding the proposed project. The Noise Assessment Report is attached as Appendix H.

A baseline assessment was undertaken to determine the current ambient noise levels at the surrounding areas of the proposed project. Locations (farm houses and residential dwellings) were selected that may possibly be impacted on by the proposed mining activities and that were identified as suitable reference points for the measurement of ambient sound levels surrounding the proposed project area.

A Cirrus, Optimus Green, precision integrating sound level meter was used for the measurements. The instrument was field calibrated with a Cirrus, sound level calibrator. Sensitive noise receptors in the area as well as the monitoring locations are depicted on Plan 25.

The results from the noise meter recordings for all the sampled points as well as the rating limits according to the SANS 10103:2008 guidelines are presented in Table 1-22. The noise level time history graph per noise measurement location can be seen in Noise Assessment Report.

Table 1-22: Results of the baseline noise measurements

Sample ID	SANS 10103:2008 rating limit					
	Type of district	**Period**	**Acceptable rating level dBA**	**$L_{Areq,T}$ dBA**	**Maximum/Minimum dBA**	**Date**
HN1	Rural	Daytime	45	44	80 / 21	06/05/2013
		Night time	35	33	65 / 19	06/05/2013
HN2	Rural	Daytime	45	43	87 / 19	07/05/2013
		Night time	35	30	70 / 14	07/05/2013
HN3	Rural	Daytime	45	39	79 / 21	13/05/2013
		Night time	35	41	79 / 21	13/05/2013
HN4	Rural	Daytime	45	42	77 / 22	08/05/2013
		Night time	35	37	57 / 25	08/05/2013
	Indicates current $L_{Aeq,T}$ levels above either the daytime rating limit or the night time rating limit					

1.1.14.1 Day time Results

Based on the day time results, the existing average ambient noise levels are below the SANS rating levels for the maximum allowable outdoor daytime limit for ambient noise in rural districts. Overall the ambient average noise levels at the rural receptors are at the level of what is expected of rural districts.

The overall trend of the day time noise indicate the levels peak between 06:00 and 10:00 in the morning and then again between 17:00 and 18:00 in the evening. The most probable reason for the increase of noise is the commencement of work during the morning and people returning from work in the evening, in terms of vehicular activity as well as farming activities.

The average of the baseline daytime levels is 42dBA and will therefore be set as such for the area.

1.1.14.2 Night Time Results

Based on the night time results, the existing average ambient noise levels range from below to barely above the SANS night time guideline limit for ambient noise in rural districts.

The overall trend of the night time sound levels indicate a steady decline in noise levels from 22:00 until 01:00 and then a rise between 05:00 and 06:00. The most probable reason for the decrease in noise levels is the decrease in activity during the night time and the respective increase in the morning is probably due to farming and vehicular increase.

The noise sources that were audible during the baseline measurements at the time of the noise survey and that were responsible for the day/night time level are summarised in Table 1-23.

The average of the baseline night time levels is 35 dBA and will therefore be set as such for the area.

Table 1-23: Noise sources during baseline measurements

Noise source description			
Day	**Duration**	**Night**	**Duration**
Truck on portion 9 of the farm Appeldoorn 38 IT	Intermittent	Livestock (cows)	Intermittent
Livestock (cows)	Intermittent	Vehicular activity on R33	Intermittent
Vehicular activity on R33	Intermittent		

The established baseline day and night time level will be used for purpose of evaluating the impact by comparing it to the modelled noise levels.

1.1.15 Archaeological / Cultural Aspects

The aim of the Heritage Assessment was to assist the client in identifying, documenting and managing heritage resources found in the proposed project area in a responsible manner. This assessment also aimed to protect, preserve and develop resources within relative legislative frameworks.

In essence, the Heritage Assessment aimed to identify, record and document sites of cultural and historic sites, including graves and cemeteries within the proposed Harwar project area.

Based on the Heritage Statement, the South African Heritage Resources Authority (SAHRA) stipulated that a Heritage Impact Assessment (HIA) must be undertaken for the project area. SAHRA required that the HIA must include an assessment of the following:

- Archaeological resources;
- Palaeontological resources;
- Built Environment resources, such as structures older than 60 years;
- Sites of cultural significance associated with oral histories;
- Burial grounds and graves; and
- Cultural landscapes or viewscapes.

The Heritage Assessment Report is attached as Appendix I.

1.1.15.1 Cultural Landscape

In this particular environment heritage resources are, based on experience, known to exist in or near landscape features such as stands of Eucalyptus trees, sandstone outcrops and ridges. In addition, wetlands were avoided as the likelihood of visible heritage resources occurring in such areas is low. Areas that were densely overgrown with Black Wattle were also avoided, in part due to safety considerations but mainly due to general low visibility and difficult access in such areas. Existing agricultural fields were not surveyed as these features may have damaged or destroyed any archaeological sites that may have been present.

The table below gives an indication of the various heritage resources recorded in the area and Plan 26 depicts the Heritage Resources identified in the area.

1.1.15.2 Overview of project area

Three categories of general protected heritage resources were identified and recorded in the Project Area. These resources included built environment resources as defined in Section 34, archaeological and palaeontological resources as defined in Section 35, and burial grounds and graves as defined in Section 36 of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA).

Identified Section 35 archaeological resources included scattered concentrations of ceramic fragments. These resources were evaluated and determined as insignificant in terms of aesthetic historical, scientific and social significance as well as having no and/or negligible integrity. The Heritage Assessment report focussed on the resources found and identified within the project boundary.

*1.1.15.2.1 **Archaeological and Historical Resources***

One isolated Iron Age/Historic occurrence was identified and recorded in the project area on Mooifontein 35 IT Portion 5. The site S.35 045 represents a single, isolated occurrence of an undiagnostic potsherd ceramic fragment. The fragment was identified and recorded in a small rock shelter along a sandstone ridge.

Another isolated Iron Age occurrence was identified and recorded on Tevreden 56 IT Portion 4. The site S.35 051 represents seven un-diagnostic potsherd ceramic fragments approximately 300 m east of a opencast area. The site was recorded in a sandstone outcrop about 20 m east of a pan.

No other material culture was noted that might provide any further site context. No evidence of archaeological deposit was noted.

*1.1.15.2.2 **Built Environment Resources (Werfs)***

Two *werfs* were identified, one on Mooifontein 35 IT Portion 2 and the other on Tevreden 56 IT Portion 4.

The site (*MSO1805/2630AA/S.34-046*) recorded on Mooifontein 35 IT Portion 2 represents a single storey sandstone house, a sandstone barn, and two stonewalled enclosures most likely used as livestock pens. These structures are collectively known as a *werf*. There are several fields around the *werf*. Contemporary use of the house was noted. In addition, contemporary additions such as a metal window frame and bricks were recorded.

The site (*MSO1805/2630AA/S.34-050*) recorded on Tevreden 56 IT Portion 4 represents a sandstone house, garage, barn and two stables. There are several fields around the *werf*. Contemporary use of the house, barn and stables were noted. In addition, contemporary additions such as corrugated iron roof and door and windows with iron bars were recorded.

*1.1.15.2.3 **Burial Grounds and Graves***

Informal burial grounds were identified and recorded on Mooifontein 35 IT Portion 2 and Portion 5.

The informal burial ground identified (*MSO1805/2630AA/S.36-047*) and recorded on Mooifontein 35 IT Portion 2 has at least eight informal burials. The burials ranged from being stone-packed burials with headstones to stone-packed burials without headstones. The burial ground is in a poor condition. The burial ground may be associated with the local community and/or the original occupants of the werf at Site S.34-046. The burial ground is located in the opencast mine area.

The informal burial ground identified (*MSO1805/2630AA/S.36-048*) and recorded on Mooifontein 35 IT Portion 5 has at least nine informal, stone-packed burials and one formal burial. The burial ground is in a poor to fair condition and is overgrown. The burial ground may be associated with the local community and/or farmworkers. The burial ground is located in the opencast mine area.

An informal burial ground (*MSO1805/2630AA/S.36-052*) was identified and recorded on Tevreden 56 IT Portion 4. At least 23 informal, stone-packed burials were noted. The burial ground is in a poor to fair condition and is overgrown. The burial ground may be associated with the local community and/or farmworkers. The burial ground is located 400 m south west of the opencast mine area.

1.1.16 Socio-economic Environment

On the basis of the information collected through the desktop review and interviews with key informants, a socio-economic baseline profile was compiled of the local and regional study areas. Topics considered as part of this profile include the following:

- Demographics, including population size and growth, composition, age and gender distributions;
- Educational levels and employment;
- Economic conditions, including an overview of the most prominent economic activities in the area;
- Infrastructure and services;
- Community needs and challenges, as well as municipal strategies to address these needs;
- Land claims, spatial development and land use; and
- Conservation and cultural heritage.

For ease of reference throughout the baseline description, the Albert Luthuli Local Municipality will be referenced ALLM and the Msukaligwa Local Municipality will be referenced MLM. The Gert Sibande District Municipality will be referenced GSDM.

The Harwar MRA area falls entirely within the boundaries of the ALLM and borders the MLM that is located to the south. The baseline information of both these municipalities are discussed as it is viewed that the MLM will also be affected by the proposed project and the towns of Chrissiesmeer and Breyten fall within the boundaries of the MLM. These two local municipalities fall within the boundaries of the GSDM.

A Social Assessment Report was compiled for this area and attached as Appendix J.

Three concentric study areas were defined for the purposes of this study. These are as follows:

- The site-specific study area – the area likely to experience impacts related to the physical intrusion by project infrastructure and project-related activities. This study area is defined as the extent of the farm portions on which the project footprint is located, as well as the immediately adjacent farm portions. This area falls entirely within Ward 21 of the ALLM.

- The local study area – the area likely to experience impacts related to the "economic pull" exerted by the project. This area is defined as the affected local municipalities in which the proposed project is situated, which includes the towns of Ermelo, Breyten, Carolina and Chrissiesmeer. These two aforementioned local municipalities also encompass the MLD, which is located around the Chrissiesmeer area.
- The regional study area – the area likely to experience the indirect or induced impacts of the project. This area is defined as the GSDM.

Geographical information about the study areas is provided, after which a socio-economic baseline profile of these areas is presented. The inclusion of this information is motivated by the fact that an understanding of the social environment is required in order to anticipate and understand the potential social impacts that may result from the proposed project.

The information presented in this section is mostly based on the following data sources:

- The 2011 Census undertaken by Statistics South Africa;
- The Integrated Development Plan (IDPs) and Spatial Development Frameworks (SDFs) of the affected district and local municipalities;
- Previous studies conducted in the area (including previous EIA reports) and other planning reports relevant to the broader area (e.g. the Environmental Management Framework (EMF) for the ALLM and MLM, prepared by SRK Consulting in 2010); and
- Qualitative data obtained through consultation with local stakeholders by means of interviews, as well as spatial data obtained during the investigative site visit.

1.1.16.1 Geographical description of the regional and local study areas

The GSDM is the largest of three municipalities, covering roughly 31 800km², equating to about 40% of the Mpumalanga Province's land mass.

The GSDM consists of seven local municipalities. The main town and surface area of the two municipalities that comprise the local study area are provided in Table 1-24. In addition to the towns listed in this table, major settlements within the district municipality include Bethal and Evander.

Table 1-24: Local municipalities within the Gert Sibande District Municipality

Local municipality	Main town	Surface area (km²)	Percentage of GSDM	Population density (people per km²)
Albert Luthuli	Carolina	5 559	17%	33
Msukaligwa	Ermelo	6 017	19%	25
GSDM	**-**	**31 841**	**100%**	**33**

The identified local municipal areas will likely experience impacts related to the "economic pull" exerted by the proposed project. As listed in Table 1-24 above, the main towns within the local study areas are Carolina (including its township area Silobela) and Ermelo. Other residential areas of importance to this study are Chrissiesmeer, Kwachibikhulu, Breyten and Kwazanele. Their importance lies partially in their proximity to the proposed project site, and partially in their demographic profile (inter alia, large numbers of relatively poorly educated and unemployed individuals). Chrissiesmeer has been included by virtue of its importance to the local communities, stemming from its unique biodiversity and the associated employment opportunities created by it.

1.1.16.2 Land Claims

Most land claims in the local study area are located in the eastern and south-eastern parts of the ALLM. There are, reportedly, no other land claims on the farm portions directly affected by the proposed project.

1.1.16.3 Spatial development

Knowledge of land use and spatial development is required in order to gauge the extent to which the proposed project is aligned with the area's current and future development plans, which will partially determine if the proposed project area will be able to accommodate the proposed project. Brief descriptions of the spatial development of towns located closest to the proposed project area (Chrissiesmeer and Breyten) are given below. [5]

1.1.16.3.1 Breyten / Kwazanele area

Although the Breyten / Kwazanele has stagnated somewhat over the past decade, it falls within the central development hub of the MLM and is expected to grow in future, especially as coal mining in the surrounding areas is expected to increase significantly (Msukaligwa Local Municipality, 2010).

The core area of Breyten/Kwazanele includes the town of Breyten and it contains the bulk of the existing urban amenities in the area. The area as a whole is degraded with many vacant

[5] The SDF for the ALLM was not available at the time of writing this report. As such, updated information regarding the spatial development of Carolina and Hendrina was not available.

and neglected buildings. As such, an urban regeneration programme is required for the area (Msukaligwa Local Municipality, 2010). The MLM envisions that a wide range of compatible land uses should be promoted in this core area, including residential densification in order to increase the viability of existing businesses and facilities.

A secondary activity node is indicated in the central part of Kwazanele, to serve the surrounding township community. This area already functions as an activity node, with a wide variety of land uses situated here; however, denser development with the addition of medium to high density housing is proposed (Msukaligwa Local Municipality, 2010).

The south-western part of Breyten is proposed as a future industrial or commercial area. This area is currently mostly vacant, with some houses, a transport business and the bulk water reservoirs situated within it. Due to its accessibility in terms of both rail and road, the MLM is of the opinion that this area should be promoted as a good location for transport, logistics and mining-related concerns (Msukaligwa Local Municipality, 2010).

Kwazanele and the Matthews Phosa Village on the northern edge of Breyten have been demarcated as service upgrading priority areas. These areas are generally characterized by low levels of infrastructural and social services (Msukaligwa Local Municipality, 2010). Future urban development is envisaged mostly to the east and south of Kwazanele, along the R36 road.

1.1.16.3.2 Chrissiesmeer / Kwachibikhulu area

The promotion of eco-tourism in the Chrissiesmeer pan-veld area has been identified as a key LED strategy and as such has been identified as a “tourism node” (Msukaligwa Local Municipality, 2010). Tourism into this area has increased significantly in the recent past, resulting in the establishment of a number of guesthouses and self-catering cottages, and in a relatively steep increase in local property prices. The MLM recognises that the town of Chrissiesmeer has a unique rural ambience which attracts visitors and investors, and that certain developments could destroy this ambience (Msukaligwa Local Municipality, 2010).

Development guidelines for this area suggest that the areas either side of the N17 (which runs through Chrissiesmeer) are redeveloped as a tourism-orientated business area catering for a variety of functions, including retail, entertainment, accommodation, etc. Furthermore, the guidelines state that the locations leading to the aforementioned “high street spine” are demarcated as conservation areas where the emphasis should be on the preservation of the ‘village character’ (Msukaligwa Local Municipality, 2010). The Kwachibikhulu Township has been demarcated as a priority area for service upgrading. The MLM envisions that any expansion of the area should take place to the north, and not towards the lake.

1.1.16.4 Economic overview

The key economic sectors in the GSDM (in terms of contribution towards the provincial and national Gross Geographic Product (GGP), as opposed to the number of employment opportunities offered) are as follows (Gert Sibande District Municipality, 2012):

- Manufacturing;

- Mining (especially coal and gold) and quarrying;
- Energy generation and supply;
- Agriculture (including crops and livestock) and forestry, especially in Standerton, Ermelo, Bethal and Piet Retief;
- Tourism; and
- Services.

Mining plays an important role for the region's output as there is extensive mining activity in the area. In addition to coal and gold, the province also produces most of the country's talc, magnetite and arsenic concentrates.

Coal mining has been identified as an economic opportunity in MLM, and its existence is expected to have a significant positive impact on the local economy by creating direct employment opportunities and through the stimulation of other economic sectors such as transport and construction (Msukaligwa Local Municipality, 2010). The MLM does, however, recognise the negative environmental impacts that may result from mining and impact negatively on other economic sectors such as tourism.

The Mpumalanga Tourism and Parks Agency (MTPA) divided the province into several themed tourism areas/segments. These segments include Cosmos Country, Cultural Heartland, Grass and Wetlands, Highland Meander, Lowveld Logogote, and the Panorama and Wild Frontier. Tourism's contribution to the local economy is still relatively small, and requires that specific strategies, especially those focussing on ecotourism, be developed (Chief Albert Luthuli Local Municipality, 2012).

Agriculture accounts for approximately 7% of Mpumalanga's GGP, making it the fourth largest contributor to the provincial economy after manufacturing, mining and electricity (Gert Sibande District Municipality, 2012). There are numerous farms in the study area involved in agricultural activities. The central and western parts of GSDM are dominated by commercial agricultural activities, whereas the eastern areas are characterised by a north-south band of commercial forestry stretching from Carolina and Warburton in the north, to Amsterdam and Piet Retief in the south (Gert Sibande District Municipality, 2012).

While the economy is reliant on the agricultural sector, the availability and cost of water is likely to be restrictive to expansion of forestry and agriculture (SRK Consulting, 2009).

Inadequate infrastructure, long distances to major markets and skills shortage have been identified as major threats to sustainable economic growth in the study areas (Gert Sibande District Municipality, 2012). Between 2000 and 2010, the economy of both the ALLM and MLM grew at a below national average rate, at 2% and 2.4% per annum respectively (SED Services, 2012).

1.1.16.5 Socio-economic conditions

This section presents the baseline profile of the regional and local study areas, namely the GSDM, the ALLM and the MLM. Some municipal ward-level statistics relevant to the site-specific study area are also explored.

1.1.16.5.1 Demographic information

As a first step to understanding the social conditions in the study areas, is through considering the population size and growth, population composition, and age and gender distribution.

1.1.16.5.2 Population size and growth

According to the 2011 Census (Statistics South Africa, 2011), just more than one million people reside in the Gert Sibande District Municipality; 65% of these individuals reside in formal residential areas, 15% on farms or small holdings and 13% in traditional residential areas (Figure 1–16). About a fifth of the district's population (just more than 186 000 individuals) can be found in the ALLM, and a further 14% (almost 150 000 individuals) in the MLM. The percentage of the population resident in the different types of residential areas in the ALLM is comparable to that of the district municipality. In the MLM, a higher proportion of the population are resident in informal residential areas and farms / small holdings.

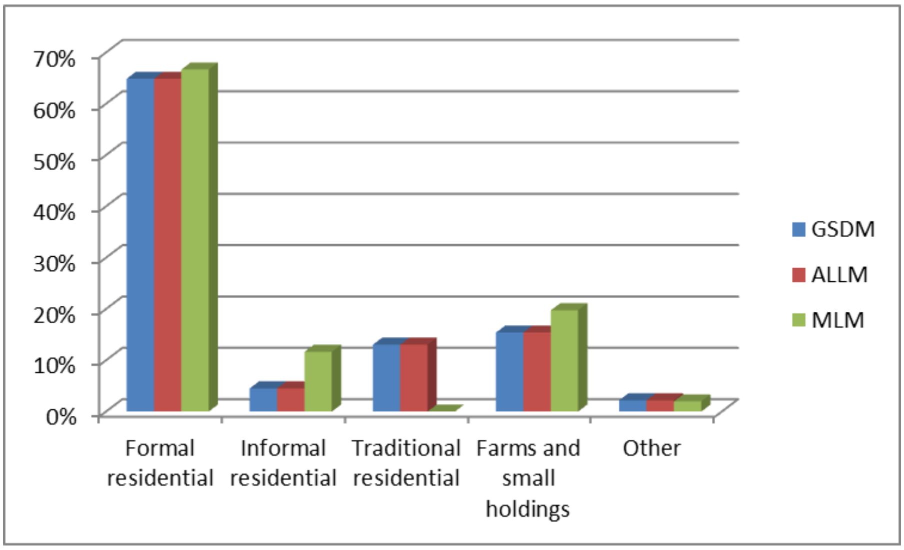

Figure 1–16: Type of residential area per municipality

In the ALLM, the majority of the population (approximately 80%) are resident in the rural (albeit formal) villages in the eastern part of the municipal area. A further 10% of the population reside in Carolina and approximately 5% in Badplaas (Chief Albert Luthuli Local Municipality, 2012). The remaining 5% of the population are scattered across the farming and forestry areas in the municipal area. In the MLM, about a quarter of the population reside in Ermelo and a further 20% in Wesselton (Msukaligwa Local Municipality, 2012). Approximately 3% of the population is resident in rural areas.

Roughly 9 900 individuals (about 5% of the local municipality's population) reside in Ward 21 of the ALLM. Just less than two-thirds of this population live on farms, a further 23% in formal residential areas, and 13% in informal residential areas.

When comparing the 2011 Census statistics with that of the 2001 Census, it shows that the population of the GSDM has grown by a total of 16% between 2001 and 2011, compared to 20% in the MLM. The ALLM has experienced a negative growth rate of 1% during this decade. According to the local municipality's IDP, this net out-migration occurs towards Gauteng, Witbank and Ermelo (Chief Albert Luthuli Local Municipality, 2012).

1.1.16.5.3 <u>Population composition</u>

The population breakdown of the local and regional study areas is presented in the Social Assessment report. Black Africans account for the vast majority (88% or more) of the study areas. The White contingent in the ALLM is almost negligible, whereas 10% of the population in the MLM, and 9% in the GSDM are White. In Ward 21 of the ALLM, 84% of residents are Black African, while 15% are White.

IsiZulu is the most commonly-spoken language in both the GSDM and MLM, whereas SiSwati it dominant in the ALLM. In Ward 21 of the ALLM, IsiZulu is the first language of 39% of residents, and SiSwati the first language of 23% of residents. First language English and Afrikaans speakers comprise 13% of the population in MLM, only 4% in ALLM, and 17% in Ward 21 of the ALLM.

1.1.16.5.4 <u>Age and gender distribution</u>

The ratio of males to females in the GSDM and the MLM is very close to equal, but is slightly skewed in the ALLM where 47% of the population is male (Statistics South Africa, 2011). Conversely, in Ward 21 of the ALLM, 52% of the population is male.

The study area is characterised by a relatively young population, with approximately one-third of individuals in the GSDM and MLM being under 16 years of age. This percentage increases to 39% in the ALLM. A large proportion of the population in each of the municipal areas is between the ages of 21 and 30, indicative of a large potential workforce in the local area to meet the needs of the project – provided that adequate skills are available.

The age distribution of the population in Ward 21 of the ALLM is comparable to that of the other study areas: about a third of the population is 15 years or younger, and about a fifth are between the ages of 21 and 30 years. Only 7% of the population is older than 65 years.

1.1.16.6 Education

School attendance of individuals between the ages of six and 20 is high in the regional and local study areas: 87% of these individuals in the GSDM, 90% in the ALLM, 86% in the MLM and 85% in Ward 21 of the ALLM were attending school in 2011 (Statistics South Africa, 2011).

The MLM and the GSDM are comparable in terms of overall education levels, but the levels in ALLM are somewhat lower with nearly a fifth of the population not having received any formal schooling and only 6% having been educated beyond secondary school level.

The education profile of Ward 21 in the ALLM is comparable to that of the ALLM as a whole.

In 2010, 65% of the population in the GSDM, 56% in the ALLM, and 65% in the MLM were considered to be functionally literate (Gert Sibande District Municipality, 2012). The advantage of being functionally literate is that one is more likely to be employed, and more likely to earn a better salary than someone who is illiterate.

1.1.16.7 Employment

Employment-related information presented in this section pertains to levels of employment, household income and the economic sectors in which working individuals are employed.

1.1.16.7.1 Levels of employment

As indicated in Figure 1–17, more than a third of the population between the ages of 20 and 64 years in the MLM and GSDM are not economically active[6], (as is the case in Ward 21 of the ALLM) while the same applies to almost half of the population residing in ALLM (Statistics South Africa, 2011). The level of unemployment is at 17% in both the ALLM and the MLM, which is 1% lower than for the GSDM. In Ward 21 of the ALLM, the unemployment level is at 12%

Unemployment is most rife among individuals between the ages of 20 and 24 years (almost a third of these individuals are unemployed), and decreases both gradually and consistently for the older cohorts. Unemployment rates also differ between males and females. In 2009, 60% of unemployed individuals in the district municipality were female (Gert Sibande District Municipality, 2012).

[6] There are various categories of individuals comprising the category of being economically inactive, most notably the discouraged work seekers, homemakers, students, those who are too old to work and those who have a disability or illness preventing them from working.

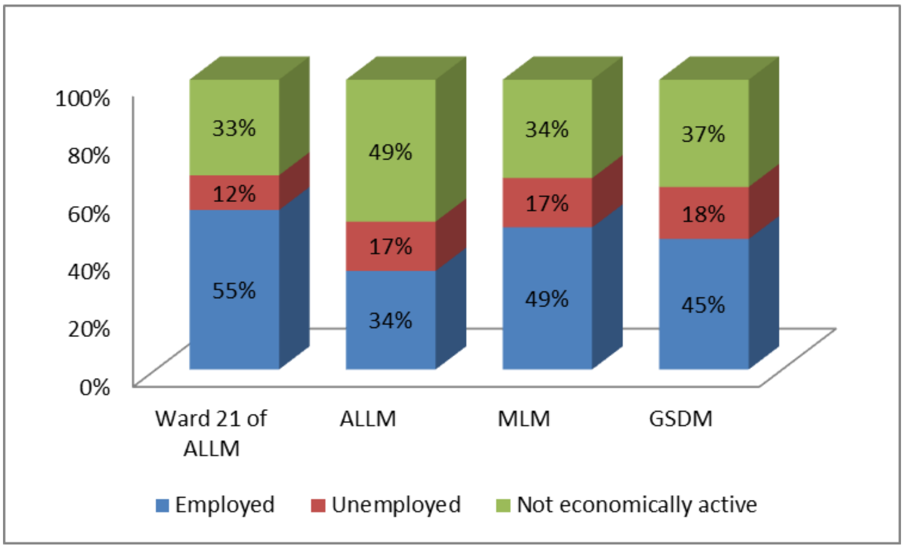

Figure 1–17: Levels of employment of individuals between 20 and 64 years of age

1.1.16.7.2 Household income

Employment rates and types of employment have a significant effect on income levels. The distribution of monthly household income in the study area (as recorded during the 2011 Census) is shown in Figure 1–18. As can be seen from this figure, between 12% and 15% of households in each of the municipalities under consideration have no income whatsoever, while half of the population in MLM and GSDM live off R3 200 or less a month. This percentage increases to 63% in the ALLM. Compared to the local and regional study areas, a smaller percentage of households in Ward 21 of the ALLM have no income (9%, compared to between 12% and 15%), and 56% of households (compared to 63% in the ALLM as a whole) live off R3 200 or less a month.

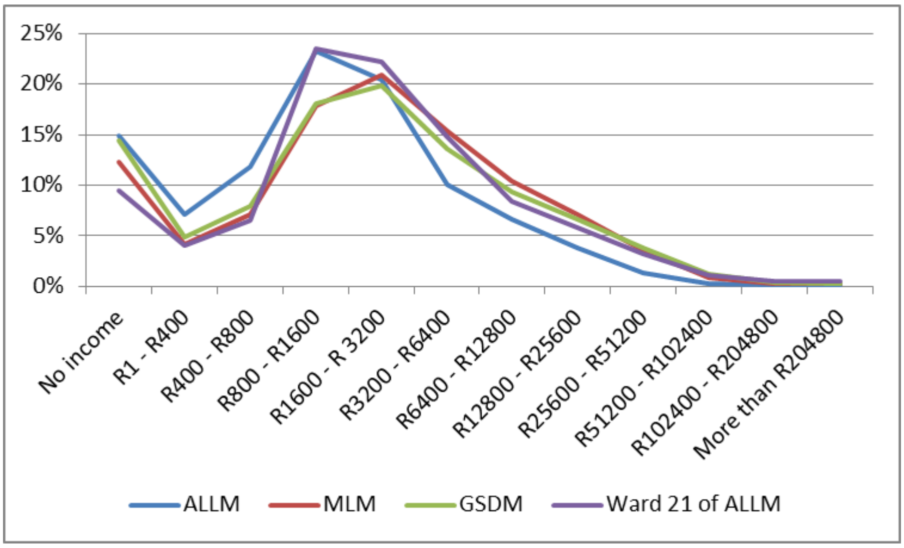

Figure 1–18: Distribution of monthly household income levels

Linked to the low income levels in the study areas, is the percentage of the population who lives in poverty. Almost half of the population in the GSDM lived in poverty in 2010 (Gert Sibande District Municipality, 2012). Although the level of poverty has decreased since 2001, it is still higher than the provincial and national averages (42% and 38% respectively) (SED Services, 2012).

The Black African racial group is most severely affected by poverty, with more than half of Black persons resident in the district municipality being considered poor. The poverty profile for the two local municipalities under consideration is comparable to that of the GSDM (Msukaligwa Local Municipality, 2010).

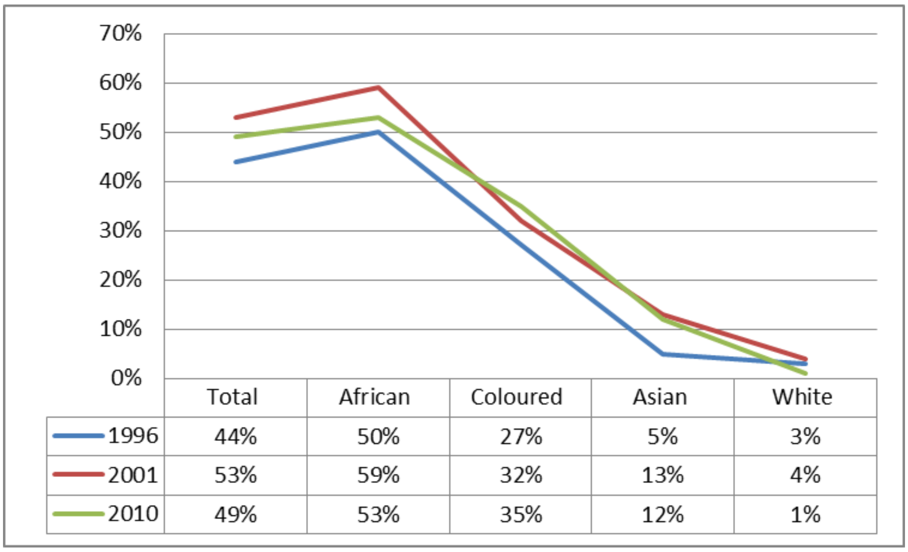

Figure 1–19: Poverty levels per racial group in the GSDM (1996 to 2010)

1.1.16.7.3 Employment sectors

Most of the employed individuals between the ages of 20 and 64 years are employed in the formal sector (Figure 1–20). The only notable difference between the areas under consideration is that the informal sector in Ward 21 of the ALLM and the ALLM as a whole is larger than what it is in the other two areas.

Figure 1–20: Employment sectors

Employment sector	Ward 21 in ALLM	ALLM	MLM	GSDM
Formal	63%	68%	72%	74%
Informal	27%	23%	17%	16%
Private household	10%	10%	11%	11%
Total	100%	100%	100%	100%

The most prominent employment sectors during 2010 in the GSDM are as follows (Gert Sibande District Municipality, 2012) (also refer to Figure 1–21):

- Trade, accounting for almost a fifth of all employment opportunities;
- Community services, accounting for 16% of jobs;
- Mining, accounting for just more than 14% of jobs;
- Agriculture, accounting for just less than 14% of jobs; and
- Manufacturing, accounting for approximately 12% of job opportunities.

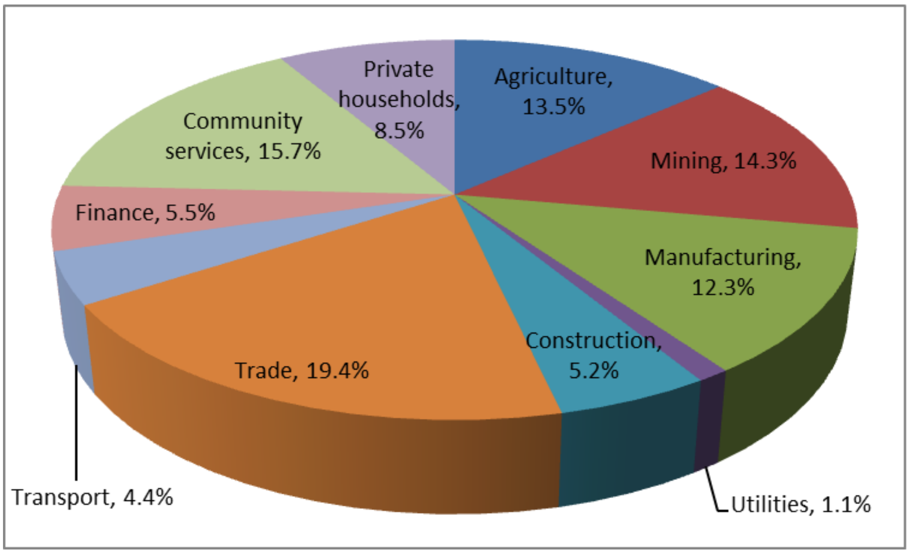

Figure 1–21: Employment sectors in the GSDM (2010)

According to the Integrated Development Plan (IDP) for the GSDM, the tourism sector does not feature within the main categories of the various employment sectors. This is mainly due to the different jobs within the tourism industry, which leads to the tourism being classified along with the other various employment sectors. The comparative economic and tourism study should provide a better understanding of the tourism sector within the immediate area of the proposed project.

In terms of the distribution of these employment opportunities, 8% are available in the ALLM, and 16% in the MLM (Gert Sibande District Municipality, 2012). The most prominent employment sectors in the local study area are listed in Table 1-25 (Gert Sibande District Municipality, 2012).

Table 1-25: Most prominent employment sectors in the local study areas (2010)

Ranking	ALLM		MLM	
	Sector	Proportion of employment opportunities	Sector	Proportion of employment opportunities
Most prominent	Community services	19%	Agriculture	15%
Second	Agriculture	14%	Transport	13%
Third	Transport	14%	Community services	12%
Fourth	Trade	13%	Finance	12%
Fifth	Construction	10%	Private households	11%

1.1.16.8 Infrastructure and services

Figure 1–22 below gives an overview of access to and utilisation of services in the local and regional study areas, as reflected in Census 2011 statistics (Statistics South Africa, 2011). Five types of services are depicted in the figure:

- Housing (the figure showing the percentage of households who live in formal houses);
- Household energy (the figure showing the percentage of households who use electricity for lighting);
- Water (the figure showing the percentage of households whose main water source is managed by a municipality or another water services provider);
- Sanitation (the figure showing the percentage of households who have flush toilets); and
- Refuse removal (the percentage of households who have their refuse removed by their local authority or another service provider at least once a week).

Roughly a quarter of the GSDM households reside in structures inferior to formal housing, about 20% of households do not have access to either electricity or water managed by the municipality or another water services provider, and about a third of households do not have access to a flush toilet or weekly refuse removal.

The provision of formal housing and electricity in the ALLM is comparable to that of the GSDM. However, 69% of households (compared to 82% in GSDM) have access to water managed by the municipality or other water services provider, and only approximately 20% of households (compared to more than two-thirds in GSDM) have access to a flush toilet or weekly refuse removal.

In the MLM, the provision of services is similar to that of the district municipality. Notable differences are seen in the use of electricity for lighting (about 10% fewer households in MLM make use of electricity for this purpose), and access to flush toilets (about 7% more households in MLM have access to these toilets).

With regards to Ward 21 in the ALLM, 61% of households are resident in formal dwelling structures, 69% have access to electricity, 42% obtain their water from a source managed by the municipality or another water services provider, 22% of households have their refuse removed at least once a week, and 39% have access to a flush toilet. The main land use in the ward is agriculture, thus settlements are scattered. It is mostly land / farm owners and their workers who are resident in Ward 21.

The state of these services is discussed below as well as the state of public service infrastructure related to transport, health, education and policing in the local municipal area, however graphs depicting this are provided in the Social Assessment Report

Figure 1–22: Access to services

1.1.16.8.1 <u>Housing</u>

The GSDM has achieved some success since 1996 in providing its residents with formal housing. In 2011, 72% of the households in the district municipality resided in formal dwellings, compared to 77% in the ALLM and 75% in the MLM (Statistics South Africa, 2011). Most progress has been achieved in the ALLM where less than half of the population had access to formal housing in 1996 (Gert Sibande District Municipality, 2012).

In the ALLM, there still exists a substantial housing backlog. In addition, the establishment of townships and formalising of informal settlements have been identified as community needs in the ALLM (Chief Albert Luthuli Local Municipality, 2012). If this could be accomplished, headway could be made in terms of the provision of formal dwelling structures and other basic services.

*1.1.16.8.2 **Household energy***

Significant progress has been made since 1996 in terms of providing electrical connections to households; almost 80% of households in the GSDM have access to electricity (Gert Sibande District Municipality, 2012). This percentage decreases to 72% in the MLM and 68% in the ALLM, the latter being the lowest in the district municipality.

The ALLM is currently experiencing a backlog of just more than 18 200 households, most of which are located in rural areas, informal settlements and the township of Silobela (Chief Albert Luthuli Local Municipality, 2012). Similarly, the provision of electrical connections to households scattered across the MLM remains a challenge (Msukaligwa Local Municipality, 2012).

*1.1.16.8.3 **Water***

The proportion of households in the study areas that have access to piped water at or above RDP-level has increase significantly since 1996. Just more than 80% of households in the GSDM had access to such water in 2009 (Gert Sibande District Municipality, 2012). This service is better established in the MLM than the ALLM, where 90% and 75%, respectively, have access to RDP-level piped water.

In 2009, the ALLM registered the highest number of households without piped water at or above RDP-level in the entire district municipality. This municipality is currently experiencing a backlog of almost 7 300 household piped water connections, the vast majority of which are located in rural and peri-urban areas (Chief Albert Luthuli Local Municipality, 2012). The sinking of boreholes, the provision of bulk water supply, and reticulation has been identified as community needs in most of the areas of the ALLM (Chief Albert Luthuli Local Municipality, 2012).

The provision of water to the rural and farmland areas in the MLM remains a challenge. An estimated R7 million is required to eradicate the backlog of water provision in the MLM; however, the municipality’s budget for the provision of this service is less than half of this amount (Msukaligwa Local Municipality, 2012).

*1.1.16.8.4 **Sanitation***

In the GSDM, some progress has been made with the provision of “hygienic toilets” at household level since 1996. Three quarters of the population in both the GSDM and MLM had access to such toilets in 2010 (which includes, but is not limited to, flush toilets) (Gert Sibande District Municipality, 2012). However, only a third of the population in the ALLM have the same standard of sanitary facilities. Since 2001, little progress in the provision of sanitary facilities has been made in the two local municipalities under consideration.

The ALLM is currently experiencing a backlog amongst almost 31 300 households; the municipality recognises that this backlog is significant and that a substantial financial injection will be required to address this problem (Chief Albert Luthuli Local Municipality, 2012). As a starting point, the municipality aims to replace existing basic opencast area latrines with ventilated improved opencast area latrines (VIPs). Similarly, in the MLM, the municipality endeavours to provide VIPs to both the rural and formal township areas.

1.1.16.8.5 __Refuse removal__

There exist a number of challenges in the district municipality that hamper the efficient and adequate removal of refuse, including un-permitted and un-rehabilitated landfill sites, the decreasing capacity of existing sites and an increase in refuse due to increased economic development, urbanisation, as well as mining and industrial activities (Gert Sibande District Municipality, 2012). In the ALLM, there is a backlog of nearly 40 000 households (the refuse removal for these households is below the RDP-level of service) (Chief Albert Luthuli Local Municipality, 2012). Most of these households are resident in the rural areas where there is no formalised solid waste disposal system. This has resulted in environmental problems as a result of dumping rubbish next to streams (Chief Albert Luthuli Local Municipality, 2012). Although the proportion of the population who receive adequate waste removal services is higher in MLM than in ALLM, the MLM is still experiencing a backlog of about 9 400 households in this regard (Msukaligwa Local Municipality, 2012).

1.1.16.8.6 __Public services infrastructure__

Several public sector services provided within the area is indicated in the Social Assessment Report.

The status of four key public services will be discussed below – namely transport infrastructure, health, education and safety/ security:

- ***Transport infrastructure:*** the <u>district</u> road network is reportedly in poor condition, mainly due to high volumes of coal haulage trucks that transport coal to power stations within and beyond its jurisdictional area (Gert Sibande District Municipality, 2012). As such, and due to the negative impact of poor road conditions on LED (most notably tourism), the district municipality has in recent years invested heavily in the procurement of equipment and vehicles for road maintenance. Some national roads, including the N17, N11 and N2 which links the district municipality to neighbouring provinces and Swaziland, have undergone reconstruction.
- Most of the district's major urban areas are located along the N17/N2 corridor, which runs through the GSDM from east to west. The major <u>regional</u> roads running through the study areas are the R33, R36, R38, R39 and the R65. In the ALLM, access to the

rural settlements (mostly located in the eastern part of the municipality) is provided via the N17 and R541 roads. Community needs in the ALLM relevant to transportation infrastructure include paving and tarring of roads, the construction and maintenance of bridges, as well as the construction of ring roads, speed humps and sidewalks (Chief Albert Luthuli Local Municipality, 2012).

- ***Health:*** there are few private doctors and facilities within the broader study areas, implying that the majority of the population rely on government-funded health care facilities. It is thus essential that the quality of care provided by such health facilities is adequate, especially in light of the fact that HIV / AIDS is rife, both within the province and the district municipality. Mpumalanga Province is among the three provinces with the highest HIV infection rates, and the infection rate in the GSDM has increased over the past couple of years (Gert Sibande District Municipality, 2012). In 2010, 39% of the population in the GSDM was HIV-positive. This percentage increases to 47% in the MLM and decreases to 33% in the ALLM.
- ***Education:*** there are 417 primary schools and 171 secondary schools in the GSDM. When considering the size of the school-going population (individuals between the ages of six and 20), this translates into one primary school for every 390 children between the ages of six and 13, and one secondary school for every 855 individuals between the ages of 14 and 20. These figures are similar for the ALLM and MLM, except for proportionally greater availability of secondary schools in the ALLM (one for every 590 individuals aged between 14 and 20).
- ***Safety and security:*** as is the case for the majority of Mpumalanga Province, crime poses a major challenge for the people and authorities in the study areas under consideration (SRK Consulting, 2009). There are 37 police stations in the GSDM, seven of which are located in the ALLM and five in the MLM. The MLM is attempting to foster a co-operative relationship between the South African Police Service (SAPS), the South African Defence Force (SADF), Taxi Associations, the trade industry and the communities to collaborate in dealing with crime and injustice in the municipal area (Msukaligwa Local Municipality, 2012).

1.1.16.9 Community development

Generally, a municipality's strategy to develop its area of jurisdiction should be informed by the demographic characteristics of its population, as well as the perceived needs and challenges of its inhabitants. The first subsection below provides information about the perceived needs and challenges of the communities within the study areas, followed by an exposition of the municipal strategies or objectives aimed at addressing these needs.

1.1.16.9.1 Community needs and challenges

The following socio-economic development needs have been identified in the ALLM (Chief Albert Luthuli Local Municipality, 2012):

- LED, including the establishment and funding of small businesses;

- Erection of street lights;
- Construction of additional public service infrastructure, including post offices, police stations, hosopencast areaals, old-age homes, care centres for the disabled, community halls and youth centres, clinics, orphanages and day-care centres, sports facilities, taxi ranks, ABET centres, shopping complexes, community parks, and a substance and drug rehabilitation centre; and
- The establishment of a community radio station (especially in Wards 4 and 7).

The following socio-economic development needs have been identified in the MLM (Msukaligwa Local Municipality, 2012):

- Upgrading of roads and improved storm-water management;
- Provision of water, sanitation, housing (including land for housing), electricity, refuse disposal sites and public lighting;
- Skills development and the creation of job opportunities; and
- Construction of speed bumps, sport facilities, multi-purpose centres, public parks, healthcare clinics and community halls.

1.1.16.9.2 Municipal strategies to address community needs and challenges

The ALLM have identified several strategic objectives in an attempt to address the needs and challenges faced by its inhabitants (Chief Albert Luthuli Local Municipality, 2012). The strategic objectives comprise the following:

- Provision of basic services, roads and storm-water management;
- Economic growth, development and job creation;
- Sustainable communities with clean, healthy and safe environments and integrated social services;
- Foster participatory democracy and implement the Batho Pele Principles;
- Promote sound governance;
- Ensure financial sustainability; and
- Organisational development and transformation.

The strategic objectives of the MLM to address the needs of its population are the following (Msukaligwa Local Municipality, 2012):

- Public participation and good governance;
- Local Economic development;
- Financial viability;
- Municipal institutional transformation and organisational development;and
- Basic service delivery.

Descriptions of these strategic objectives and lists of planned municipal projects, aligned with the strategic objectives listed above, are available in the IDPs of these municipalities.

1.1.17 Traffic Conditions

The project area enjoys very good regional accessibility in that it is located close to the R 33, N17, P117-1, R542 and the R36 which are national and provincial routes, offering road network connectivity to the wider surrounding areas. The R33 passes through the project area on the northern border. The P117-1 road traverse the project area close to Tevrede se pan and this road connects Carolina with Chrissiesmeer. The P117-1 road has a tonnage restriction of 10 tonnes (Provincial road sign). The R542 pass the project area to the south and connects Chrissiesmeer with Breyten. The N17 is a national route connecting Chrissiesmeer with Ermelo. The R542 and the N17 intersects the R36 towards the west. The Spitzkop Colliery is situated along the R36 approximately 5 km and 7 km south of Kwazanele and Breyten respectively.

The Road Classification and Access Management (RCAM) guideline 2010 provides for roads classification into the following six class systems:

- Class 1: Principal arterial
- Class 2: Major arterial
- Class 3: Minor arterial
- Class 4: Collector
- Class 5: Local Street
- Class 6: Walkway

The first three classes (the arterials) are mobility roads, the second three classes are activity / access streets.

1.1.17.1 Road Classification

The proposed project area is serviced well with a class 1, 2 and 3 network which feeds onto the surrounding network. The N17 and R36 are Class 2 routes, primary distributors.

The N17 is a national road, under the jurisdiction of South African National Roads Agency Limited (SANRAL). The section of the road within the project area's vicinity can be classified as a Class 2 arterial. It links up the major regional destinations and the surrounding local network. According to the information available from SANRAL the road carries fairly high traffic volumes with Annual Average Daily Traffic volumes of between 2000 and 5000 vehicles. The road is a single carriageway and has gravel shoulders. The existing road surfaces indicate that the road currently has a good riding surface and is being maintained and the posted speed limit is 120km/hr; this is reduced on approaches to Chrissiesmeer.

The R36 (P26-3) is a provincial road, which can be classified as a Class 2 arterial. It links up the major regional destinations and the surrounding local and national road network. According to the information available from the provincial department the road carries fairly high traffic volumes with Annual Average Daily Traffic volumes of between 2000 and 5000 vehicles. The road is a single carriageway and has gravel shoulders; however at certain sections the near towns the road has localized upgrade to absorb the increased urban traffic. The existing road surfaces indicate that the road currently has a good riding surface and is being maintained.

P117-1 is a provincial road, linking Carolina to Chrissiesmeer. It can be classified as a Class 3 arterial as it links up the major regional destinations and the surrounding local and national road network. According to the information available from the provincial department the road carries fairly high traffic volumes with Annual Average Daily Traffic volumes of between 2000 and 5000 vehicles. The road is a single carriageway and has gravel shoulders. The road however has tonnage restrictions raising concerns on the structural strength of the existing pavement. This road currently has a tonnage restriction of 10 tonnes (Provincial road sign) which poses a risk in terms of the carrying capacity of this road should any heavy mine vehicles use this stretch of road.

The existing road surfaces indicate that the road currently has a good riding surface and is being maintained. The posted speed limit on the road ranges between 80km/hr to 100km/hr.

Gravel Road D270/D239 is a provincial road and can be classified as a Class 3/4 minor road, which act as collectors linking up to the surrounding road network. The gravel road forms part of the immediate road network for the surrounding farming community around the project area extent and carry low traffic volumes.

1.2 Description of each of the existing environmental aspects which may require protection or remediation

Due to the project area and surrounding areas being characterised by sensitive natural environments and the fact that the project area is an important water catchment area (EMF, 2010), the identified sensitive areas should be avoided. The project area will require post-closure monitoring and management in order to obtain rehabilitation success which will enable the land to return to pre-mining activities. The environmental aspects identified that may require protection or remediation are described below.

1.2.1 Aquatic Ecology

Based on the NFEPA, the associated river systems are considered important for ecosystem maintenance (WRC, 2011). Plan 14 depicts the NFEPA priority areas identified within the project area and its surrounds. A high sensitivity is given to aquatic ecosystems containing species that may be highly sensitive to any modifications in the catchment area. The plan indicates that the area to the east of the project area is regarded as highly sensitive and the area to the west is indicated as moderately sensitive.

The aquatic ecosystems associated with the proposed Harwar project vary from natural to moderately modified states.

When the current aquatic ecological study is compared to the ecological and management categories for the quaternary catchments set out in Kleynhans (2000), the Present Ecological Status Categories of the Mpuluzi River reaches is not largely natural and is a Class C/B. The Boesmanspruit is no longer in a Class B and is now Class B/C. The reach of river in the Buffelspruit has an improved Present Ecological Status Category from Class C to Class B. The Ecological sensitivity classes for each quaternary catchment remain the same as in Kleynhans (2000).

A single near threatened species was expected to be present within the Mpuluzi River. This species was however not sampled during the low flow survey conducted in 2013. The National Red Data Status and protected fish species list (Government Gazette, 16 April 2013) was consulted and no red data or protected fish species were present in the associated aquatic ecosystems. The fish species present and expected in the associated ecosystems are endemic to several other river systems in the surrounding area and are not restricted to the affected river courses.

The associated ecosystems provide various functions including habitat for spawning of local fish populations and tourism functions. The amphibians of the associated river systems are of great importance to the local tourist attractions. Several sites along the affected river courses, namely the Mpuluzi River and Buffelspruit have habitat that may serve as spawning areas for various species.

The current land use within the Mpuluzi River and Boesmanspruit catchments is currently impacting on the ecological state of the catchment with the main impacts being livestock agriculture, forestry encroachment and the creation of small impoundments. Any development within these catchments must ensure no impacts on the receiving aquatic environment through the implementation of appropriate mitigation measures.

Should mining go ahead within these catchments, it is recommended that biomonitoring activities should occur bi-annually.

1.2.2 Archaeological / Cultural Aspects

Evidence from the assessment conducted for this HIA indicates that several tangible heritage resources occur within the Harwar Colliery project area. These resources give context to the intangible heritage of this cultural landscape.

Architecturally, adequate assessment of the built environment is required to accurately identify structures of historical significance and assess the potential impacts of the proposed mining. As such, a Phase 2 Built Environment Impact Assessment is recommended for the Harwar Project.

1.2.2.1 Built Environment Resources

It is recommended that the werf S.34 046 and werf S.34 050 undergo a Phase 2 Built Environment Assessment by a qualified historical architect to accurately determine the significance value of the resources and provide appropriate mitigation measures. If the site is not 60 years or older then it may not require further assessment.

1.2.2.2 Burial Grounds and Graves

The burial grounds S.36 047 and S.36 048 will be negatively impacted by the proposed mining activity as it lies directly in the proposed opencast area. As such, it is recommended that the burial ground be relocated should the project proceed. A Grave Relocation Plan (GRP) must be drafted and implemented in accordance with Section 36 of the NHRA and NHRA Regulations.

The informal burial ground S.36 052 was identified during the survey and could be impacted on. The immediate threats include site clearance for development. Potential sources of threats and risk include vandalism by workers on site and/or accidental destruction or alteration of the burials and burial ground by construction workers on site.

Potential impacts on the burial ground S.36 052 may be avoided though the implementation of feasible mitigation measures related to Project design and planning. The burials and the burial ground may therefore be preserved *in situ*, properly demarcated, ensuring protection during development and the long-term.

1.2.3 Flora and Fauna Aspects

The project area is of high biodiversity value (refer to Plan 20 and Plan 21 depicting the ecological sensitivity of the project area).

The proposed project area is characterised by transformed areas (agriculture) and areas of alien vegetation. These areas are classified as having a low ecological sensitivity. However, some natural areas are still present on the project area and these are classified as having a high to very high ecological sensitivity. The preliminary vegetation and flora assessment determined that the wetland areas, as well as the rocky ridges have a very high biodiversity value, along with remaining natural vegetation.

When the ecosystem function/services is taken into account, and considering the overall high biodiversity of the proposed project area (both flora and fauna) and the high biodiversity value of the regional area, specifically the proposed Chrissiesmeer Biodiversity Area, it is clear that the entire area is, as the updated C-plan indicates; irreplaceable.

The regional area, specifically the proposed Chrissiesmeer Biodiversity Area, is internationally important for biodiversity, and an application to proclaim and gazette the area as protected, as well as a RAMSAR site, is underway. The proposed Chrissiesmeer Biodiversity Area is also deemed irreplaceable from a biodiversity perspective.

Although additional studies have been recommended in order to place the proposed project area in context, it is clear from existing information that the area is of exceptional biodiversity value. It is certain that additional field studies will increase confidence herein, by adding support and evidence for this.

The catchment including the pan complex of Harwar should not be mined in any circumstances. Although it is recommended that no mining take place over the entire site, if the northern side should be mined, an offset strategy will be imperative. If this area is considered for mining, an offset study will need to be conducted in order to best assess biodiversity in the surrounding areas as well as what can be used realistically as an offset. It should be noted at this point, that as the grassland of the region is considered irreplaceable by the Mpumalanga C-plan, offsets will need to include restoration of grasslands, not simply setting aside of exisiting grassland areas.

1.2.4 Soils, Land Use and Land Capability

One of the key economic activities in the area is agriculture. Presently, the Harwar project area is used for arable commercial farming, specifically mixed arable and grazing (cattle). Agriculture in Mpumalanga has been in existence for more than a century. The project area is located within a high agricultural potential band within the ALLM.

The soils occupying the project area should be carefully managed due to the unique relation of the soil types occupying the Harwar project landscape with the sustainability of the pans in the project area. A Soil Management Plan is outlined in section 8.2 of the conceptual Rehabilitation Plan attached to this report as Appendix N.

1.2.5 Wetland and Pan Areas

The NFEPA wetlands map (refer to Plan 12) indicates that the wetland areas that occur within the project area are classified as depressions (pans), seeps and flats. The identified wetland areas are ranked (Rank 2 and Rank 4) due to the biodiversity support functions. According to the Mpumalanga Aquatic Biodiversity sub-catchments, the aquatic biodiversity of the X11B quaternary catchment is considered highly significant. The aquatic biota of the W55A quaternary catchment is described as irreplaceable.

The hillslope seepage wetland and the valley bottom without a channel, wetland areas are regarded as extremely important due to the water quality enhancement capacities. Furthermore the Tevrede se Pan is regarded as extremely important as a unique wetland system as well as the capacity to maintain biodiversity.

Tevrede se Pan Peatland complex is made up of Tevrede se Pan and a smaller perennial pan located south east of the main pan. Tevrede se Pan is covered by a dense growth of *Phragmites* reeds (emergent) with a narrow outer ring of open water. A stranded floating reedbed with a submerged peat body below the surface was identified by Grundling et al, (2007). A number of factors influence the formation of pans; these factors include climate, availability of geologically susceptible surfaces (mainly calcrete), surface disturbance by the animals and salt weathering, lack of integrated drainage system and deflational processes such as wind and waterborne erosion (Goudie and Thomas, 1985). Mining activities within the subcathment of Tevrede se Pan and the smaller perennial pan could have major impacts on the natural functionality of the pans. It is recommended that no mining activities should take place within the subcathment of Tevrede se Pan and the smaller perennial pan. According to McCarthy et al, (2007), there is little doubt that opencast coal mining will disrupt the hydrology of the pans, and irreversibly pollute the water in the pans.

1.2.6 Surface Water

A major concern with regard to surface water is the erosion control and sediment / contamination mobilisation on the slopes that will be cleared of vegetation at the proposed opencast areas and haul roads. The understandings of the hydrological process on the slopes, which may be impacted by the mining activities, are unknown.

Tevrede se Pan Catchment is a closed system and any impacts within this catchment may be very significant. It is imperative that further studies be undertaken in the understanding the pan's hydrology.

Sampled surface water at the perimeter of Tevrede se Pan is representative of pan water quality particularly since the samples were collected in the dry season where salt concentrations will increase due to evaporative losses.

Water quality descriptions at the various sample locations extracted from previous studies indicated that surface water within the area is generally of excellent quality.

The Boesmanspruit is of social and environmental importance in the area as it flows towards the Carolina Dam used for urban water supply. Inhabitants of informal settlements also make use of the raw dam/ stream water on a daily basis.

1.2.7 Topography Aspects

As indicated previously, the proposed project is situated on a topographically elevated area which forms a major watershed between the two WMAs. A number of rivers take their source from the project area. To the west and north, tributaries of the Boesmanspruit, Swartspruit and Buffelspruit drain the project site and eventually flow into the Komati River system. To the east, tributaries such as The Pearl Stream and Blouwaterspruit drain the project site towards Swaziland finding their way into the Mpuluzi and Great Usutu Rivers. The numerous rivers in the area have carved a number of valleys over millennia which have given rise to an undulating topography. Alteration of the project area's topography could alter on-site surface water drainage patterns.

Of particular concern to the topography is the position of some of the proposed opencasts as well as potential accompanying dumps on some of these slopes. The mean annual Precipitation for the region is 800 mm per year, and may be a cause of soil erosion if dumps and opencast areas are not maintained. Any soil erosion resulting from these opencast areas will wash down slope into nearby streams and pans which may cause sedimentation and possible contamination of water resources.

1.2.8 Groundwater Quality

It can be anticipated that mining operations could and will impact on the local groundwater system in terms of quantity and quality. There is the potential for the formation of Acid Mine Drainage (AMD). Geochemical test work is underway in order to determine the AMD of the parent material. These impacts may only become apparent after mining has ceased and the area has been rehabilitated.

If AMD is encountered, there is a very high risk that there will be significant long term negative impacts on surface water, groundwater quality and on aquatic systems, unless the potential decant water is effectively intercepted, collected and treated (at present it is expected that decant will occur).

AMD can impact on aquatic environments and once created; metals are released into the surrounding environment and become readily available to biological organisms. The impacts from AMD on aquatic systems can have detrimental impacts to aquatic ecosystems leaving them devoid of most living organisms. This can be further compounded when people and other animals depend on the river system for drinking water and food.

Based on the current hydrogeological assessment, it is indicative that there is a risk of AMD formation in these opencast areas. Taking into account the location of the proposed project it is anticipated that if the correct mitigations are not implemented that AMD water could enter the environment and have major impacts on the local water resources. As a result of the sensitivity of the area and the high levels of biodiversity it is important that the AMD risk associated with the proposed project is determined and the appropriate mitigation measures implemented to either mitigate the impact completely or reduce the impact to acceptable levels.

If water is allowed to cover the potential acid generating portions of the mining sequence for the foreseeable future and does not move through the area at a large flow rate, then it can be expected that the rate of oxidation of the layers will be lower, however the longer term impacts associated with AMD would need to be addressed. The topsoil layer and its vegetation will minimise the movement of oxygen from the atmosphere into rehabilitated areas.

1.3 Description of the specific land uses, cultural and heritage aspects and infrastructure on the site and neighbouring properties/farms

1.3.1 Land Uses and Infrastructure

This section focuses on the characteristics of the site-specific study area, namely the farm portions on which the proposed project footprint is located, as well as the immediately adjacent farms (see and Plan 3). Knowledge of the physical characteristics of the immediate project area is important as it will largely determine the significance of direct social impacts that may arise as a result of the project, particularly those associated with the physical intrusion of project infrastructure and project-related activities.

As was mentioned earlier, the proposed Harwar project is situated within the proposed Chrissiesmeer Biodiversity Site, less than 10 km north of the small town of Chrissiesmeer. Dominant land uses involve privately owned commercial farming (mainly maize and soya, as well as dry beans), and livestock (mainly cattle and sheep). Some prospecting is taking place in the broader area, while the proposed Lusthof mine is located immediately to the east of the proposed project. Several guest houses operate in the area, mainly catering for nature lovers who visit the Chrissiesmeer pans.

Some farm owners stated that they farm jointly with other family members (e.g. father and son), while others would share farming equipment and labour. Some farms have been operated intergenerationally. Farms vary considerably in size, ranging from relatively small farm portions to large commercial farms.

Human settlement is characterised by farmhouses and outbuildings (workshops/stores), as well as farm worker homesteads. The latter are scattered throughout the project site, and one cluster comprising seven homesteads was observed. It should be noted that access to several farms was denied during the SIA site visit and it was, therefore, not possible to determine the number of homesteads and people residing on these farms. Refer to Plan 27 depicting the Site Specifict Human Activity identified within the area.

The project area is serviced by a network of gravel farm access roads. Electricity power lines and telephone lines traverse the project area. The photograph below depicts a cluster of farm worker homesteads.

Photograph 1: Cluster of farm worker homesteads

1.3.2 Cultural and Heritage Aspects

Heritage resources pertaining to the built environment and burial grounds that fall within defined legal parameters, were identified and recorded for the project site (refer to Section 1.1.15 of this report).

The immediate receiving environment at Harwar is characterised by agricultural land and small hills. Informal and formal burials were identified and recorded in and around these features. Archaeological sites are rare and only two isolated Iron Age occurrences were identified and recorded. Structures that fall within legal parameters to be considered heritage resources include historical and contemporary werfs (yards) that were identified on the farms Mooifontein 35 IT Portion 2 and Tevreden 56 IT Portion 4.

Potential fossil sites may exist on the farms Harwar 58 IT and Vryheid 59 IT, but this can only be verified through a paleontological assessment inclusive of a site visit. Access to these farms was denied. It is therefore recommended that a Phase 1 Paleontological Assessment be conducted on the farms Harwar 58 IT and Vryheid 59 IT.

1.3.3 List of Site-specific Human Activity

The directly affected farms' specific land uses, cultural and heritage aspects and infrastructure on the project site and adjacent properties are given below in Table 1-26. Plan 27 depicts the site-specific human activity of the project area.

Table 1-26: Site-specific Human Activity - Specific Land Uses, Cultural and Heritage Aspects and Infrastructure

Farm Name	Portion (Ptn)	Site Description
De Goedeverwachting 57 IT	MA/1 on Ptn 5	▪ 2 Farmhouses ▪ 1 Farm Building ▪ Heritage Resources: S.35-049 and S.35-045
	MA/2 on Ptn 10	▪ 1 Farm Building ▪ 2 Farmworker Homesteads
	Ptn 6	No buildings or Heritage Resources
Harwar 58 IT	MA/1 on Remaining Extent	▪ 1 Farm Building ▪ 1 Farm House ▪ 1 Farmworker Homestead
Vryheid 59 IT	Farm	▪ 1 Farmworker Homestead
Tevreden 56 IT	Ptn 1	▪ Heritage Resource: S.34-054
	Ptn 4 (of Ptn 1)	▪ 1 farm Building ▪ 1 Farm House ▪ Heritage Resources: S.34-050 and S.36-052
	Ptn 6 (of Ptn 1)	No buildings or Heritage Resources
	Ptn 5	▪ 1 Farm Building ▪ 1 Farmhouse

Farm Name	Portion (Ptn)	Site Description
		▪ Heritage Resource: S.34-053
	Ptn 9 (of Ptn 5)	▪ 1 Farmworker Homestead
Mooifontein 35 IT	Ptn 2	No buildings or Heritage Resources
	Ptn 5	▪ 1 Farm Building ▪ Heritage Resources:S.34-046, S.36-047 and S.36-048
Lusthof 60 IT	Remaining Extent	▪ 1 Farm Building

1.4 Annotated map

The environmental, cultural and heritage aspects identified in and around the project area which will, most likely, be impacted on by the proposed mining operation are depicted on the various plans indicated in the table below.

Table 1-27: Annotated Maps

Plan Name	Plan Number in Appendix A
Affected Water Courses	Plan 8
National Freshwater Ecosystems Priority Areas Wetlands	Plan 12
Aquatic Sensitivity	Plan 14
Land Capability	Plan 16
Land Use	Plan 17
Ecological Sensitivity (Flora)	Plan 20
Ecological Sensitivity (Fauna)	Plan 21
Important Bird Areas	Plan 23
Practical Viewshed Model	Plan 24
Sensitive Noise Receptors	Plan 25
Heritage Resources	Plan 26

2 PROPOSED MINING OPERATION

2.1 The mineral to be mined

The mineral to be mined is bituminous coal located within the Ermelo Coal Field. The proposed project area is made up of 3 resource areas covering 5 farms. The B and C seams are developed in the project area. The A Seam has been removed by erosion over most of the area. It is too thin (<0.5 m) to be of economic importance. The B-seam is present over most of the area, but has been removed by weathering in the low lying areas. The C Seam group has been removed by channel sandstone in the Tevreden area. On average the B and C seams are 4.39 m thick. The seams are shallow and preserved in three hills with an average depth to the top of the B and C seams of 22 and 30 m respectively. A measured resource total of 18.1 Million tonnes (Mt) of resources can be mined by means of opencast methods. The life of mine (LoM) of the Harwar Colliery is estimated to be 15 years if the entire resource is mined.

The proposed mine plan provides for the mining in year one of approximately 1075 kilotons (Kt), thereafter in the next 13 years, as the operation stabilises, the mine will produce approximately 1200 kilotons per annum (Ktpa) and in the last year due to coal depletion approximately 863 Kt will be mined. The existing infrastructure has led to the development of seven opencast areas will be developed for the Harwar Colliery Project throughout the LoM. The proposed opencast and stockpile areas are depicted on Plan 28. The areas recommended to be avoided are also depicted on this plan. Table 2-1 below gives a summary of each opencast area and the size of the proposed opencast areas.

Table 2-1: Proposed opencast sizes

Opencast area	Area (ha)
Area 1	38.3
Area 2	51.9
Area 3	185.6
Area 4	48.3
Area 5	30.7
Area 6	94.9
Area 7	213.9
Total	**663.6**

2.2 The mining method

Both the B and C seams will be mined with the use of the opencast truck and shovel / rollover methods. The surface area to be affected by opencast mining methods at the proposed Harwar Colliery is in extent of 664 ha. The mined coal will be transported via haul trucks to the Spitzkop Colliery and possibly other beneficiation plants within the area for processing (an Msobo Coal operation located approximately 40 km west of the project area) using the existing road network, with road upgrades where required. Therefore, there will be no coal processing plant at the proposed Harwar Colliery. After the beneficiation of the RoM coal at the Spitzkop Colliery Plant or other beneficiation plants, the coal product will be loaded onto trains at railway sidings for transport to the export ports (RBCT, Durban, Mputo, etc.) for export and/or hauled by road to inland customers to regional power stations for power generation and other domestic consumers.

2.2.1 Opencast Mining

This involves the utilisation of truck and shovel mining method to excavate the opencast. With this method, both mining and rehabilitation will take place simultaneously. The opencast area will be created by establishing a box cut, followed by the creation of mining strips. Ramps will be used to access the coal and enable mining to be continued at various depths and widths. Initially topsoil is stripped followed by the overburden. Topsoil and overburden will be stockpiled adjacent to the opencast area for rehabilitation. The coal strips can then be created at different widths and depths, depending on the individual coal seams. The coal seam is drilled and blasted and then removed by means of either Front End Loaders (FELs) or Excavators and then trucks. The product will be transported to a crushing and screening plant where it will be crushed, and stockpiled at the Run of Mine (RoM) stockpile. The coal seams will be mined with an average strip ratio of 6.75.

2.2.1.1 Removal of topsoil

The topsoil surveyed within the proposed project area varies from location to location. The depth of soils associated with the proposed opencast area to the south of the proposed project area varies between 250 mm and 800 mm. The opencast areas located in the centre of the proposed project area ranges from 100 mm to 700 mm and the opencast areas to the north of the proposed project area ranges from 100 mm to 800 mm.

In mining terms topsoil and subsoil are usually combined during the stripping process in order to reduce the number of machine passes. The combined top and subsoil stockpile is then labelled as topsoil.

2.2.1.2 Removal of Overburden

The overburden will be stockpiled and replaced back into the opencast area so that the final voids can be rehabilitated.

2.2.1.3 Blasting

It is anticipated that blasting will take place three times per week.

2.2.1.4 Rehabilitation

Rehabilitation will take place concurrently with mining activities. As mining extends into a certain direction at a particular opencast, the mined out areas will be backfilled with overburden material taken out during the initial construction phase of the opencast. Initial topsoil removed, which will be stockpiled separately, will be spread over the backfilled areas to reinstate the land capability as far as possible.

2.2.2 Mineral Processing

No mineral processing will take place at the Harwar Colliery. RoM material will only be crushed and screened using crushers and screeners to a size of >500 mm to <90 mm. Once the coal is crushed, this will be loaded onto the trucks for transportation to the Spitzkop Colliery and other beneficiation plants in the area (Msobo Coal still to undertake negotiations) where processing will take place. Coal could also be sold directly from the mining area to final customers, either as “delivered” or Free-on-Truck (FOT) product.

The coal will be washed at the Spitzkop Colliery’s beneficiation facility or other nearby wash plants depending on the outcomes of negotiation with the respective mines. The Spitzkop Colliery plant is a dense medium, single-stage wash plant with a feed capacity of 450 tons/hr. Discard from the beneficiation process will be disposed of at a discard dump facility located at the existing Spitzkop Plant.

2.2.3 Coal Markets

The main coal products to be produced at the coal beneficiation plant at the Spitzkop Colliery are:

- A and B-grade steam coal for export and local purposes; and
- C-grade coal for Eskom (power station) and other domestic power generation markets.

The product consumers include export, inland, Eskom and regional markets.

2.2.4 Proposed Access Routes

No specific access routes have been allocated for the mine. Alternative route options will be investigated in order to bypass the town of Chrissiesmeer and joining the project area with the R542 directly and using this route to transport coal to the Spitzkop Colliery for processing. The R542 intersects the R36 near Breyten and the Spitzkop Colliery is located on the R36.

2.2.5 Transportation

The raw, unprocessed, RoM from the opencast operations will be transported utilising interlink road trucks from the Harwar Colliery Project area to the Spitzkop Colliery located approximately 40 km west of the project area and/or other processing facilities in the area for processing. The average weight of the loaded trucks will carry between 30 and 36 tonnes of coal. After the beneficiation of the RoM coal at the Spitzkop Colliery Plant or other nearby beneficiation plants, the coal product will be loaded onto trains at railway sidings for transport to the export ports (RBCT, Durban, Mputo, etc.) for export and/or hauled by road to inland customers to regional power stations for power generation and other domestic consumers.

Water bowsers will be used to conduct dust suppression on the mine haul roads. The anticipated dust control efficiency is between 70% and 90%.

Alternative route options will be investigated in order to bypass the town of Chrissiesmeer and joining the project area with the R542 directly and using this route to transport coal to the Spitzkop Colliery and other processing facilities in the area.

2.2.6 Operational Times

The operational hours of the mining and hauling will be 24 hours per day and hauling will be approximately 12 hours per day. The crushing of RoM material will be a 24 hour operation.

2.2.7 Expected Workforce

According to the Harwar Social and Labour Plan (SLP), approximately 74% of the workforce is sourced from the Albert Luthuli Local Municipal area.

The Harwar Project is an extension of Msobo Coal's current mining operations (i.e. the Spitzkop and Tselentis Collieries); sustainable jobs will be created for the existing workforce and local employment opportunities will also be created, mainly during the construction phase.

An anticipated 647 permanent positions will be sustained by the proposed project. An estimated 477 of the above 647 permanent employment positions will be filled by individuals from the local municipal area.

2.3 A list of all the main mining actions, activities, or processes

Supporting surface infrastructure will be required for the proposed mining operations. The associated infrastructure to be constructed on the Harwar Colliery Project area will support the opencast activities. The proposed mining activities during the construction, operational and decommissioning phases are indicated in Table 2-2.

Table 2-2: Mining Activities during the LoM at the Harwar Colliery Project

Activity No.	Activity

Activity No.	Activity
Construction Phase	
1	Site Clearing: Removal of topsoil and vegetation.
2	Construction of any surface infrastructure e.g. access roads, pipes, storm water diversion berms, change houses, admin blocks etc. (including transportation of materials and stockpiling).
3	Drilling, blasting and development of infrastructure and adits for mining.
4	Temporary storage of hazardous products (fuel, explosives), and waste (e.g. sewage).
5	Monitoring: Environmental monitoring of construction activities' potential impacts.
Operational Phase	
6	Use and maintenance of roads and infrastructure.
7	Removal of overburden and ore (mining process) and backfilling when possible (including drilling/blasting of hard overburden & stockpiling it).
8	Water use and storage onsite (storm water, PC Dam, domestic waste water, and abstraction).
9	Storage, handling and treatment of hazardous products (fuel, explosives, oil) and waste (waste, sewage, PC Dam).
10	Concurrent rehabilitation by replacement of overburden, subsoil, topsoil and vegetation as mining progresses.
11	Monitoring: Environmental monitoring of operational activities' potential impact
Decommissioning Phase	
12	Demolition and Removal of all infrastructure (incl. transportation off site).
13	Rehabilitation (spreading of soil, re-vegetation & profiling/contouring).
14	Storage, handling and treatment of hazardous products (fuel, explosives, oil, etc.) and waste (waste, sewage, PC Dam).
15	Monitoring: Environmental monitoring of decommissioning activities' potential impact.
Post – Closure	
16	Post-closure monitoring and rehabilitation.

2.3.1 Construction Phase

The area is a Greenfields site in terms of coal mining and as such, the following activities will take place in order to gain access to prepare the area for operations. During the construction phase, the area will be cleared and vegetation and topsoil will be removed in preparation for the required surface infrastructure.

- Mining Related Activities:

  - Construction of haul roads to and from the site, where possible existing roads will be used and upgraded.
  - Removal of vegetation and topsoil for the stockpiles.
  - Preparation for on-site water management structures such as diversion berms, trenches and pollution control dams.
  - Preparing water, road and power servitudes for site.
- Monitoring:
  - Continuous monitoring of environmental aspects such as ground- and surface water, air quality and noise.

The construction of roads to boxcut areas, topsoil stripping for stockpiling, stockpiling of overburden material, coal stockpile and pollution control structures will take 3 months to construct. Excavation of the boxcut leading to coal exposure will take 3 months. A total of 6 months will take to mine the first coal.

2.3.2 Operational Phase

The operational phase will include the following activities:

- Mining infrastructure:
  - Use of potable water and the treatment and recycling of used water;
  - Domestic waste removal; and
  - Maintenance of water diversion berms and pollution control dam.
- Mining Activities:
  - Removal of soil and overburden during new opencast operations, the temporary stockpiling of these, and the filling of the voids of mined out areas as the opencast operations proceed;
  - Vehicular movement on haul roads;
  - Blasting of rock and coal;
  - Opencast mining of coal seams using the truck and shovel method; and
  - On-going rehabilitation of mining areas.
- Monitoring:
  - Continuous monitoring of environmental aspects such as surface and, groundwater, air quality and noise.

Haul roads will be used to transport coal to Spitzkop Colliery and other beneficiation plants for processing and to domestic markets.

2.3.3 Decommissioning Phase

The decommissioning phase will include the following activities:

- Infrastructure:
  - Removal of all mining infrastructure not functional or utilised by other users at that time;
  - Rehabilitation of haul roads if it is serving no purpose; and
  - Removal of cut-off berms and diversion trenches once rehabilitation has been completed.
- Mining Activities:
  - Filling of the final voids with overburden;
  - Replacement of topsoil;
  - Rehabilitation of surface damage; and
  - Rehabilitation and re-vegetation of disturbed areas.
- Monitoring:
  - Continuous monitoring of environmental aspects such as groundwater, air quality and noise.

2.3.4 Post Closure Phase

The post closure phase will include the following activities:

- Mining Activities:
  - Profiling of the area to prevent ponding of water and ensuring the area is free draining;
  - On-going rehabilitation of areas disturbed by mining activities with regards to all environmental and social aspects; and
  - Managing post mining impacts to prevent further pollution.
- Monitoring of environmental aspects.
- Application for a closure certificate.

2.3.5 Mine Infrastructure

The proposed infrastructure will be placed within the boundary of the mining right. Currently no mine infrastructure layout plan is available indicating where the ancillary mine infrastructure such as workshops, offices, etc. will be located.

The planned opencast areas are depicted on Plan 28 as well as the areas which are recommended not to be mine.

Roads to the boxcut areas as well as mine haul roads to transport coal will be constructed. The excavation of the boxcut leading to the development of the adit highwall will be constructed. Electricity will be required for the operation of the surface operations such as pumps, stores and workshops. Water will be utilised for dust suppression and consumption.

The proposed infrastructure associated with the opencast activities at the proposed Harwar Colliery Project includes:

- Access roads;
- Electrical Substations;
- Security / access control checkpoint with entry and exit roadways;
- Topsoil storage areas;
- Waste rock / Overburden stockpiles;
- Infrastructure for services including potable water and fire water, compressed air and sewage reticulation;
- Dirty water settling dams and pollution control dams (PCDs);
- Storm water diversion berms;
- Weigh bridges for outgoing haul trucks;
- Bus and taxi off-loading area;
- Parking for office and mine personal;
- Diesel, petrol and oil storage facilities;
- RoM crushing plant;
- Product stockpiling and loading facilities;
- Vehicle and mechanical workshops;
- Employee change house facility and lamp house;
- Storage yard;
- Explosives storage;
- Salvage yard and waste storage facility; and
- Services such as power lines, pipelines, roads, telephone lines, communication and lighting masts.

2.3.6 Water Management Facilities

The proposed project will require potable water for the mine employees and water for the mining operations (crushing and screening). Msobo Coal will truck water to the site using water bowsers. Infrastructure associated with the water management facilities include:

- Clean water management:

    - Surface water storage dams; and
    - Water pipelines.
- Dirty water management infrastructure including:
    - Sewage treatment plant;
    - Water treatment plant;
    - Storm water diversion berms; and
    - Dirty water settling dams and PCDs.

2.3.7 Waste Management Facilities

Waste will be generated during the LoM and will include domestic waste, industrial and hazardous waste. The storage and handling of hazardous substances will take place and these will include:

- Fuel;
- Lubricants;
- Various process input chemicals;
- Raw material stockpiles / bunkers; and
- Explosives.

Waste management on-site will entail temporary handling and storage of general and hazardous waste. Storage and handling of hazardous substances such as fuel, lubricants, various process input chemicals, raw material stockpiles / bunkers, and explosives will also be erected. The operation entails shovels which will excavate topsoil.

The topsoil will be placed separately on a dedicated stockpile or immediately placed on levelled hards to re-vegetate the disturbed area. The softs which are largely weathered sandstone will be removed and placed on a stockpile for re-use as a backfill material to voids or immediately placed in voids. The hards material immediately below the softs material will be trucked for stockpiling for later backfilling and levelling of voids or immediately levelled back in the voids.

2.4 A plan showing the location and aerial extent of the main mining actions, activities, or processes

The proposed infrastructure will be placed within the boundary of the mining right. Currently no mine infrastructure layout plan is available indicating where the ancillary mine infrastructure such as workshops, offices, etc. will be located.

The planned opencast areas are depicted on Plan 28 as well as the areas which are recommended not to be mined.

2.5 Listed activities in terms of NEMA EIA regulations

Currently only authorisation in terms of the MPRDA is sought. However, if any environmental authorisation is required in terms of the MPRDA as amended, read with the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), the necessary applications will be compiled in terms of the NEMA Regulations. This approach will be taken for the Water Use Licence and the Waste Licence applications, and no activities will commence prior to receiving said authorisations.

2.6 Timeframes

The planned Life of Mine (LoM) is 15 years.

The timeframes according to the preparation and mining of the B and C seams during the construction, operational and decommissioning phases are detailed in Table 2-3 below.

Table 2-3: Harwar Colliery LoM Timeframes for Mining Activities

Month/Year	Activity
Construction Phase	
3 Months	▪ Removal of top soil, overburden, and initial construction of mine infrastructure; and ▪ Establishment of boxcuts and adit highwall.
Operational Phase – Opencast Mining	
(Month 6 – +)	▪ First RoM coal to be mined; ▪ Full production; and ▪ Transportation of coal to RBCT and domestic markets.
Decommissioning Phase	
Last year	Final rehabilitation, removal of redundant infrastructure and preparation for closure of the operations.

3 POTENTIAL IMPACTS

3.1 List of the potential impacts

The environmental and socio-economic potential impacts that may emanate on the receiving environment due to the activities from the proposed development were identified during each mining phase and are described below. These potential impacts were then assessed and quantified and are described in greater detail in the Impact Assessment Section, Section 7.

3.1.1 Potential Impacts on Aquatic Environment

Due to the varied nature of the aquatic ecosystems associated with the project area the potential impacts on water quality and quantity on the aquatic biota have been summarised for the two river courses directly affected.

The following impacts on water quality are listed below:

- Impact 1: Introduction of hydrocarbons from oil/lubricants and nutrients from explosives and sewage treatment facilities.
- Impact 2: Introduction of dissolved salts and metals from stockpiles and exposure of contaminated soil.
- Impact 3: Alteration of pH from contaminated soil, overburden and exposed coal seam.

The following impact on water quantity was identified:

- Impact 4: Reduced water quantity of the Mpuluzi and Boesmanspruit River.

The impact of activities on the Boespanspruit would not be as large as in the more sensitive ecosystem of the Mpuluzi River. Sedimentation of surface water resources, such as water courses and Tevrede se Pan, could impact negatively on the water quality which could lead to impacts on the aquatic biota. After closure and rehabilitation the potential for AMD exists and has been included in the impact assessment on water quality.

3.1.2 Potential Impacts on Fauna and Flora Environment

3.1.2.1 Issue 1: Loss of Habitat types

The removal of vegetation / habitat types will result in the definite loss of habitats for reptiles, birds, frogs, insects and mammals. Of special concern is the wetland areas and the pan areas.

- Impact 1: Loss of Grassveld and Rocky Ridges.
- Impact 2: Loss of Wetland Vegetation.

3.1.2.2 Issue 2: Loss of biodiversity

Loss of biodiversity will occur in the construction phase of the development as a result of clearing of the vegetation/habitat types, and the operational phase as a result of trampling and increased access to the natural areas of the Primary grassveld and riparian areas.

- Impact 3: Loss of Biodiversity (General).
- Impact 4: Loss of Plant Species of Special Concern.
- Impact 5: Loss of Animal Species of Special Concern.

3.1.2.3 Issue 3: Loss of ecosystem function

The general functioning and provision of ecosystem services in the greater area will be reduced and impaired.

- Impact 6: Fragmentation and edge effects.
- Impact 7: Influx of alien invasive plants.

3.1.3 Potential Impacts on Soils, Land Use and Land Capability

Activities during early works and construction (removal of topsoil and vegetation) in the project area could lead to the following impacts on soils:

- Impact 1: Soil compaction and topsoil loss leading to reduced agricultural potential.
- Impact 2: Soil erosion (sediment release to land and surface water).

The impacts of soil stripping will be negative and restricted to on-site. Limited impacts are expected outside of the proposed project area, with the exception along unpaved roads within the region, where erosion can impact on adjacent areas.

Impacts could occur as a result of the storage of hazardous products such as fuel and explosives etc. The impact on soil resources are dependent on the size of the spill and the speed with which it is addressed and cleaned up. The following impact could occur during the construction and operational phases.

- Impact 3: Contamination of soil resources.

During the decommissioning activities, impacts to soil resources may include compaction and contamination.

- Impact 4: Soil compaction and contamination.

During the post closure monitoring the post closure impacts to soil resources may include compaction and low fertility.

- Impact 5: Soil compaction and low fertility.

3.1.4 Potential Impacts on Ambient Noise Levels

The findings present the results of the predictive modelling for the various mining phases, which subsequently indicates the noise attenuation from the proposed continuous mining activities in relation to all the surrounding noise sensitive receptors. The breakdown of the expected noise contribution of the individual opencasts on the indicated noise sensitive receptors can be seen in Appendix B (Construction Phase) and Appendix C (Operational Phase) of the Noise Impact Assessment Report.

3.1.4.1 Construction Phase

The following proposed activities during the construction phase are identified as possible noise sources and may impact on the ambient noise level of the area:

- Construction of haul roads to and from site; and
- Removal of vegetation and topsoil for stockpiles.

The construction machinery involved with the site clearing and haul road construction will be a source of continuous noise and is considered as a negative impact throughout this phase.

The grid noise map, shown in Figure 9-1 of the Noise Impact Assessment Report, presents the noise contour lines and visually indicates the noise propagation during site clearing of proposed opencast areas. The noise levels during the construction phase will not measure above the SANS daytime rural rating limits at any of the indicated noise sensitive receptors.

3.1.4.2 Opersational Phase

The blasting activities during the operational phase will only take place during daylight hours. The following proposed activities during the operational phase are identified as possible noise sources:

- Operation of mining infrastructure;
- Removal of soil and overburden during opencast operations, the temporary stockpiling of these and the filling of the voids of mined out areas as mining proceeds;
- Vehicular movement on haul roads;
- Blasting activities; and
- Truck and shovel mining of coal seams.

The grid noise map, shown in Figure 9-2 of the Noise Impact Assessment Report, presents the noise contour lines and visually indicates the noise propagation during the operational phase for the day and night time. During the operational phase the truck and shovel activities are not likely to measure above the daytime baseline level.

The proposed opencast areas that will measure above the baseline night time level during the operational phase include the following:

- Opencast 1 at receptor 17 by 8dBA;
- Opencast 2 at receptor 15 by 1dBA;
- Opencast 4 at receptor 13 by 3dBA; and
- Opencast 5 at receptor 18 by 5dBA.

Of the receptors listed above, only receptor 17 (House on portion 9 of the farm Tevreden 56 IT) will be impacted on significantly.

According to the noise levels, the blasting noise will measure above the baseline level at all indicated noise sensitive receptors within proximity of 2900 m of any given opencast. However, receptors within proximity of 1700 m will experience the impulsive noise from blasting to be significantly louder.

Blasting noise levels at the opencast areas on Tevrede se Pan will range from 40 dBA at opencast area 7 to 70 dBA at opencast area 5.

In addition, the truck and shovel activities at opencast 5 is expected to measure above the night time baseline at Tevrede se Pan.

The blasting activities will measure at least 10 dBA above the baseline during a blast at the following receptors:

- Receptor 5 (house on portion R of the farm Lusthof 60 IT);
- Receptor 7 (house on portion 9 of the farm Appeldoorn 38 IT);
- Receptor 11 (house on portion 1 of the farm Lusthof 60 IT);
- Receptor 12 (house on portion 4 of the farm Lusthof 60 IT);
- Receptor 13 (house on portion 5 of the farm De Goedeverwachting 57 IT);
- Receptor 14 (house on portion 10 of the farm De Goedeverwachting 57 IT);
- Receptor 16 (house on portion 8 of the farm Tevreden 56 IT);
- Receptor 17 (house on portion 9 of the farm Tevreden 56 IT);
- Receptor 18 (house on portion R of the farm Leliefontein 79 IT); and
- Receptor 31 (house on portion R of the farm Vryheid 59 IT).

3.1.4.3 Decommissioning Phase

It is assumed that the decommissioning activities will only take place during daylight hours. The machinery involved during the decommissioning phase will be a source of continuous noise throughout the decommissioning phase.

The impact during the decommissioning phase is expected to be lower than both that of the construction and operational phases due to the limited activities and less machinery used, therefore it is probable that the noise from the proposed rehabilitation activities will be lower to that of the current ambient noise levels at the indicated noise sensitive receptors.

3.1.5 Potential Impacts on Wetland Areas

3.1.5.1 Issue 1: Direct Loss of Wetland Areas

The proposed mine plan indicates that direct destruction of hillslope seepage wetlands will occur as a result opencast mining activities within the project area. The following impacts are expected to result from the direct loss of hillslope seepage areas:

- Impact 1: Direct loss of hillslope seepage areas.
- Impact 2: Loss of hillslope wetland habitat.

3.1.5.2 Issue 2: Indirect Loss of Wetland Areas

Hillslope seepage wetland areas as well as pans are maintained by infiltration that occurs in the greater catchment. The following impacts are expected:

- Impact 1: Loss of non-wetland perched water table recharge areas.
- Impact 2: Desiccation of springs.

3.1.5.3 Issue 3: Loss of Wetland Integrity

The proposed project is expected to result in anthropogenic impacts that will impact on the integrity of the delineated wetland areas. The following impacts are expected:

- Impact 1: Chemical contamination of surface water resources.
- Impact 2: Sedimentation of surface water resources.
- Impact 3: Alien invasive species encroachment.
- Impact 4: Loss of biodiversity.

3.1.5.4 Issue 4: Loss of Wetland Functionality

Anthropogenic impacts impact on the wetland integrity and the ability to perform the important functions. The following impacts are expected on wetland functionality:

- Impact 1: Loss of water quality enhancement capacity.
- Impact 2: Loss of biodiversity support.
- Impact 3: Loss of unique wetland types.
- Impact 4: Loss of sensitive species.

3.1.6 Potential Impacts on Groundwater

3.1.6.1 Groundwater Quantity

Potential reduction in recharge to the perched aquifer may impact springs in the immediate vicinity. The resultant impact on local springs will affect fresh water seepage to pans. If the initial box cuts during the construction phase breaches the water table, any significant groundwater inflows into the box cuts should be pumped out.

Excavation of the opencast areas will change the topography, creating a cone of depression with a hydraulic gradient toward the opencast area centres. As a result groundwater from both catchments will flow towards opencast area centres in response to the hydraulic gradient. Therefore the boundary between the two catchments (groundwater divide during pre-mining) will no longer be a no-flow boundary during mining.

Abstraction from any aquifer will eventually be matched by some combination of the following three responses:

- A decrease in the volume of groundwater in natural storage;
- An increase in the rate of groundwater recharge; and
- A decrease in the rate of natural groundwater discharge.

Dewatering may impact inflow from the weathered and fractured aquifer that report to the pans. Russell (2008) showed that boreholes that have pan signatures are located close to pan boundaries suggesting that the pans are most likely leaking into the groundwater aquifers and recharging them.

The rate of rise of groundwater levels in the rehabilitated areas during the decommissioning and post-closure phase will depend on inflows from the surrounding weathered material and fractured Karoo aquifers. The quality of the rehabilitation will influence the recharge into the rehabilitated material as well as the volume of water that can be contained within the rehabilitated opencast area. If the hydraulic conductivities of the weathered aquifer are too low to transmit significant volumes of mine water from the rehabilitated opencast areas, recharge rates to the mines will exceed seepage rates, and excess water will eventually decant onto the surface.

3.1.6.2 Groundwater Quality

The potential threat to the groundwater quality from the chemical characteristics of the natural rock material that will be excavated and exposed to oxidation processes include AMD formation from spoil piles, exposed shale and backfilled spoils and discard in rehabilitated areas. Operational groundwater flow directions will be directed towards the opencast areas. The portions of poor quality leachate emanating from the discard area which eventually joins the underlying saturated zone will migrate towards the mine opencast areas. Contaminant migration away from the mining area is expected to be limited as groundwater flow direction will be towards the opencast area centres.

There are several potential impacts on the groundwater quality due to general operational procedures and these include the following:

- During the performance of all opencast mining activities the potential exists for the contamination of groundwater due to the utilisation of various materials, these include rock drill lubricant, ammonium nitrate based explosives, fuels and lubricants storage;

- The potential incorrect disposal of domestic waste at the offices and ablutions may have an impact on groundwater quality;
- The potential incorrect handling of sewerage at the offices and ablutions may have an impact on groundwater quality; and
- The potential incorrect disposal of hazardous wastes, workshop effluent as well as spills and leaks at the maintenance workshops may have an impact on groundwater.

In the post operational environment, rising water levels in the rehabilitated opencast area will remove oxygen and effectively stop oxidation reactions that could lead to AMD conditions. Should decant occur, the decant waters may flow and contaminate nearby springs through seepage to the perched aquifer, and eventually the nearby Tevrede se Pan.

Any pollutants transported into, for example, Tevrede se Pan may remain in the Pan until they become available for transport in different ways. In the event the pans are impacted by AMD, carrying heavy metals, the acid water would slowly filter into the pans concentrating metals through evaporation unless outflows through surface or groundwater exist for these pans. The majority of the pans would initially be able to resist the change in pH as the AMD moves into them due to the high alkalinity and good buffering capacity but eventually this would be exhausted.

3.1.7 Potential Impacts on Topography

The opencast areas are located on top of a ridge with the majority of them extending onto sloped land with sensitive pans and drainage lines located in the valleys.

The development of haul roads will add features to the topography thereby changing it. Piles of construction material will temporarily change the topography of the study area. The construction of surface infrastructure will add features to the topography thereby changing it.

Blasting and development of the initial box cut areas will significantly change the topography of the area. This will result in a void in the topography. Topsoil and overburden stockpiling involves adding to the surface and will thereby change the topography of the study area.

The removal of overburden and ore will increase the size of the void as well as the stockpiles and significantly change the topography of the area.

Concurrent rehabilitation activities will reduce the size (height) of the stockpile areas and the size of the void. It is however believed that excess material will be available after all the voids are backfilled which will result in remaining stockpile areas.

3.1.8 Potential Impacts on Visual Receptors

The construction and operational phases will have a negative visual impact on the receiving environment. The project area will become noticeable to the nearby visual receptors as it will contrast the surrounding areas. Dust will be generated during this phase which will have a negative visual impact on visual receptors.

Vehicular activity and the resulting dust will draw attention to the project area.

Infrastructure lighting will be visible at night and will have a negative visual impact on the receiving environment.

The box cut will dramatically contrast the surrounding grassland areas. This will leave a permanent scar on the landscape. Topsoil and overburden stockpiling will have a negative visual impact on the receiving environment.

During the decommissioning phase, the removal of infrastructure will assist in removing the negative visual impacts on the receiving environment.

Profiling and contouring will decrease the visual impact on the receiving environment. Re-vegetation of areas disturbed by infrastructure will have a neutral visual impact on the receiving environment.

3.1.9 Potential Impacts on Air Quality

The construction phase may result in high levels of dust impacting on nearby residential communities. This can be exacerbated further by the construction of surface infrastructure e.g. haul roads, pipes, storm water diversion berms (including transportation of materials and stockpiling).

Vehicle entrainment of friable dust from unpaved roads is one of the main sources of particulate emissions. The dust levels may also increase due to removal of coal via opencast mining, as well as stockpiling of topsoil, overburden, and RoM coal, as well crushing and screening. The mining operations will mainly comprise of fugitive dust releases, including materials handling operations (loading, tipping and offloading).

Demolition and removal of all infrastructures (incl. transportation off site) is a dust generating process. The rehabilitation (spreading of soil, re-vegetation and profiling/contouring) process that follows have potential to reduce dust levels within the regulatory limits.

3.1.10 Potential Impacts on Surface Water

Potential impacts on the surface water resources within the area are listed below:

- Potential erosion that could lead to siltation of the water resources. Particularly since the site is located at the headwaters of streams and Tevrede se Pan.
- The construction of upslope diversion berms will result in surface runoff being prevented from reporting to the catchment. There might be increased runoff on the slopes of the berms and that may alter the flow regime of the drainage area leading to the streams;
- There is potential for contaminants to be deposited on the surface in the dry season only to be transported into the streams and pan at the onset of the wet season;
- It is expected that there will be elevated levels of elements in the dry season as a result of evapotranspiration and subsequent concentration of elements;

- During mining there will be water pumped from the opencast areas to surface. The water may be nitrate rich and also contain coal/ pyritic material which may cause water quality impacts;
- There may be potential for groundwater decant to surface which may become acid mine water due to the interaction of air, water and pyrite material resulting in impacts on surface water resources.

3.1.11 Potential Impacts on Current Trafic Conditions

Based on the typical design capacities of 1500 vehicles per hour on a single carriageway, the existing road traffic (Annual Average Daily Traffic data) and traffic generated by the proposed development considering the low traffic volumes per hour from the mine will most likely not cause any capacity constraints on the network. The Annual Average Daily Traffic data for N17, P117-1 and R36 will reduce to approximately 750 Design Hourly Volumes respectively assuming a 15% value of the Annual Average Daily Traffic. Spare capacity on the road network is anticipated, which can accommodate the development trips.

The development of the mine and the proposed haul of the coal using M&HCV will most likely result in an impact on the degradation of the existing gravel roads due to the increased loads.

It should also be noted that the P117-1 Road connecting the towns of Chrissiesmeer and Carolina has a tonnage restriction of 10 tonnes (Provincial road sign). This road should be upgraded should it be used. It is also currently investigated to use a complete different route or new haul road for the transportation of the coal to the Spitzkop Colliery.

3.2 Potential impacts on cultural and / or heritage resources

The identified resources include the following:

- Werfs;
- Undiagnostic potsherd ceramic fragments; and
- Informal burial grounds.

The undiagnostic potsherd ceramic fragments have a negligible value in aesthetic and technical characteristics. No impact will occur on these heritage resources.

The werfs identified on the project area are located on the proposed opencast areas. These sites could potentially be destroyed during the construction and operational phase of the project.

The informal burial grounds (S.36-047 and S.36-048) identified on the project area are located on the proposed opencast areas. Clearence and development of the opencast areas could potentially destroy these sites.

Another informal burial ground (S.36-052) is located 400m from the proposed opencast areas however the potential impact on this resource could relate to vandalism by workers on site or accidental destruction by construction workers.

3.3 List of all impacts that may potentially emanate from each activity

The table below provides a summary of the potential impacts that could result during each of the project phases.

Table 3-1: Potential impacts per project phase

Activity #	Activity	Potential Impacts
Construction Phase		
1 - 4	Site Clearing: Removal of topsoil and vegetation. Construction of surface infrastructure e.g. access roads, pipes, storm water diversion berms, change houses, admin blocks etc. (including transportation of materials and stockpiling). Drilling, blasting and development of infrastructure and adits for mining. Temporary storage of hazardous products (fuel, explosives), and waste (e.g. sewage).	■ Damage to heritage resources; ■ Loss of Grassveld, loss of Wetland Vegetation, loss of Biodiversity (General), loss of faunal habitats; loss of Plant Species of Special Concern, loss of Animal Species of Special Concern, fragmentation and edge effects; and Influx of alien invasive plants; ■ Impact on aquatic biota; ■ Soil compaction, soil erosion, soil contamination; ■ Increase of ambient noise levels; ■ Direct loss of wetland areas, indirect loss of wetland areas, loss of wetland integrity, loss of wetland functionality; ■ Groundwater inflows into the opencast area may lead to minor dewatering and the formation of a drawdown cone in the aquifers around the adit; ■ Deterioration in groundwater quality due to the increased suspended solids and oxidation of pyrite; ■ Direct and indirect water quality and quantity impacts on the pans (Tevrede se Pan); ■ Change in natural topography; ■ Impacts on ambient air quality (Fugitive dust emmssions PM_{10} and $PM_{2.5}$); and ■ Potential impacts on the socio-economic environment.
Operational Phase		

Activity #	Activity	Potential Impacts
6 - 10	Removal of soil and overburden during new opencast operations, the temporary stockpiling of these, and the filling of the voids of mined out areas as the opencast operations proceed; Vehicular movement on haul roads; Blasting of rock; Opencast mining of coal seams using the truck and shovel method; and On-going rehabilitation of mining areas.	■ Chemical contamination of surface water and loss of sensitive species, impacting on wetlands; ■ Stagnant pools of water in the mine workings will deteriorate in quality; ■ Change in natural topography; ■ Impacts on ambient air quality (Fugitive dust emmssions PM_{10} and $PM_{2.5}$); ■ Groundwater inflows into the adit may lead to minor dewatering and the formation of a drawdown cone in the aquifers around the adit; ■ Deterioration in groundwater quality due to the increased suspended solids and oxidation of pyrite; ■ Direct and indirect water quality and quantity impacts on the pans (Tevrede se Pan); ■ Impact on aquatic biota; ■ Soil compaction, soil erosion, soil contamination; ■ Increase of ambient noise levels; and ■ Direct loss of wetland areas, indirect loss of wetland areas, loss of wetland integrity, loss of wetland functionality as mining progress;
Decommissioning Phase		
12 - 15	Filling of the final voids with overburden; Replacement of topsoil; Rehabilitation of surface damage; and Rehabilitation and re-vegetation of disturbed areas.	■ Soil compaction, soil erosion, soil contamination; and ■ Change in topography; ■ Impacts on ambient air quality (Fugitive dust emmssions PM_{10} and $PM_{2.5}$); ■ Increase of ambient noise levels; ■ Negative impacts on socio-economic environment.
Post – Closure		
16	Profiling of the area to prevent ponding of water and ensuring the area is free draining;	■ Alteration of drainage lines resulting in land capability and land use changes and wetlands;

Activity #	Activity	Potential Impacts
	On-going rehabilitation of areas disturbed by mining activities with regards to all environmental and social aspects; and Managing post mining impacts to prevent further pollution.	■ AMD generating water quality impacts; ■ Groundwater levels will recover during the decommissioning and post-closure phase; and ■ If the mine water decants, sulphide oxidation will be reactivated due to an ample supply of oxygen from the atmosphere. Many of the streams below the mine workings will eventually run the risk of mine water contamination when the mine workings are flooded to its holding capacity.

3.4 List of all potential cumulative environmental impacts

Cumulative effects are caused by the accumulation and interaction of multiple stresses affecting the parts and the functions of ecosystems. Of particular concern is the knowledge that ecological systems sometimes change abruptly and unexpectedly in response to apparently small incremental stresses. For purposes of this report, cumulative impacts have been defined as “the changes to the environment caused by an activity in combination with other past, present, and reasonably foreseeable human activities”.

The cumulative impacts have been assessed in order to determine how the Harwar Colliery Project will contribute to the already existing and potential future environmental impacts occurring in the area, especially due to the fact that the proposed project will be located within a highly sensitive area. The cumulative impacts according to each environmental and social aspect are listed and discussed below.

The key economic activities surrounding the project area are those of coal mining and agriculture. Residential activities also occur within the area and consist of small towns such as Breyten, Chrissiesmeer and Carolina. The nearest mining activities are located ±13 km NNW from the project area. The mining activities are associated with coal and clay mines. Most of the mines surrounding the project area are opencast mines. The current and proposed mines (mines under application), within a 50 km radius of the project area are indicated in Table 3-2, below. Plan 4 depicts the mines surrounding the project area.

Table 3-2: Mines within a 50km radius of the project area

Mine	Distance (km)	Direction
Proposed Lusthoff Colliery (under application)	Adjacent	SE
Droogvallei Colliery	13	NNW
Mimosa Colliery	14	W

Mine	Distance (km)	Direction
Tselentis Colliery (MR area borders the Harwar MRA area)	15	SW
Paardeplaats Colliery	16	N
Spitzkop Colliery	27	SW
Umlabu Colliery	28	SW
Brickfab	36	SW
Goedehoop Stene	37	NW
Marlin-Prairie Granite	40	N
Strathrae Colliery	41	NW
Ermelo Stene	42	SSW
Klippan Colliery	46	NW
Kobra Mining-Usutu West	47	SSW
Penumbra Coal Mining	49	SSW

The mining activities will result in a high cumulative impact in the region. Mining is one of the key economic activities in the municipalities, therefore, it is likely that much of the area will change from the current land use (agriculture) to that of mining.

According to the EMF (2010), seven (7) environmental management zones have been identified in the municipalities, with zone six (6) being mining. The development guidelines for the management of this zone include the following:

- Mineral and Petroleum Resources Development Act (Act No. 28 of 2002);
- National Environmental Management Act (Act No. 107 of 1998);
- EIA regulations (GN 543 (18 June 2010) of NEMA); and
- National Water Act (Act No. 36 of 1998).

According to Map 7 of the EMF (2010), the proposed project area falls within Zone 6 (Mining) with Zone 1 (Conservation), Zone 2 (Agriculture) and Zone 4 (Tourism) bordering the proposed project area. According to Map 6 of the EMF (2010), the proposed project area is identified as a coal mining area. The development guidelines for the seven management zones indicate that agriculture and residential development will have an impact on potential mining areas.

Current agricultural activities, which includes grazing and crop production, within the immediate vicinity of the project area currently impacts on the biophysical environment and should mining commence cumulative impacts are expected.

Even though one of the objectives of the Gert Sibande Growth and Development Strategy (2011) is to facilitate, promote, and support mining, the Development Principles produced for mining activities will necessitate the establishment of a strong, district driven, Environmental Management Unit/ Office, and the formulation of an Environmental Management Plan (GSDS, 2011).

3.4.1 Potential Cumulative Impact on the Aquatic Environment

The proposed project is located in a coal rich area and therefore other mines may be constructed within the associated aquatic ecosystems catchment area. Agriculture and forestry activities are also prevalent in the catchments. Due to the varied/unique nature of the affected river systems the cumulative impacts have been separated per river system.

3.4.1.1 The Mpuluzi River

The current land use associated with the river course is maize farming (irrigated and dry land) with extensive cattle agriculture, plantations and small residential areas. Current water quality impacts on this river coarse due to agriculture, forestry and livestock includes the introduction of pollutants and dissolved salts from agriculture runoff, modification of riparian zones and river bank impacts (erosion and trampling). Due to the presence of limited irrigated agriculture and several impoundments, the quantity of water within the ecosystem is currently being affected (Mantel et al., 2010). The removal of water effects the volumes and flow velocities within the associated water courses, thereby affecting the available habitat structures as well as altering the flow-depth scenarios, affecting the biotic structures of the system. The current impacts on the water quality and quantity on aquatic biota within this river course are however not seen as significant.

The current impact of anthropogenic activities within this river catchment is of limited nature and taking into consideration that the species present within this catchment are very sensitive; any changes to the water quality and quantity could have a significant impact on the aquatic biota within this catchment.

3.4.1.2 The Boesmanspruit

The current land use associated with the river course is maize farming (irrigated and dry land) with extensive cattle agriculture, wattle plantations and small residential areas. Several coal mining activities are also present within the X11B catchment. The current impacts on the water quality on the aquatic ecology relates to the introduction of pollutants and dissolved salts from agriculture and industry (mining) runoff. Riparian zones are being modified due to agriculture enchroachment and river bank livestock. The impacts on the water quanity are the same as for the Mpuluzi River. The current impacts on the water quality and quantity on the aquatic ecology is not seen as significant.

The Boesmanspruit is under considerable stress from mining activities in the X11B quaternary catchment. Although the aquatic study found the status of the upper river systems to be only moderately affected, further downstream, the river is impacted on via several mining operations and decants from abandoned closed mines. The Boesmanspruit is the main source of water for the town of Carolina and therefore further impacts to the water quality / quantity of this system should be viewed as very significant and serious. Due to the importance of the Boesmanspruit and the impacted nature of the downstream river reaches the cumulative impact of the proposed Harwar mine would be seen as significant.

3.4.1.3 The Buffelspruit

The current land use associated with this river course is livestock, plantations and a coal mine in the upper reaches. The current impacts associated with these land uses are the same as for the other two river courses however these impacts are not seen as significant.

The Buffelspruit is considered to be in a natural state and therefore any effects would be considered high. The cumulative impacts of the current project would therefore be seen as high due to activities within the upper catchment.

3.4.2 Potential Cumulative Impact on Biodiversity (Flora and Fauna Environment)

Currently the available habitat of animals in the Harwar study site ranges from farms, with associated infrastructure such as houses, storage and sorting areas, dirt roads and agriculturally developed land. These farming practices occur on any available and suitable areas, with sloped areas and wetland areas actively excluded. These activities result in a decrease of the area of the different vegetation types, as well as the loss of biodiversity (specifically Species of Special Concern), and ecosystem functioning. These activities have led to areas of overgrazing and trampling, as well as large cleared areas. Clearing of new agricultural areas could lead to Species of Special Concern being affected. Current land uses on the project area have caused fragmentation of the natural grassveld. Additionally, alien invasive species have encroached upon the area, mostly within disturbed areas and along water courses.

Taking the current land uses and the ecological sensitivity of the project area into consideration, and the numerous mines already operating in the vicinity, the cumulative impacts would be significant should the project go ahead. Several coal mines have been proposed and awarded for the region, which may result in very large-scale cumulative impacts with international implications due to the proximity to the Chrissiesmeer Panveld which already has International Biodiversity status as it occurs in an IBA (Plan 23). The impacts to the ecology of the area will be significant. The primary impacts will be fragmentation and edge effects with a reduction in movement of remaining naturally occurring wildlife and isolation of pockets of vegetation. Secondary cumulative impacts will include increased accessibility to the area and the resulting increase in development and resource dependence. Ideally, a strategic environmental plan for the area should be developed and adhered to such as linking the NPAES to the Chrissiesmeer Pan area. This should include the conservation of important areas as well as the provision of corridors for faunal movement. Map 1 of the EMF (2010) indicates that the proposed project area is partially located within the identified Ecological and Aquatic corridor. These ecological corridors allow for the conservation of vegetation and allows for the migration of fauna and seed dispersal by fauna. Covering a width of 7 km these ecological corridors include mixed natural and transformed areas and correspond with river lines, altitudinal gradients and mountain ranges. The ecological corridor extends into and bisects the MLD including a large proportion of its irreplaceable patches. This corridor makes up approximately 19% (105,371 ha) of the ALLM (EMF, 2010).

3.4.3 Potential Cumulative Impact on the Soils, Land Use and Land Capability

At the current rate of coal mining in Mpumalanga 12 % of South Africa's total high potential arable land will be degraded. Map 3 of the EMF (2010) indicates that the project area is classified as Class III, moderate arable potential and Class VI, moderate grazing potential.

The pans present in the proposed project area are part of the Mpumalanga Lake District (MLD) in South Africa. These lakes (pans) contain sustainable water in other words are anently flooded and contains more water compared to pans elsewhere in South Africa. Opencast coal mining within the area of the MLD would threaten the pristine wetland present (Terence McCarthy et al, 2007).

In addition to the potential impacts to wetlands, arable agricultural land will be converted to grazing land thereby changing the land capability permanently. Available arable farming land will decrease while land available to grazing will increase. This change in land use will have an impact on food production because less maize can be produced on available arable land on one hand while more cattle can be grazed on the other hand. However South Africa is dominated by grazed areas while arable land is very limited. Changing land capability from arable to grazing, especially in Mpumalanga where climatic conditions are favouring arable agriculture, is undesirable.

3.4.4 Potential Cumulative Impact on the Noise Environment

Cumulative impacts should be considered for the overall improvement of ambient noise levels. The proposed project is considered a causative source of noise pollution of medium-high significance during the operational phase. To avoid a significant cumulative impact the indicated opencasts should be mined individually, if technically and economically feasible, and only move onto the next opencast area once all mining phases have ceased at the present opencast area.

The nearest mining operations are 4.5 km to the north-west and 12 km to the south-west of the proposed project, near the town of Carolina and Breyten respectively. The existing noise sources in the immediate area of the proposed project are limited to agricultural activities, vehicular movement on the R33 as well as Baadjiesbult and Tevreden roads.

Potential future mines starting up in the area will contribute to ambient noise levels in the area and influence the contribution of all mines in the area with regards to the cumulative impact on the ambient noise levels.

After post closure phase of the proposed project, overall ambient levels will decrease to the pre-mining baseline and the cumulative impacts in the area could improve.

3.4.5 Potential Cumulative Impact on the Wetland Areas

Due to the nature of the project and the sensitivity of the host environment the cumulative impacts are regarded as very significant. Current land uses impact on the wetland areas within the catchments. Agriculture is considered the principal cause of wetland loss. For the Mpumalanga Province cultivated lands have a 6.96% impact on floodplain wetlands and a further 12.37% impact on seepage wetlands. Agriculture is one of the main reasons for the drainage of floodplain and seepage wetlands, which has dramatic impacts on their hydrological value. Loss of wetland areas especially hillslope seepage areas has occurred within the project area as a result of agricultural activities. The temporary and seasonal sections of the hillslope seepage have been destructed in order to maximise arable land. As a result of the loss of wetland areas to arable land, the associated wetland vegetation has also been impacted.

Some of the hillslope seepage wetlands within the project area have been converted into crop plantations, mainly maize crops. This has resulted in a change in the vegetation communities within the seepage wetland zone. Furthermore the development of farm dams within the valley bottom wetlands have resulted in a change in the vegetation communities and change in water flow patterns. The application of fertilizers, herbicides and pesticides has also resulted in the contamination of the water associated with the wetland areas. The wetland areas are also extensively used for livestock grazing especially during the dry season. These activities have resulted in the loss of wetland integrity and the ability to perform important functions within the project area.

The wetland areas within the MLD are known to support large numbers of birds. When the pans are wet, total numbers regularly exceed 20 000 birds. Loss of habitat as a result of mining activities within the area may results in significant losses in biodiversity support.

Quaternary catchment X11B is the headwaters of the Carolina Dam (Boesmanspruit), which already has major water quality issues. Mining in the catchment will increase the pressure on water quality within the catchment area. Further loss of wetland areas within the quaternary catchment will result in the reduction in the capacity of the surface water resources to assimilate the impacts.

Quaternary catchment W55A is located at the top of the Usutu River catchment; contamination of surface water resources at this level may have detrimental effects for the entire primary catchment area.

3.4.6 Potential Cumulative Impact on Surface Water

Chemicals associated with fertilisers used for agricultural activities and erosion caused by grazing has impacted on surface water resources. The proposed mining activities could further add to the surface water quality and quantity impacts on rivers and streams and could lead to cumulative impacts down stream due to other land use activities taking place along the surface water courses.

Cumulative water quantity impacts could be experienced at mine closure if rehabilitation is not done properly and this will affect stream flow downstream in the long-term.

3.4.7 Potential Cumulative Impact on Topography and Visual Receptors

The proposed mine is situated in a rural area dominated by grassland, maize and livestock production. Mining activities exist 2 km to the north-west and 8 km towards the south-west of the project area. Proposed developments in the area include the Lusthof Colliery Project to be developed by Black Gold Coal Estate (Pty) Ltd, located 2.5 km to the east of the project area on the farm Lusthof 60 IT. The uniqueness of the area along with its rich history enforces a strong sense of place. The proposed mine will have a high visual intrusion on the surrounding landscape and alter the current sense of place which is experienced in this area. Should additional mining development take place in this area, the cumulative effects would be additive, and it is expected that the character of this landscape would be further altered, resulting in a semi-industrial environment.

3.4.8 Potential Cumulative Impact on Ambient Air Quality

Current land use activities which include the clearing of large areas for agricultural activities such as grop farming has an impact on the current ambient air quality due to barren soil being susceptible to wind erosion.

Cognisance must be taken of the fact that there are existing opencast mines in the area (Tselentis, Spitzkop, Paardeplaats Colliery, Droogvaleei Colliery, and Mimosa Colliery) which can contribute to the cumulative impact on ambient air quality of the area.

3.4.9 Potential Cumulative Impact on Groundwater

The cumulative impacts associated with the groundwater systems within the area will be addressed in the final EMPR report for submission. The cumulative impacts on the groundwater regime can only be accurately assessed once the percussion drilling and groundwater models have been completed.

4 THE ALTERNATIVE LAND USE OR DEVELOPMENTS THAT MAY BE AFFECTED (REGULATION 50 (B))

4.1 A concise description of the alternative land use of the area in which the mine is proposed to operate

The project area is predominately associated with agricultural activities. The mining activities will occur over a 15 year period. The post mining activities include rehabilitation of the affected surface areas to as close as possible pre-mining conditions.

There are three main alternatives to the proposed mining operation. The first alternative is to continue to use the land for agriculture, mainly for maize and soya farming, grazing and fodder production. Maize farming and grazing occurs in the immediate surroundings and this practice will incur disturbances by the proposed opencast mining operation.

It must be noted that due to the nature of the proposed operation, agricultural activities will be temporarily disrupted on the mining area and this land will then return to productive use at the end of mine life. Other land not directly required by mining can continue to be used for agricultural purposes.

The second land use alternative is tourism, not only the farms associated with the MRA, but taking into consideration that the MRA area falls within the proposed Chrissiesmeer Biodiversity Site. Tourism is one of the viable alternatives to the current land use in the region, and includes guest houses and tourism activities in the area.

No guesthouses are located within the project area. A guesthouse is however located to the east of Chrissiesmeer. This is shown on Plan 24.

The extent of the affected properties' and adjacent properties' reliance on ecotourism will be evaluated in a Tourism Assessment of the area which has not been finalised at the completion of the draft EMPR report. The results of the Tourism Assessment will be included in the final EMPR report for submission.

Increased traffic volumes on the road network could be experienced due to additional vehicle activity in the area as a result of the proposed mining activities.

While most of the above activities currently exist in the area, there is potential for additional growth and thus these activities are considered as a feasible alternative to mining. Mining is however a temporary land use, although anticipated for 15 years, and it is possible that all of the above options can be pursued in conjunction with mining and after mining has ceased.

4.1.1 Agriculture

Maize farming and grazing is the most suitable land use on the site. There are, however, a number of impacts that maize farming and stock farming have on the environment. The first such impact is that of vegetation disturbance and damage. Animals physically damage plants by eating, cutting, bruising and breaking them. If this is done to excess, severe erosion may occur. Another impact is that of soil disturbance. Animals alter the structure of soils by chipping or loosening the soil surface or they may compact the soil, depending on its moisture. Though the loosening of the soil can be advantageous, excessive soil loosening can cause soil loss through wind and water erosion. When soils are moist, soil can easily be compacted through hoof action. This causes a loss of soil structure, which causes the reduction in infiltration, aeration and water holding capacity. General conditions for plant growth will become less favourable. These impacts are likely to be insignificant if correct management is applied.

The use of this land for stock farming compared to mining is less economical as mining produces greater value, far quicker than stock farming per unit area of land. Stock farming is extensive with large amount of land needed to sustain the livestock, this not only means that more land will be subject to the impacts associated with this type of farming but also that it will be using more land than the mining operations with less economical gain per hectare used.

Maize farming results in extensive areas of vegetation and the fauna dependant on them being destroyed for the areas under cultivation. The impacts may spread from the site if pesticides and herbicides are used which may wash off the area. It is likely that a few years after crop farming has ceased that the vegetation diversity will recover and return to its former state over time if excessive erosion has not occurred. In the project area, although the soils lend themselves in areas to crop farming, lack of rain results in predominantly stock farming only. Topographical disturbance may occur if contour drains are constructed.

The cumulative impact on the environment from agricultural activities can be highly significant. The use of fertilisers and pesticides can impact on local water sources and cause pollution. Dust and noise during ploughing and planting can be a nuisance factor, particularly with other agricultural or mining activities in the area. If more areas are used for agriculture, there will be a loss of natural habitats and biodiversity. Cumulative impacts are therefore negative overall and the impacts dependant on the scale of farming.

4.1.2 Residential

Residential use has been assessed as low density farm dwellings and farm labourer dwellings. Residential land use, however, is not feasible; development of residential areas is expected in the vicinity of existing towns and larger centres.

4.1.3 Tourism

The Harwar Colliery Project is situated within a sensitive and unique biodiversity area. The proposed project is located less than 10 km north of the small town of Chrissiesmeer. A number of guest houses and self-catering cottages operate in the Chrissiesmeer area, generally catering for nature lovers who visit the Chrissiesmeer pans.

The promotion of eco-tourism in the Chrissiesmeer pan-veld area has been identified as a key LED strategy and has been identified as a tourism node (Msukaligwa Local Municipality, 2010). Several non-governmental organisations are active, or have an interest, in the greater

Chrissiesmeer area. These include Birdlife South Africa, Endangered Wildlife Trust (EWT), Mpumalanga Tourism and Parks Agency, the Centre for Environmental Rights, and the Foundation for a Sustainable Environment (FSE).

The MLM is of the opinion that more could be done to develop tourism in the Chrissiesmeer area (Msukaligwa Local Municipality, 2010). Tourism's contribution to the local economy is still relatively small, and this sector requires specific strategies, especially those focussing on ecotourism, be developed (Chief Albert Luthuli Local Municipality, 2012).

Development guidelines for the Chrissiesmeer area suggest that the areas either side of the N17 (which runs through Chrissiesmeer), are redeveloped as a tourism-orientated business area catering for a variety of functions, including retail, entertainment, accommodation, etc. Furthermore, the guidelines propose that specific locations are demarcated as conservation areas with the emphasis on the preservation of the "village character" (Msukaligwa Local Municipality, 2010).

4.1.4 Summary of Alternatives Land Use

It can be concluded that tourism activities have the least environmental impact in the area. Agriculture, in the form of maize production and grazing, has impacted negatively, although not significantly, on the environment and this could icrease if agricultural activities are expanded and not controlled. Agriculture does, however, provide for food security, and the agricultural potential of the area in which the project area is located is moderate to high. Mining will have an impact on the environment; however the benefits of mining include social upliftment, provision of jobs, earnings of foreign currency and local economic development.

4.2 No-go Option

The no-go alternative entails the maintenance of the status quo within the project area. If the proposed mining takes place it will have a number of both positive and negative impacts on the immediate surroundings. In terms of positive impacts, it is noted that the operation will have a positive effect on the local population in terms of employment creation and multiplier effect on the local economy through economic empowerment of the communities of Chrissiesmeer, Carolina, and Breyten. If the proposed project were not to proceed, these benefits would not be created. It should however also be stated that current employment levels will decrease due to job lossess when the Tselentis and Spitzkop Collieries close down.

Further, if Msobo Coal does not proceed with the proposed operation, it will not necessarily stop mining in the area, as another application can be made by other mining companies in line with the requirements of the MPRDA. However, theoretically, without the mine, the current land use and capability would remain and the coal resource would remain untapped.

The No-go Option has been assessed in several specialist assessment reports. This includes the aquatic assessment report, the flora and fauna assessment report and the wetland assessment report. The no-go option was quantitatively assessed within these reports. A description of the current land uses within the area and on the project area is discussed below.

As mentioned previously, the current land use associated with the river courses is mainly maize farming (irrigated and dry land) with extensive cattle agriculture, plantations and small residential areas. Several coal mining activities are also present within the X11B catchment.

Current water quality impacts on this river coarse due to agriculture, forestry and livestock includes the introduction of pollutants and dissolved salts from agriculture and industry (mining) runoff, modification of riparian zones and river bank impacts (erosion and trampling). Due to the presence of limited irrigated agriculture and several impoundments, the quantity of water within the ecosystem is currently being affected (Mantel et al., 2010). The removal of water effects the volumes and flow velocities within the associated water courses, thereby affecting the available habitat structures as well as altering the flow-depth scenarios, affecting the biotic structures of the system. The current impacts on the water quality and quantity on aquatic biota within this river course due to agricultural practices are however not seen as significant.

The Boesmanspruit is under considerable stress from mining activities in the X11B quaternary catchment. Although the aquatic study found the status of the upper river systems to be only moderately affected, further downstream, the river is impacted on via several mining operations and decants from abandoned closed mines.

With regards to the flora and fauna of the project area, the current land use activities (agriculture and grazing) result in a decrease of the area of the different vegetation types, as well as the loss of biodiversity (specifically Species of Special Concern), and ecosystem functioning. These activities have led to areas of overgrazing and trampling, as well as large cleared areas. Clearing of new agricultural areas could lead to Species of Special Concern being affected. Current land uses on the project area have caused fragmentation of the natural grassveld. Additionally, alien invasive species have encroached upon the area, mostly within disturbed areas and along water courses.

Loss of wetland areas especially hillslope seepage areas has occurred within the project area as a result of agricultural activities. The temporary and seasonal sections of the hillslope seepage have been destructed in order to maximise arable land. As a result of the loss of wetland areas to arable land, the associated wetland vegetation has also been impacted.

Some of the hillslope seepage wetlands within the project area have been converted into crop plantations, mainly maize crops. This has resulted in a change in the vegetation communities within the seepage wetland zone. Furthermore the development of farm dams within the valley bottom wetlands have resulted in a change in the vegetation communities and change in water flow patterns. The application of fertilizers, herbicides and pesticides has also resulted in the contamination of the water associated with the wetland areas. The wetland areas are also extensively used for livestock grazing especially during the dry season. These activities have resulted in the loss of wetland integrity and the ability to perform important functions within the project area.

4.3 A list and description of all the main features and infrastructure related to the alternative land uses or developments

The existing features and infrastructure related to the alternative land uses or developments in the proposed area include:

- Agriculture (Maize Farming and Grazing)
- Farm roads are present in the project area that is likely used by local farmers;
- The P117 road that runs through the project area with a carting capacity of 10 tonnes (Provincial road sign);
- Landowners and their workers are reliant on groundwater for consumption and agricultural production through the use of boreholes;
- Powerlines;
- Pans (Tevrede se Pan);
- Farm dams;
- Fences;
- Telephone lines present in the project area, etc.

It is currently anticipated that a Sasol Gas pipeline traverses the most northern part of the proposed project area towards the R33. This will be confirmed and included in the final EIA/EMPR report for submission.

4.4 Map/plan

The current land uses on the project area is depicted on Plan 17. The current land uses include the following:

- Agriculture (Maize and Livestock farming);
- Grazing land;
- Pans for ecotourism and birding;
- Farm roads on the project site that are likely used by local farmers; and
- Power lines and telephone lines.

5 THE POTENTIAL IMPACTS OF THE ALTERNATIVE LAND USE OR DEVELOPMENT (REGULATION 50 (B))

5.1 A list of the potential impacts of each of the aforesaid main features and infrastructure related to the alternative land use or development and related listed activities

The potential impacts of each of the aforesaid features / infrastructure related to the alternative land use or development are listed below. The current impacts are also described for the current agricultural activities.

5.1.1 Potential Impacts of Maize Farming (Current Land Use)

The potential impacts of maize farming are listed below:

- Introduction of pollutants from agriculture runoff (including sedimentation);
- Modification of riparian zones through agricultural encroachment, erosion and flooding of the riparian zones;
- Loss of grassveld habitat;
- Loss of wetland habitat;
- Fragmentation and edge effects;
- Influx of alien invasive plants;
- Introduction of dissolved salts from agriculture;
- Increased pressure on water resources resulting in a loss of habitat and reduced water flows due to damming of rivers and streams; and
- Continued mechanisation of agricultural practices leading to the loss of employment.

Many of the above mentioned impacts are already present in the landscape.

5.1.2 Potential Impacts of Grazing / Livestock Farming (Current Land Use)

The potential impacts of livestock farming are listed below:

- Introduction of pollutants from agriculture runoff (including sedimentation);
- Modification of riparian zones through agricultural encroachment, erosion and flooding of the riparian zones;
- River bank livestock impacts through trampling and erosion as well as nutrient input;
- Overgrazing and trampling;
- Loss of grassveld habitat;
- Loss of wetland habitat;

- Loss of biodiversity;
- Loss of faunal species of special concern;
- Loss of flora species of special concern;
- Fragmentation and edge effects;
- Influx of alien invasive plants;
- Introduction of dissolved salts from agriculture; and
- Removal of water through the presence of off channel dams and water abstraction.

Many of these impacts are already present in the landscape.

5.1.3 Potential Impacts of Residential Developments

Residential developments will bring with them various impacts that will potentially affect the natural environment. The construction of infrastructure to provide essential services such as water, electricity, etc. will potentially impact negatively on the receiving environment. Increase in human activity within the area will also potentially impact on the natural environment. Along with increased human activity, is an increase in vehicle movement which could potentially have an impact on local road infrastructure and also a safety risk.

5.1.4 Potential Impacts of Tourism (Current Land Use)

The potential impact of the proposed project on the socio-economic aspects of tourism and tourism potential is discussed in terms of the potential loss of current and potential ecotourism opportunities, and the potential for business tourism development resulting from the project and possible other developments in the greater Chrissiesmeer area.

The promotion of eco-tourism in the Chrissiesmeer pan-veld area has been identified as a key LED strategy and has been identified as a tourism node (Msukaligwa Local Municipality, 2010).

The tourism potential of the area does increase the number of people that visit the area throughout the year. New infrastructure associated with tourism activities can however negatively impact on local infrastructure already established for tourism activities. A potential benefit of tourism activities could be the creation of employment opportunities for local people. An economic and tourism study is currently underway; however this study was not completed at the time of submitting the draft EIA/EMPR report. The results of this study will however be included in the final EIA/EMPR report for submission.

5.2 Description of potential cumulative impacts of the main features and infrastructure related to the alternative land use or development.

The potential cumulative impacts that could result or have resulted from the agricultural activities and livestock farming activities are described below.

5.2.1 Maize Farming Activities - Cumulative Impacts

- Contamination of wetlands, surface water and groundwater resources through the use of pesticides, fertlisers and herbicides;
- Continued change in natural drainage patterns by the construction of farm dams, cut-off trenches and water abstraction for irrigation;
- Increased pressure on water resources;
- Increase in the loss of biodiversity;
- Influx of alien invasive plants;
- Soil disturbance resulting in soil erosion sourced from poor management of soils;
- Soil degradation in the area;
- Contribution to the degradation of air quality though dust and vehicle emissions; and
- Continued contribution to the country's economy and food security.

5.2.2 Livestock Farming Activities – Cumulative Impacts

- Continued change in natural drainage patterns by the construction of farm dams, cut-off trenches and livestock watering;
- Soil disturbance due to overgrazing could result in soil erosion sourced from poor management of soils;
- Increase in dust generation through the transportation of livestock on and off site;
- Increased pressure on water resources;
- Contamination of wetlands, surface water and groundwater through nutrients and contaminants originating from the livestock feedlots; and
- Continued contribution to the country's economy.

5.2.3 Tourism

The potential cumulative impacts related to tourism activities within the area will mainly be positive on both the natural and social environments. The natural environment could benefit due to increased focus on conservation strategies of the area which will protect the natural environment. The socio-economic environment could potentially benefit economically due to increased tourism activities in the area and the creation of employment opertunities. Potential negative cumulative impacts could relate to the increase in newly built infrastructure such as accommodation which could place strain on current municipal service infrastructure available within the area; for example sewage treatment facilities. A more detailed assessment of the impacts associated with tourism activities will be provided in the final EIA/EMPR report for submission.

6 IDENTIFICATION OF POTENTIAL SOCIAL AND CULTURAL IMPACTS (REGULATION 50 (C))

6.1 List of potential impacts of the proposed mining operation on the socioeconomic conditions of other parties' land use activities both on the site and on adjacent and non- adjacent properties and farms to the extent that their socioeconomic conditions may be directly affected

Although it is necessary to keep the complexity of social impacts in mind, it is also necessary to produce an SIA report that will be accessible to a non-specialist audience and meet the requirements of the proponent. Within each category, anticipated positive and negative impacts have been grouped together.

This categorisation of impacts is shown in Table 6-1. Impacts are discussed in greater detail below, and appropriate mitigation measures are recommended to ameliorate negative impacts and enhance positive ones. Where relevant, the reader is referred to applicable specialist studies in which more comprehensive and quantitatively-orientated information is provided regarding aspects that contribute to the identified social impacts.

Table 6-1: Summary of potential impacts

Cause of impact		Impact
Effects on local economy	Positive aspects:	Job creation during construction
		Job creation during operation
		Multiplier effects on local economy
		Economic empowerment of previously disenfranchised communities
	Negative aspects:	Loss of farm/ other labour to the mine
		Dependency on mine for sustaining local economy
Impacts on the physical environment	Positive aspects:	Improved availability of/ access to services for local population
	Negative aspects:	Safety and security impacts
		Disruption of daily movement patterns
Population influx	Positive aspects:	Increased markets for local entrepreneurs
	Negative aspects:	Negative impacts related to construction camp
		Increased social pathologies
		Conflict/ competition between newcomers and incumbent population

Cause of impact		**Impact**
		Increased pressure on local services/ resources
		Growth of informal settlements
Displacement impacts	Negative impacts:	Impact on current occupants of the project area
		Impact on surrounding farms as a result of possible transport routes
Community development	Positive aspects:	Establishment/ upgrading of services
		Improved economic opportunities through entrepreneurial development projects
		Skills development
	Negative aspects:	Increased economic dependency on the mine
Impact on tourism/tourism potential	Negative aspect:	Loss of current and potential ecotourism opportunities
	Positive aspect:	Potential for business tourism development

Negative impacts on the physical environment and surrounding communities could also relate to noise generated from the proposed project as well as air quality impacts in terms of possible increased dust levels.

6.2 List of potential impacts of the mining operation on any cultural and/ or heritage resources which may be applicable

The potential impacts of the proposed development on heritage resources are described below.

The identified resources include the following:

- Undiagnostic potsherd ceramic fragments;
- Werfs; and
- Informal farm burial grounds and graves.

Potential impacts on these identified resources will be during the construction and operational phase of the proposed project as these resources are located within the proposed opencast mining areas. The identified resources will be destroyed during these project phases. Refer to section 3.2 for a discussion on the potential impacts on the heritage resources. Management measures have however been recommended to preserve these resources.

6.3 In cases where cultural and heritage features have been identified, a description of such heritage feature and describe the potential impact on such heritage feature

The potential impacts on heritage resources will be caused by the proposed opencast mining activities. The potential impacts have been quantified and rated in section 6.3.5. of this report. A description of the Heritage Impact Rating methodology is given in Section 6.3.4.

A description of the heritage resources identified in the project area is given below.

6.3.1 Undiagnostic potsherd ceramic fragments

An isolated Iron Age/Historic occurrence was identified and recorded in the opencast mine area on Mooifontein 35 IT Portion 5. The site S.35 045 represents a single, isolated occurrence of an undiagnostic potsherd ceramic fragment. The fragment was identified and recorded in a small rock shelter along a sandstone ridge. No other material culture or features were noted that might provide any further site context. No evidence of archaeological deposit was noted.

Another isolated Iron Age occurrence was identified and recorded on Tevreden 56 IT Portion 4. The site S.35 051 represents seven un-diagnostic potsherd ceramic fragments approximately 300 m east of the opencast area. The site was recorded in a sandstone outcrop about 20 m east of a pan. No other material culture was noted that might provide any further site context. No evidence of archaeological deposit was noted.

The sites S.35 045 and S.35 051 have a negligible value in aesthetic, technical characteristics and scientific information because these are undiagnostic finds that cannot be associated with a particular group of people.

6.3.2 Werfs

Two built environment sites or werfs were identified within the project area. These sites are briefly described below. For a more in depth description of the sites refer to the Heritage Assessment report.

6.3.2.1 MSO1805/2630AA/S.34 046

The site represents a single storey sandstone house, a sandstone barn, and two stonewalled enclosures most likely used as livestock pens identified and recorded on Mooifontein 35 IT Portion 2. Contemporary use of the house was noted. In addition, contemporary additions such as a metal window frame and bricks were recorded.

The construction of the opencast will destroy the site. In addition, any removal of vegetation and ground clearing may expose more extensive deposit potentially existing subsurface.

6.3.2.2 MSO1805/2630AA/S.34 050

The site represents a sandstone house, garage, barn and two stables identified and recorded on Tevreden 56 IT Portion 4. There are several fields around the werf.

Contemporary use of the house, barn and stables were noted. In addition, contemporary additions such were recorded.

The construction of the opencast will destroy the site. In addition, any removal of vegetation and ground clearing may expose more extensive deposit potentially existing subsurface.

6.3.3 Informal Farm Burial Grounds and Graves

Two informal farm burial ground sites were identified within the proposed opencast areas and one site approximately 400 m south west of the proposed opencast areas. These sites are briefly described below. Refer to the Heritage Assessment report for a more detailed description.

6.3.3.1 MSO1805/2630AA/S.36 047

An informal burial ground was identified and recorded on Mooifontein 35 IT Portion 2. At least eight informal burials were noted. The burials ranged from being stone-packed burials with headstones to stone-packed burials without headstones. The burial ground is in a poor condition. The burial ground may be associated with the local community and/or the original occupants of the werf at Site S.34 046.

The burial ground is located in the opencast mine area. Immediate threats include site clearance for the development of the opencast mining areas. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.

6.3.3.2 MSO1805/2630AA/S.36 048

Another informal burial ground was identified and recorded on Mooifontein 35 IT Portion 5. At least nine informal, stone-packed burials and one formal burial were noted. The burial ground is in a poor to fair condition and is overgrown. The burial ground may be associated with the local community and/or farmworkers. The burial ground is located in the opencast mine area.

The burial ground will be negatively impacted by the proposed mining activity as it lies directly in the proposed opencast.

6.3.3.3 MSO1805/2630AA/S.36 052

An informal burial ground was identified and recorded on Tevreden 56 IT Portion 4. At least 23 informal, stone-packed burials were noted. The burial ground is in a poor to fair condition and is overgrown. The burial ground may be associated with the local community and/or farmworkers. The burial ground is located 400 m south-west of the opencast mine area.

The informal burial ground was identified during the survey and could be impacted on. The immediate threats include site clearance for development. Potential sources of threats and risk include vandalism by workers on site and/or accidental destruction or alteration of the burials and burial ground by construction workers on site.

6.3.4 Heritage Impact Rating Methodology

The significance of a heritage resource was evaluated in terms of four dimensions - aesthetic, scientific, historic and/or social value – and integrity. Each dimension included certain relevant assessment criteria defined in Section 3 of the NHRA. The following formula thus applies:

Value = importance x integrity

Where

Importance = average sum of aesthetic + historic + scientific + social significance

A heritage resource's value is a direct indication of its sensitivity to change (impacts) and must therefore be determined before any assessment of impacts can be completed.

Field ratings or the proposed grading of heritage resources are required by SAHRA in terms of Section 7(1) of the NHRA. Field ratings prescribe criteria for assessing heritage resources consistent with Section 3(3) of the NHRA.

Assessment of impacts on heritage resources relies on two factors that must be considered when rating impacts:

- The potential physical and/or visual impact on the heritage resource; and
- The impact on the cultural landscape should any heritage resource change or be destroyed.

6.3.4.1 Heritage Impact Assessment

The impact rating takes into account spatial scale, expected duration and intensity to determine the consequence of impacts on heritage resources. The consequence rating considers the significance value of a resource. Magnitude of impacts on heritage resources are determined by multiplying the consequence rating with the probability of the impact occurring. The following formula thus applies:

Magnitude = consequence x probability

Where

Consequence = (spatial + duration + intensity) x heritage significance value

The impact rating is then applied to pre-mitigation and post-mitigation scenarios with the intention of removing all impacts on heritage resources.

6.3.5 Heritage Impact Assessment

The impacts on Heritage Resources are assessed using the Impact Assessment Methodology as described above.

6.3.5.1 Archaeological and Historical Resources

Criteria	**Details/ Discussion**
Mining phase/s	Construction Phase
Ref.	MSO1805/2630AA/S.35-045; and MSO1805/2630AA/S.35-051.
Description of impact	The heritage resources are of a negligible value and hence no impact.
Value of the heritage resource	The sites S.35 045 and S.35 051 have a negligible value in aesthetic and technical characteristics and scientific information because these are undiagnostic finds that cannot be associated with a particular group of people.
Mitigation required	No heritage mitigation is required.

6.3.5.2 Built Environment Resources

Criteria	**Details/ Discussion**
Mining phase/s	Construction and Operational Phase
Ref.	MSO1805/2630AA/S.34-046; and MSO1805/2630AA/S.34-050.
Description of impact	The construction of the opencast will destroy the sites. In addition, any removal of vegetation and ground clearing may expose more extensive deposit potentially existing subsurface. The heritage resource has a low to medium heritage value in aesthetic and technical characteristics, historic association and social association. The rating was informed by credible information sources such as peer-reviewed publications and other impact assessment reports which indicate that werfs with sandstone houses are commonly found in around Chrissiesmeer.
Value of the heritage resource	Grade IV B

Criteria	Details/ Discussion					
Mitigation required	The heritage resource is of a low to medium heritage value. Furthermore, the werf may have a strong association to the local community or farmworkers for social, cultural and spiritual reasons. Its importance is also based on highly credible information sources. Phase 2 mitigation is required so that the site is adequately recorded. It is recommended that the werf S.34-046 and S.34-050 undergo a Phase 2 Built Environment Assessment by a qualified historical architect to accurately determine the significance value of the resources and provide appropriate mitigation measures. If the site is not 60 years or older then it may not need to be assessed by the impact rating system.					
Parameters	*Spatial scale*	*Duration*	*Severity*	*Probability*	*Value*	*Magnitude*
Pre-Mitigation	Municipal area	Permanent	Medium to high	Certain	Low to Medium	Minor
Post-Mitigation	Limited	Permanent mitigated	Low to medium	Unlikely		Low to Minor

6.3.5.3 Burial Grounds and Graves

6.3.5.3.1 S.35-047 and S.35-048

Criteria	Details/ Discussion					
Mining phase/s	Construction and Operational Phase					
Ref.	MSO1805/2630AA/S.36-047; and MSO1805/2630AA/S.36-048.					
Description of impact	Site clearance for development such as the opencast mining areas will destroy the heritage resources as these are located in the opencast mining areas.					
Value of the heritage resource	Grade IV A					
Mitigation required	Project-related mitigation measures such as changes to design or mine plan were not considered as the burials are located in the opencast and could never be preserved. It is therefore recommended that the burial grounds be relocated.					
Parameters	*Spatial scale*	*Duration*	*Severity*	*Probability*	*Value*	*Magnitude*
Pre-Mitigation	Municipal area	Permanent	Medium to high	Certain	Low to Medium	Minor
Post-Mitigation	Limited	Project	Low to	Unlikely		Low to Minor

		Life	medium			

6.3.5.3.2 S36.052

Criteria	**Details/ Discussion**					
Mining phase/s	Construction and Operational Phase					
Ref.	MSO1805/2630AA/S.36-052.					
Description of impact	The burial ground may be associated with the local community and/or farmworkers. The burial ground is located 400 m south west of the opencast mine area. Site clearance for development such as opencast areas and/or infrastructure could impact on this heritage resource.					
Value of the heritage resource	Grade IV A					
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ The graves should be restored where these are dilapidated, protected and conserved in perpetuity. Access to this burial ground should be negotiated with communities in the immediate area. ▪ A perimeter fence should be built around the burial ground and placed two meters away from the perimeter of the graves. The perimeter fences should include an entry gate to allow visits from relatives and family friends. The mine should be responsible for the maintenance of these fences. ▪ The Environmental Control Officer (ECO) should be present on site when these fences are being erected around the burial ground.					
Parameters	*Spatial scale*	*Duration*	*Severity*	*Probability*	*Value*	*Magnitude*
Pre-Mitigation	Municipal area	Permanent	Medium to high	Probable	Low to Medium	Minor
Post-Mitigation	Limited	Project Life	Medium	Unlikely		Low to Minor

6.4 Quantification of the impact on the socio-economic conditions

The impacts on the socio-economic conditions of directly affected persons are determined by the findings of the Social Assessment Report.

During the consultation process that took place for the purposes of the Social Assessment, a variety of stakeholders were consulted. The purpose of the consultation was to assess stakeholders' perceptions, concerns and expectations regarding the proposed project. The main social issues and concerns are listed below and discussed in further detail in the sections to follow:

- Loss of land rights/ownership;
- Loss of sense of place;
- Property devaluation;
- Negative visual impact;
- Groundwater pollution/depletion;
- Influx of foreign workforce:
  - Increase in social pathologies;
  - Safety and security; and
  - Labour conflict.
- Dust and noise pollution (impact on humans, animals and crops);
- Impact on tourism development/potential of the greater Chrissiesmeer area;
- Local employment opportunities should be maximised; and
- Local communities must share in the economic benefits of the project.
- A number of potentially affected property owners have stated that, should the mine proceed, Msobo Coal will be required to buy their property in total, as these farms are operated as a single economic unit.

In addition, several stakeholders (including farm owners, parastatal organisations and non-governmental organisations), have expressed concern about the lack of comparative studies to determine the relative advantages and disadvantages of mining versus other land uses, such as tourism and agriculture. A Comparative Economic Study was subsequently commissioned partly in response to the above concern. This study was still in progress at the time of writing the report. The findings of the above study will be incorporated in the final EMPR report.

6.4.1 Socio-economic Impact Rating Methodology

The impact rating process is designed to provide a numerical rating of the various social impacts identified. The significance rating follows the established impact/risk assessment formula, as shown below:

Significance = consequence of an event x probability of the event occurring

Where

Consequence = Type of impact x (Intensity + Spatial Scale + Duration)

And

Probability = Likelihood of an impact occurring

In the formula for calculating consequence:

Type of impact = +1 (for positive impacts) or -1 (for negative impacts)

The weight assigned to the various parameters for positive and negative impacts in the formula is presented in Table 6-2 to Table 6-6 below.

Table 6-2: Rating Options: Intensity

Rating	Negative impacts (Type of impact = -1)	Positive impacts (Type of impact = +1)
7	Irreparable damage to highly valued items of great cultural significance or complete breakdown of social order	Noticeable, on-going social benefits which have improved the livelihoods and living standards of the local community in general
6	Irreparable damage to highly valued items of cultural significance or breakdown of social order	Great improvement to livelihoods and living standards of a large percentage of population
5	Very serious widespread social impacts. Irreparable damage to highly valued items	On-going and widespread positive benefits to local communities which improves livelihoods
4	On-going serious social issues. Significant damage to structures / items of cultural significance	Average to intense social benefits to some people
3	On-going social issues. Damage to items of cultural significance	Average, on-going positive benefits, not widespread but felt by some
2	Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected	Low positive impacts experience by very few of population
1	Minimal social impacts, low-level repairable damage to commonplace structures	Some low-level social benefits felt by very few of the population

Table 6-3: Rating Options: Spatial Scale

Rating	Definition
7	International: The effect will occur across international borders
6	National: Will affect the entire country
5	Province/ Region: Will affect the entire province or region
4	Municipal Area: Will affect the whole municipal area

Rating	Definition
3	Local: Extending across the site and to nearby settlements
2	Limited: Limited to the site and its immediate surroundings
1	Very limited: Limited to specific isolated parts of the site

Table 6-4: Rating Options: Duration

Rating	Definition
7	Permanent: The impact will remain long after the life of the project
6	Beyond project life: The impact will remain for some time after the life of the project
5	Project Life: The impact will cease after the operational life span of the project
4	Long term: 6-15 years
3	Medium term: 1-5 years
2	Short term: Less than 1 year
1	Immediate: Less than 1 month

Table 6-5: Rating Options: Probability

Rating	Definition
7	Certain/ Definite: There are sound scientific reasons to expect that the impact will definitely occur
6	Almost certain/ Highly probable: It is most likely that the impact will occur
5	Likely: The impact may occur
4	Probable: Has occurred here or elsewhere and could therefore occur
3	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur
2	Rare/ improbable: Conceivable, but only in extreme circumstances and/ or has not happened during lifetime of the project but has happened elsewhere. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures
1	Highly unlikely/None: Expected never to happen.

Impacts are rated prior to mitigation and again after consideration of the proposed mitigation measures. The impact is then determined and categorised into one of eight categories, as indicated in the table below.

Table 6-6: Significance Rating

Score	Description	Rating
109 to 147	A very beneficial impact which may be sufficient by itself to justify implementation of the project. The impact may result in permanent positive change	Major (positive)
73 to 108	A beneficial impact which may help to justify the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and/or social) environment	Moderate (positive)
36 to 72	An important positive impact. The impact is insufficient by itself to justify the implementation of the project. These impacts will usually result in positive medium to long-term effect on the social and/or natural environment	Minor (positive)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the social and/or natural environment	Negligible (positive)
-3 to -35	An acceptable negative impact for which mitigation is desirable but not essential. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the social and/or natural environment	Negligible (negative)
-36 to -72	An important negative impact which requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the social and/or natural environment	Minor (negative)
-73 to -108	A serious negative impact which may prevent the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term change to the (natural and/or social) environment and result in severe effects	Moderate (negative)
-109 to -147	A very serious negative impact which may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects	Major (negative)

The relationship between consequence, probability and significance ratings is graphically depicted in Figure 6–1.

Significance

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

Figure 6–1: Relationship between consequence, probability and significance ratings

6.4.2 Socio-economic Impact Assessment

6.4.2.1 Effects on the local economy

This section deals with social impacts derived from the project's effect on the local economy. These include:

- Three positive impacts (employment creation during construction and operation, multiplier effects on the local economy and economic empowerment of previously disadvantaged communities); and
- Two negative impacts (loss of farm labour to the mine, and dependency on the mine for sustaining the local economy).

6.4.2.1.1 Positive aspects

6.4.2.1.1.1 Job creation during construction

An anticipated 647 permanent positions will be sustained by the proposed project. An estimated 477 of the above 647 permanent employment positions will be filled by individuals from the local municipal area. It is expected that a fairly large proportion of the workforce will be derived from within the borders of the local municipality. The creation of local employment opportunities during the construction phase can therefore be seen as a significant positive impact on the surrounding communities.

In addition to creating job opportunities for construction workers, the project may also lead to employment creation in both the formal and informal sectors through a multiplier effect from the project activities.

<table>
<tr><th colspan="5">Impact Description: Job creation during construction</th></tr>
<tr><th>Predicted for project phase:</th><th>Pre-construction</th><th>Construction</th><th>Operation</th><th>Decommissioning</th></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><th colspan="5">Pre-Mitigation</th></tr>
<tr><td>Duration</td><td>Medium term (3)</td><td>Equal to the duration of the construction phase</td><td rowspan="3">Consequence: Moderately beneficial (11)</td><td rowspan="4">Significance: Minor - positive (44)</td></tr>
<tr><td>Extent</td><td>Municipal Area (4)</td><td>Some positions will be filled by persons living in the local municipal area; the remainder from elsewhere in SA</td></tr>
<tr><td>Intensity x type of impact</td><td>Moderately high - positive (4)</td><td>About 700 full-time equivalent jobs will be created over construction period. Local jobs will be mostly low skilled</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td colspan="2">Without appropriate mitigation, forecasts of majority local recruitment might not be achieved</td></tr>
<tr><th colspan="5">Mitigation</th></tr>
<tr><td colspan="5">- Maximise and monitor local recruitment
- Prevent nepotism/ corruption in local recruitment structures
- Promote employment of women and youth
- Train workforce</td></tr>
<tr><th colspan="5">Post-Mitigation</th></tr>
<tr><td>Duration</td><td>Project Life (5)</td><td>As for pre-mitigation</td><td rowspan="3">Consequence: Highly beneficial (15)</td><td rowspan="4">Significance: Moderate - positive (75)</td></tr>
<tr><td>Extent</td><td>Province/ Region (5)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>High - positive (5)</td><td>Mitigation will maximise local job creation</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td colspan="2">Mitigation will maximise probability that local recruitment targets are achieved and local benefits optimised</td></tr>
</table>

6.4.2.1.1.2 *Job creation during operation*

As with the construction phase, Msobo Coal’s recruitment policy should dictate that local persons (i.e. persons residing within the local municipality) will be given preference as far as possible when positions are filled. It is acknowledged that Msobo Coal has indicated that a proportion of the workforce at the existing operations will be employed at Harwar. However, local applicants with the required skills and experience for skilled or semi-skilled positions should also be considered for employment at Harwar. It is likely that there are sufficient numbers of unemployed local persons to take up available unskilled positions.

As is the case with the construction phase, the operational phase of the proposed project could give rise to a number of indirect employment opportunities. These could include jobs in the informal sector (e.g. petty trading), and in the formal sector (e.g. through employment of a local security company).

Impact Description: Job Creation During Operation				
Predicted For Project Phase:	**Pre-Construction**	**Construction**	**Operation**	**Decommissioning**
Dimension	**Rating**	**Motivation**		
Pre-Mitigation				
Duration	Project Life (5)	Equal to the duration of the construction phase	Consequence: Highly beneficial (14)	Significance: Minor - positive (70)
Extent	Municipal Area (4)	Most positions will be filled by persons living in the project area; some from elsewhere in the country and from abroad		
Intensity x type of impact	High - positive (5)	Permanent employment will provide security for workers and their families		
Probability	Likely (5)	Without appropriate mitigation, forecasts of majority local recruitment might not be achieved		
Mitigation				
- Maximise and monitor local recruitment - Prevent nepotism/ corruption in local recruitment structures - Promote employment of women and youth - Use of local labour for maintenance during operation - Training of workforce				
Post-Mitigation				
Duration	Project Life (5)	As for pre-mitigation	Consequence: Highly beneficial (16)	Significance: Moderate - positive (80)
Extent	Province/ Region (5)	As for pre-mitigation		
Intensity x type of impact	Very high - positive (6)	Mitigation will maximise local job creation		
Probability	Likely (5)	Mitigation will maximise probability that local recruitment targets are achieved and local benefits optimised		

6.4.2.1.1.3 <u>Multiplier effects on local economy</u>

The Comparative Economic Study will assess the multiplier effect on the local economy in terms of total value of business sales leveraged by the caopencast areaal investment, as well as through indirect and induced employment creation. It is anticipated that the project's multiplier effect will be significant, while most of these economic benefits will accrue to the construction and manufacturing sectors.

During full production capacity of the project, in addition to people directly employed by the mine, overall production and consumption induced effects will support additional jobs. It is anticipated that this will outweigh the number of agricultural jobs that will be lost through the sterilisation of agricultural land by the project.

The Harwar SLP and Local Economic Development (LED) Programme will provide further benefits to the local economy by stimulating the growth of small businesses and contributing towards skills development.

Impact description: multiplier effect on local economy				
Predicted for project phase:	**Pre-construction**	**Construction**	**Operation**	**Decommissioning**
Dimension	**Rating**	**motivation**		
Pre-mitigation				
Duration	Project Life (5)	Will continue through the life of the mine	Consequence: Moderately beneficial (12)	Significance: Minor - positive (60)
Extent	Municipal Area (4)	Will include micro- and macro-economic impacts		
Intensity x type of impact	Moderate - positive (3)	Will derive from increased cash flow from wages, local procurement, LED initiatives and fiscal impacts		
Probability	Likely (5)	Will depend on proportion of local spending by employees and availability local enterprises to supply required goods/ services		
Mitigation				
As for maximising employment benefits. Also: - Development of a register of local SMMEs - Linkages with skills development/ SMME development institutions - SMME skills development as part of SLP commitments				
Post-mitigation				
Duration	Project Life (5)	As for pre-mitigation	Consequence: Moderately beneficial (13)	Significance: Moderate - positive (78)
Extent	Municipal Area (4)	As for pre-mitigation		
Intensity x type of impact	Moderately high - positive (4)	As for maximising employment benefits		
Probability	Highly probable (6)	Increased local employment and procurement will enhance likelihood of benefits to local economy		

6.4.2.1.1.4 *Economic empowerment of previously disadvantaged communities*

The mine's SLP states a commitment to ensure career progression of its employees, and in particular, Historically Disadvantaged South Africans (HDSAs), as well as the participation of women in the mining industry.

It is anticipated that the benefits of the proposed project will extend beyond HDSA members of the mine's workforce to suppliers and service providers. Throughout the life of the mine, Msobo Coal will seek to procure from local suppliers and, where applicable, provide mentoring and other assistance to develop local HDSA companies, which, at the time of closure, will be sufficiently established to supply goods and services to non-mining enterprises.

Impact description: economic empowerment of previously disadvantaged communities				
Predicted for project phase:	**Pre-construction**	**Construction**	**Operation**	**Decommissioning**
Dimension	**Rating**	**Motivation**		
Pre-mitigation				
Duration	Project Life (5)	Will continue through the life of the mine	Consequence: Moderately beneficial (12)	Significance: Minor - positive (48)
Extent	Municipal Area (4)	Will benefit local communities		
Intensity x type of impact	Moderate - positive (3)	Will involve procurement progression and HDSA & women career progression		
Probability	Probable (4)	Appropriately skilled HDSA suppliers may not be available		
Mitigation				
- Develop capacity of local HDSA - Prevent nepotism/ corruption in local recruitment structures - Promote employment of women and youth - Use of local labour for maintenance during operation				
Post-mitigation				
Duration	Project Life (5)	As for pre-mitigation	Consequence: Moderately beneficial (13)	Significance: Minor - positive (65)
Extent	Municipal Area (4)	As for pre-mitigation		
Intensity x type of impact	Moderately high - positive (4)	Mitigation will increase benefits HDSAs		
Probability	Likely (5)	Recommended mitigation will increase the probability of benefits accruing for HDSAs		

6.4.2.1.2 <u>Negative Aspects</u>

6.4.2.1.2.1 <u>Loss of farm/other labour to the mine</u>

During consultation with affected landowners, some parties expressed the concern that farm workers may desert their current jobs to take up more lucrative positions at the mine. It is acknowledged that surrounding farming operations may suffer some negative impact as a result of a loss of labour to the mine. It must be noted, however, that the local labour pool is unlikely to be depleted because of the project, as the number of employment opportunities that would become available will be far smaller than the number of unemployed persons in the area. Furthermore, farm workers employed by the project on a temporary basis are likely to acquire skills and experience that would benefit both them and their employers. A negative impact that could occur is the increased competition for semi-skilled labour between farm owners and the mine.

Some farmers expressed the concern that the living conditions of those farm workers (and families), who unsuccessfully applied for employment at the mine, or who only managed to secure casual labour, could deteriorate. This will not only affect these families, but could also place an additional burden on the farm owner to support these families.

<table>
<tr><th colspan="5">Impact description: loss of farm/other labour to the mine</th></tr>
<tr><th>Predicted for project phase:</th><th>Pre-construction</th><th>Construction</th><th>Operation</th><th>Decommissioning</th></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><th colspan="5">Pre-mitigation</th></tr>
<tr><td>Duration</td><td>Medium term (3)</td><td>Is expected to peak during ramp-up, when new workers are recruited</td><td rowspan="3">Consequence: Slightly detrimental (-9)</td><td rowspan="4">Significance: Minor - negative (-36)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Will impact on surrounding landowners</td></tr>
<tr><td>Intensity x type of impact</td><td>Moderate - negative (-3)</td><td>Local labour pool unlikely to be depleted</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td colspan="2">Already a problem due to existing mining operations</td></tr>
<tr><th colspan="5">Mitigation</th></tr>
<tr><td colspan="5">-Avoid recruitment on farms
- Adhere to labour legislation</td></tr>
<tr><th colspan="5">Post-mitigation</th></tr>
<tr><td>Duration</td><td>Medium term (3)</td><td>As for pre-mitigation - people are constitutionally entitled to take up work where they please</td><td rowspan="3">Consequence: Slightly detrimental (-8)</td><td rowspan="4">Significance: Negligible - negative (-32)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>As above</td></tr>
<tr><td>Intensity x type of impact</td><td>Low - negative (-2)</td><td>As above</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td colspan="2">As above</td></tr>
</table>

6.4.2.1.2.2 Dependency on mine for sustaining local economy

As indicated in the baseline description, the local economy, specifically Breyten and Carolina, is heavily dependent on mining and agriculture. While mining undoubtedly has contributed to economic development in the area, this positive impact also has a negative side, in that mining is not a permanent activity. Inevitably, mines eventually close, and this can have devastating consequences for an area that has not invested in economic diversification.

It is expected that the proposed mine will reach the end of its economic life approximately 15 years after commencing operation. Upon closure, the employment opportunities associated with the project will be lost. Retrenchments could also be necessitated by external forces that result in reduced profitability, and/or technical innovation, the need to remain globally competitive or changes to the mine's strategic business plan.

The retrenchments will lead to loss of income and local expenditure, particularly if other mines in the area also approach the end of their economic life at about the same time, and if no new mines are developed. Loss of employment and an economic downturn in the area could result in increases in social pathologies, such as crime, prostitution and substance abuse.

Impact Description: Dependency On Mine For Sustaining Local Economy				
Predicted For Project Phase:	**Pre-Construction**	**Construction**	**Operation**	**Decommissioning**
Dimension	**Rating**	**Motivation**		
Pre-Mitigation				
Duration	Beyond project life (6)	Effects of retrenchments/ mine closure will be long-lasting	Consequence: Moderately detrimental (-13)	Significance: Minor - negative (-52)
Extent	Municipal Area (4)	Will mainly affect surrounding communities		
Intensity x type of impact	Moderate - negative (-3)	Local economy heavily dependent on mining		
Probability	Probable (4)	Mining is not a permanent activity		
Mitigation				
- Effect retrenchments according to procedure stipulated in SLP - Support economic diversification through development of alternative markets				
Post-Mitigation				
Duration	Beyond project life (6)	As for pre-mitigation	Consequence: Moderately detrimental (-12)	Significance: Negligible - negative (-24)
Extent	Municipal Area (4)	As for pre-mitigation		
Intensity x type of impact	Low - negative (-2)	Mitigation will reduce the impact of retrenchment		
Probability	Improbable (2)	Mitigation will somewhat reduce dependency of local economy of mining		

6.4.2.2 Impacts on the physical environment

The mine will have numerous effects on the physical environment that will give rise to social impacts. These impacts are expected to be both positive and negative:

- On the positive side, improvements to infrastructure such as access roads will benefit local communities; and
- On the negative side, increased traffic could give rise to safety impacts, while mining activities could cause visual, acoustic, vibration and air quality impacts and physical obstructions could disrupt people's daily movement patterns.

6.4.2.2.1 Positive aspects

6.4.2.2.1.1 Improved availability of/access to services for local population

During construction, surrounding roads may be upgraded to provide access to the mine site for construction vehicles and machinery. If this occurs, it could have positive spin-offs for neighbouring communities who also use these roads, as an improvement of these roads will lead to reduced travelling time, lower transport costs and better access to services such as schools, shops and other amenities.

<table>
<tr><th colspan="5">Impact Description: Improved Availability Of/Access To Services For Local Population</th></tr>
<tr><th>Predicted For Project Phase:</th><th>Pre-Construction</th><th>Construction</th><th>Operation</th><th>Decommissioning</th></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><td colspan="5">Pre-Mitigation</td></tr>
<tr><td>Duration</td><td>Beyond project life (6)</td><td>Upgraded infrastructure will be maintained for the life of the mine</td><td rowspan="3">Consequence: Highly beneficial (14)</td><td rowspan="4">Significance: Minor - positive (56)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Will benefit neighbouring communities</td></tr>
<tr><td>Intensity x type of impact</td><td>High - positive (5)</td><td>Will improve access to services</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td colspan="2">Depends on detailed mine planning</td></tr>
<tr><td colspan="5">Mitigation:</td></tr>
<tr><td colspan="5">Integration with mine and local government plans</td></tr>
<tr><td colspan="5">Post-Mitigation</td></tr>
<tr><td>Duration</td><td>Beyond project life (6)</td><td>As for pre-mitigation</td><td rowspan="3">Consequence: Highly beneficial (14)</td><td rowspan="4">Significance: Minor - positive (56)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>High - positive (5)</td><td>As for pre-mitigation</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td colspan="2">As for pre-mitigation</td></tr>
</table>

6.4.2.2.2 Negative aspects

6.4.2.2.2.1 Safety impacts

Construction activities are likely to result in an increase in traffic volumes on certain roads in the vicinity. This could lead to damage of roads and increased speeding through residential areas, thereby impacting on the safety of residents in surrounding communities. In particular, traffic could pose a risk to the safety of people using or crossing this road, while cattle crossing the road would also be at risk.

Other health- and safety-related risks associated with the proposed project include the following:

- If members of surrounding communities gain unauthorised access to the project site, they could at serious risk of accidents;
- An increased risk of veld fires as a result of construction workers making fires. Such fires may pose a risk to the safety of community members and construction workers. Other impacts associated with a construction camp are discussed in the sections below.
- Possible increase in crime rates in the area could also be accompanied by a greater safety risk to local communities.

Impact Description: Safety Impacts				
Predicted For Project Phase:	**Pre-Construction**	**Construction**	**Operation**	**Decommissioning**
Dimension	**Rating**	**Motivation**		
Pre-Mitigation				
Duration	Project Life (5)	Will Continue During Operational Phase	Consequence: Moderately Detrimental (-13)	Significance: Moderate - Negative (-78)
Extent	Local (3)	Will Affect Nearby Communities		
Intensity X Type Of Impact	High - Negative (-5)	Could Place The Lives Of Community Members At Risk		
Probability	Highly Probable (6)	Increase In Traffic Levels Has Been Quantitatively Assessed In A Separate Specialist Study		
Mitigation				
- Traffic Control To Prevent Speeding - Implementing Continuous Maintenance Programme. - Possibly Form A Joint Fund To Pay For Road Maintenance. - Fencing Of Mine Site - Prevention Of Fires - Community Education				
Post-Mitigation				
Duration	Project Life (5)	As For Pre-Mitigation	Consequence: Moderately Detrimental (-12)	Significance: Minor - Negative (-60)
Extent	Local (3)	As For Pre-Mitigation		
Intensity X Type Of Impact	Moderately High - Negative (-4)	Mitigation Will Reduce Severity Of These Impacts To Some Extent		
Probability	Likely (5)	Mitigation Will Maximise Probability That Local Recruitment Targets Are Achieved And Local Benefits Optimised		

6.4.2.2.2.2 <u>*Disruption of daily movement patterns*</u>

Construction activities may cause temporary disruptions of vehicle and pedestrian traffic, as well in the mobility of cattle that are moved to different farm portions for grazing purposes. The impact may be particularly negative on the road network in and around the project area. Disruptions of traffic along the road would therefore constitute an additional impact on some people's daily movement patterns.

This impact may continue during the construction and operational phases of the project.

<table>
<tr><th colspan="5">Impact Description: Disruption Of Daily Movement Patterns</th></tr>
<tr><th>Predicted For Project Phase:</th><th>Pre-Construction</th><th>Construction</th><th>Operation</th><th>Decommissioning</th></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><th colspan="5">Pre-Mitigation</th></tr>
<tr><td>Duration</td><td>Project Life (5)</td><td>Likely to continue throughout operational phase</td><td rowspan="3">Consequence: Moderately detrimental (-12)</td><td rowspan="4">Significance: Minor - negative (-60)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Will affect communities using road running through Breyten</td></tr>
<tr><td>Intensity x type of impact</td><td>Moderately high - negative (-4)</td><td>Traffic volumes likely to increase because of population influx</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td colspan="2">Roads already severely congested due to other mines</td></tr>
<tr><th colspan="5">Mitigation:</th></tr>
<tr><td colspan="5">- Recommend that traffic impact assessment is undertaken (Currently only basic traffic conditions were assessed.)
- Inform communities of planned construction activities that would affect vehicle/ pedestrian traffic</td></tr>
<tr><th colspan="5">Post-Mitigation</th></tr>
<tr><td>Duration</td><td>Project Life (5)</td><td>As for pre-mitigation</td><td rowspan="3">Consequence: Moderately detrimental (-12)</td><td rowspan="4">Significance: Minor - negative (-48)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>Moderately high - negative (-4)</td><td>Mitigation will maximise local job creation</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td colspan="2">Mitigation measures will reduce disruption and ensure communities are informed in advance</td></tr>
</table>

6.4.2.3 Population Influx

As news regarding the proposed project spreads, expectations regarding possible employment opportunities may also take root. It is expected that the towns located closest to the project area will be affected the most.

The magnitude of this impact will be influenced by the severity of unemployment in surrounding areas. As was mentioned, poverty and unemployment are significant challenges for communities surrounding the proposed mine site. The regional profile also indicates that poverty and unemployment are a widespread problem throughout the region, therefore it can be expected that a large enough number of job seekers will flock to the area. This impact may commence prior to construction, and is likely to continue after construction has been completed.

In the event that some of the workforce are recruited from outside the local area (for instance, to supply skills required for the construction of the processing plant), their presence will constitute an additional influx of people. This impact, however, will most likely be limited to the construction phase of the project.

The influx of construction workers and job-seekers is expected to have a variety of social consequences:

- On the positive side, the population influx could present improved opportunities for local entrepreneurs, and could offer other benefits for the local economy; and
- On the negative side, the presence of a non-local workforce could require the establishment of a construction/ labour camp, which can have a variety of negative social consequences. In addition, population influx could lead to social pathologies, conflict or competition between locals and newcomers, increased pressure on local infrastructure and services, and the growth of informal settlements.

6.4.2.3.1 <u>Positive aspects</u>

6.4.2.3.1.1 <u>Increased markets for local entrepreneurs</u>

Although the social consequences of a substantial population influx would be mostly negative, it will also have some positive effects on the local economy. Small businesses may experience improved markets and increased numbers of customers for consumable items they sell. This will particularly be the case if workers recruited from elsewhere represent higher-level occupations and have relatively high disposable incomes.

In addition, migrants can bring assets to the local economy, and skilled people who have previously out-migrated to seek work elsewhere but whose families are resident in the local area may return in the hope of employment at home.

Both the nature and the magnitude of impacts associated with a population influx would therefore depend on the numbers, skill sets, behaviours, employment expectations and family status of migrants, as well as on the response of people in the local study area.

<table>
<tr><th colspan="6">Impact Description: Increased Markets For Local Entrepreneurs</th></tr>
<tr><th>Predicted For Project Phase:</th><th>Pre-Construction</th><th>Construction</th><th>Operation</th><th colspan="2">Decommissioning</th></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="4">Motivation</th></tr>
<tr><th colspan="6">Pre-Mitigation</th></tr>
<tr><td>Duration</td><td>Medium term (3)</td><td>Will be most pronounced during construction phase, due to temporary presence of non-local, skilled workers</td><td rowspan="3">Consequence: Moderately beneficial (10)</td><td rowspan="4" colspan="2">Significance: Minor - positive (40)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Will benefit surrounding communities</td></tr>
<tr><td>Intensity x type of impact</td><td>Moderately high - positive (4)</td><td>Will increase customer base for local entrepreneurs</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td colspan="2">Without appropriate mitigation, forecasts of majority local recruitment might not be achieved</td></tr>
<tr><th colspan="6">Mitigation</th></tr>
<tr><td colspan="6">-As for enhancing multiplier effects on the local economy</td></tr>
<tr><th colspan="6">Post-Mitigation</th></tr>
<tr><td>Duration</td><td>Medium term (3)</td><td>As for pre-mitigation</td><td rowspan="3">Consequence: Moderately beneficial (11)</td><td rowspan="4" colspan="2">Significance: Minor - positive (55)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>High - positive (5)</td><td>Mitigation measures will increase benefits for local communities</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td colspan="2">Mitigation measures will increase benefits for local communities</td></tr>
</table>

6.4.2.3.2 <u>Negative aspects</u>

6.4.2.3.2.1 <u>Negative impacts related to a construction camp</u>

If part of the construction workforce is recruited from outside the local area, it may be necessary to find accommodation for them in the vicinity of the project site. One option would be to house them in a construction camp. At the time of writing this report, it was not yet known what the physical extent of the camp would be or how many people would be housed there, if a construction camp is established at all.

As has been well-documented from other mining projects, construction camps used to accommodate workers can be a potential source of annoyance to nearby communities, and also pose security-related risks. Specific potential impacts in this regard include:

- Negligence with regard to starting fires around the construction site, which could pose a fire hazard to farms;
- Loss of livestock due to poaching by construction workers;
- Lack of control over contract employees in respect of ablutions, which could pose a risk of cattle being infected with tapeworm;
- Littering by construction workers;
- Construction camps are predominately inhabited by single men who can often create social disturbances, usually as a result of drinking and or being away from their wives or girlfriends; these can be a major source of annoyance to nearby communities, and can also give rise to various social pathologies;
- Once construction is complete and the camp is vacated, it may be illegally occupied by squatters. This risk is especially acute given the shortage of housing and the absence of services in the area.

<table>
<tr><th colspan="5">Impact Description: Negative Impacts Relating To Construction Camps</th></tr>
<tr><th>Predicted For Project Phase:</th><th>Pre-Construction</th><th>Construction</th><th>Operation</th><th>Decommissioning</th></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><th colspan="5">Pre-Mitigation</th></tr>
<tr><td>Duration</td><td>Medium term (3)</td><td>Will be limited to construction phase</td><td rowspan="3">Consequence: Moderately detrimental (-11)</td><td rowspan="4">Significance: Minor - negative (-55)</td></tr>
<tr><td>Extent</td><td>Limited (2)</td><td>Will impact on surrounding landowners and communities</td></tr>
<tr><td>Intensity x type of impact</td><td>Very high - negative (-6)</td><td>Will impact on surrounding landowners and communities</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td colspan="2">Details on construction camps not available. Construction camp</td></tr>
<tr><th colspan="5">Mitigation</th></tr>
<tr><td colspan="5">- Suitable location for camp, with adequate facilities
- Camp must be fenced and access controlled
- Fire safety and fire fighting strategy included in the EMP
- Rules of construction worker conduct stipulated in EMP
- Demolition of camp after it is vacated</td></tr>
<tr><th colspan="5">Post-Mitigation</th></tr>
<tr><td>Duration</td><td>Medium term (3)</td><td>As for pre-mitigation</td><td rowspan="3">Consequence: Moderately detrimental (-10)</td><td rowspan="4">Significance: Minor - negative (-50)</td></tr>
<tr><td>Extent</td><td>Limited (2)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>High - negative (-5)</td><td>Mitigation will maximise local job creation</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td colspan="2">Mitigation will maximise probability that local recruitment targets are achieved and local benefits optimised</td></tr>
</table>

6.4.2.4 Increased social pathologies

An influx of job-seekers may lead to an increase in various social pathologies, such as drug/ alcohol abuse, abuse of women, and the incidence of sexually transmitted diseases (STDs).

This impact may be aggravated by the presence of a temporary construction workforce. With a predominantly male population, construction camps often become a focal point for promiscuous sexual activities. Such activities can result in increases in STDs and in particular AIDS among the employees and partners. Farmworker households currently resident in the project area are particularly vulnerable in this regard.

An influx of construction workers and job seekers might also be accompanied by an increase in crime. Even if particular instances of crime are not as a result of the newcomers, they may still be attributed to them by local communities.

<table>
<tr><th colspan="5">Impact Description: Increased Social Pathologies</th></tr>
<tr><th>Predicted For Project Phase:</th><th>Pre-Construction</th><th>Construction</th><th>Operation</th><th>Decommissioning</th></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><th colspan="5">Pre-Mitigation</th></tr>
<tr><td>Duration</td><td>Beyond project life (6)</td><td>Would be most pronounced during construction but could continue into operational phase</td><td rowspan="3">Consequence: Highly detrimental (-15)</td><td rowspan="4">Significance: Moderate - negative (-75)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Will affect surrounding communities</td></tr>
<tr><td>Intensity x type of impact</td><td>Very high - negative (-6)</td><td>Could severely affect well-being of communities, especially as cumulative impact combining with existing effects of other mining operations in the area</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td colspan="2">Construction workforce need to enter the properties to implement construction activities</td></tr>
<tr><th colspan="5">Mitigation:</th></tr>
<tr><td colspan="5">- Maximise & monitor local recruitment
- Prevent nepotism/ corruption in local recruitment structures
- Promote employment of women and youth
- Use of local labour for maintenance during operation</td></tr>
<tr><th colspan="5">Post-Mitigation</th></tr>
<tr><td>Duration</td><td>Beyond project life (6)</td><td>As for pre-mitigation</td><td rowspan="3">Consequence: Highly detrimental (-14)</td><td rowspan="4">Significance: Minor - negative (-56)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>High - negative (-5)</td><td>Mitigation will maximise local job creation</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td colspan="2">Mitigation will maximise probability that local recruitment targets are achieved and local benefits optimised</td></tr>
</table>

6.4.2.5 Conflict/ competition between newcomers and incumbent population

As was mentioned above, a proportion of the construction workforce for the project will be locals, while the remainder will be sourced from elsewhere in South Africa. It is possible that conflict might arise between the newcomers and local residents. One possible reason for such conflict would be the perception among locals that the outsiders are taking up jobs that could have gone to unemployed members of the local community. If any outsiders instigate sexual relationships with wives, daughters or girlfriends of locals, this would certainly exacerbate the problem. An influx of unemployed job seekers could also add to the potential for conflict.

<table>
<tr><th colspan="5">Impact Description: Conflict/Competition Between Newcomers And Incumbent Population</th></tr>
<tr><th>Predicted For Project Phase:</th><th>Pre-Construction</th><th>Construction</th><th>Operation</th><th>Decommissioning</th></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><th colspan="5">Pre-Mitigation</th></tr>
<tr><td>Duration</td><td>Medium term (3)</td><td>Equal to the duration of the construction phase</td><td rowspan="3">Consequence: Moderately beneficial (11)</td><td rowspan="4">Significance: Minor - positive (55)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Will affect surrounding communities</td></tr>
<tr><td>Intensity x type of impact</td><td>High - positive (5)</td><td>High unemployment in the area is likely to engender intense competition for jobs</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td colspan="2">Very likely that some workers would have to be recruited from elsewhere</td></tr>
<tr><th colspan="5">Mitigation</th></tr>
<tr><td colspan="5">- Clearly communicated local recruitment policy
- Use of community structures to identify local labour pool</td></tr>
<tr><th colspan="5">Post-Mitigation</th></tr>
<tr><td>Duration</td><td>Medium term (3)</td><td>As for pre-mitigation</td><td rowspan="3">Consequence: Moderately detrimental (-10)</td><td rowspan="4">Significance: Minor - negative (-40)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>Moderately high - negative (-4)</td><td>Stringent enforcement of preferential local employment policy may reduce influx of job-seekers</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td colspan="2">Verification of workers as locals will reduce probability of outsiders fraudulently gaining positions</td></tr>
</table>

6.4.2.6 Increased pressure on local services/resources

An influx of job-seekers into the area, combined with the presence of a large workforce, will place significant pressure on local infrastructure and services, such as schools, police, the clinic, etc. This impact will be compounded by the fact that the municipality is already experiencing backlogs in the provision of services.

Impact Description: Increased Pressure On Local Services/Resources				
Predicted For Project Phase:	**Pre-Construction**	**Construction**	**Operation**	**Decommissioning**
Dimension	**Rating**	**Motivation**		
Pre-Mitigation				
Duration	Long term (4)	May continue after construction is complete	Consequence: Highly detrimental (-14)	Significance: Moderate - negative (-98)
Extent	Municipal Area (4)	Will affect local municipality		
Intensity x type of impact	Very high - negative (-6)	Municipality already experiences backlogs		
Probability	Certain (7)	Will add to the existing pressure on services and infrastructure (roads, water, sanitation, housing, etc.)		
Mitigation:				
-Discourage influx of job-seekers by: - Prioritising employment of unemployed members of local communities. - Enforcing local employment targets for contractors -Liaise with local municipality to ensure that expected population influx is taken into account in infrastructure development planning.				
Post-Mitigation				
Duration	Long term (4)	As for pre-mitigation	Consequence: Highly detrimental (-14)	Significance: Moderate - negative (-84)
Extent	Municipal Area (4)	As for pre-mitigation		
Intensity x type of impact	Very high - negative (-6)	Will add to the existing pressure on services and infrastructure (roads, water, sanitation, housing, etc.)		
Probability	Highly probable (6)	Mitigation will reduce likelihood of impact to the extent predicted		

6.4.2.7 Growth of informal settlements

The shortage of services described above includes a shortage of housing. This issue deserves special mention, as it underlies one of the most pressing social problems in the area, namely the establishment and uncontrolled growth of informal settlements.

Unless properly managed, the influx of job-seekers and workers from elsewhere is expected to contribute to the growth of such informal settlements, and possibly also the establishment of new ones. This anticipated effect of the project qualifies as a cumulative impact, since it will combine with the effects of existing mining operations.

<table>
<tr><th colspan="5">Impact Description: Growth Of Informal Settlements</th></tr>
<tr><th>Predicted For Project Phase:</th><th>Pre-Construction</th><th>Construction</th><th>Operation</th><th>Decommissioning</th></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><th colspan="5">Pre-Mitigation</th></tr>
<tr><td>Duration</td><td>Long term (4)</td><td>Likely to extent throughout the operational phase</td><td rowspan="3">Consequence: Moderately detrimental (-13)</td><td rowspan="4">Significance: Minor - negative (-65)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Will affect nearby communities</td></tr>
<tr><td>Intensity x type of impact</td><td>Very high - negative (-6)</td><td>Will exacerbate existing negative social conditions</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td colspan="2">Growth of informal settlements is already a problem</td></tr>
<tr><th colspan="5">Mitigation</th></tr>
<tr><td colspan="5">- Establishment of Community Safety Committee
- Monitoring growth of informal settlements and speculative building
- Prompt reporting of illegal squatting</td></tr>
<tr><th colspan="5">Post-Mitigation</th></tr>
<tr><td>Duration</td><td>Long term (4)</td><td>As for pre-mitigation</td><td rowspan="3">Consequence: Moderately detrimental (-12)</td><td rowspan="4">Significance: Minor - negative (-48)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>High - negative (-5)</td><td>Mitigation is likely to reduce the number of new squatting residences establishing</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td colspan="2">Mitigation will reduce the likelihood of this impact occurring to the extent predicted</td></tr>
</table>

6.4.2.8 Displacement impacts

A large number of farm houses and farm worker homesteads were identified within the project site area. These include both single households and homestead clusters comprising several households. This section deals with the anticipated impacts of the project on these occupants.

6.4.2.8.1 Negative aspects

As indicated in Table 6-1, the anticipated displacement impacts of the project are exclusively negative.

6.4.2.8.1.1 Impact on current occupants of the project area

This section deals with the acquisition and clearing of land to make way for mining activities and surface infrastructure. From a social perspective, the most pertinent consequence of land acquisition and clearing will be the displacement of farming activities and occupants.

It is anticipated that directly affected property owners will be compensated at market-related, or higher, prices if these farms are purchased by the mine. Fair compensation does not however mean that current farm owners and occupants will not experience any impact when the farms are acquired by the mine.

Impact Description: Displacement				
Predicted For Project Phase:	**Pre-Construction**	**Construction**	**Operation**	**Decommissioning**
Dimension	**Rating**	**Motivation**		
Pre-Mitigation				
Duration	Permanent (7)	Displacement from project area will be permanent	Consequence: Highly detrimental (-16)	Significance: Moderate - negative (-96)
Extent	Local (3)	Will impact on directly-affected landowners/occupants		
Intensity x type of impact	Very high - negative (-6)	Loss of a life-long material, social and emotional investment		
Probability	Highly probable (6)	Without the sale of the lands, the project cannot go ahead		
Mitigation				
- Adequate compensation to displaced farmers - Meet with land owners and farm managers to discuss the eviction of farmers and the legislative requirements as outlined in ESTA. - Liaise with the MLM as they have already begun allocating land and assisting with agricultural livelihoods development for evicted farmworkers. - Consider including evicted farm workers who are no longer employed in local skills development and training undertaken as part of SLP commitments.				
Post-Mitigation				
Duration	Permanent (7)	As for pre-mitigation	Consequence: Highly detrimental (-15)	Significance: Moderate - negative (-75)
Extent	Local (3)	As for pre-mitigation		
Intensity x type of impact	High - negative (-5)	Mitigation may reduce severity of impact		
Probability	Likely (5)	With adequate compensation, livelihoods can be rebuilt elsewhere, if land of similar agricultural value is available		

6.4.2.8.1.2 *Impact on surrounding farms*

This section deals with the expected impacts of the proposed project on the farms located immediately adjacent to the project. These impacts will be qualitatively different from the impacts on the farms directly affected by the project. This difference stems from the fact that, whereas the farms constituting the proposed project site will likely be purchased by the mine, the surrounding farms might not be acquired by the mine, even in cases where the impact on these farms will be significant. The farm owners and occupants will therefore be faced with the prospect of living with the mine's impacts, or else relocating at their own expense.

The ways in which surrounding farms could be impacted by the mine are numerous and inter-related. Firstly, blasting, combined with construction and operational traffic, could lead to increased noise and vibration, as well as changes in air quality.

Secondly, the aforementioned traffic and blasting impacts, combined with the visual impact of surface infrastructure and the various social changes discussed earlier could alter the area's sense of place. "Sense of place" is a social phenomenon that refers to the identity and character of a landscape felt by local inhabitants, and often visitors. This attribute is derived from the natural environment and a mix of natural and cultural features in the landscape, and it usually includes the people who occupy the place.

The quantitative assessment of the hydrological, acoustic, visual, traffic-related and blasting impacts of the project is the subject of separate specialist studies (the Hydrological, Noise, Air Quality, Visual, Topographic, Traffic and Blasting Impact Assessments) and will not be repeated here. Instead, this section focuses on the social implications of these impacts.

These implications can be divided into two main categories:

- First, impacts on water sources and on the health and reproduction of livestock (and game) could influence the profitability of farming operations; and
- Second, changes in the area's sense of place, combined with actual or perceived changes in safety and security, could negatively affect the quality of life of farm owners and occupants.

It is important to note, however, that not all surrounding farms, and not all persons on the same farm, will experience these impacts in the same way or to the same degree. With regard to impacts on the profitability or farming operations, this will largely depend on a farm's distance from the mine, with closer farms being more severely affected. With regard to sense of place, additional factors need to be considered. One of these factors is the current state of the landscape: The impact of a large and conspicuous artificial structure on the sense of place will be correspondingly larger than if the landscape already bears the marks of development. Another factor is the meanings that people attach to the anticipated changes. If a development promises to offer tangible benefits to surrounding communities (for example job creation), it is unlikely that its impact on the character of the landscape will be perceived in a negative light by most community members – even if that impact is substantial from an aesthetic point of view.

Although mining already constitutes an important activity in the broader area (and has left its mark on the landscape), some properties directly adjacent to the project site have until now maintained a predominantly rural character. The project is likely to impact negatively on the sense of place of these areas. As far as the people who stand to benefit from the project (in terms of job creations, etc.) are concerned, however, it is likely that such impacts will be regarded as largely irrelevant.

Impact Description: Impacts On Surrounding Farms				
Predicted For Project Phase:	**Pre-Construction**	**Construction**	**Operation**	**Decommissioning**
Dimension	**Rating**	**Motivation**		
Pre-Mitigation				
Duration	Project Life (5)	For duration of the life of the mine	Consequence: Moderately detrimental (-11)	Significance: Minor - negative (-66)
Extent	Local (3)	Project area and neighbouring settlements		
Intensity x type of impact	Moderate - negative (-3)	Mine will impact on visual character of area and on peoples sense of place Mine may impact on existing water sources		
Probability	Highly probable (6)	Impacts are unavoidable as a result of mining activities		
Mitigation				
Refer to specialist studies				
Post-Mitigation				
Duration	Project Life (5)	As for pre-mitigation	Consequence: Slightly detrimental (-8)	Significance: Minor - negative (-40)
Extent	Very limited (1)	As for pre-mitigation		
Intensity x type of impact	Low - negative (-2)	Mitigation will lessen physical impacts. Affected people will adapt over time		
Probability	Likely (5)	Impacts will still occur		

6.4.2.9 Community development / CSR initiatives

Through a consultation process with local authorities and communities, the mine is in the process of developing LED programme to maximise the socio-economic and developmental impact of the proposed project on the surrounding communities, as well as contribute to the greater vision and mission of the MLM as identified in its IDP and SDF Framework.

This programme, combined with the Human Resources Development Programme outlined in the SLP, will have significant positive impacts on surrounding communities, including:

- The establishment and upgrading of services and infrastructure;
- Creating improved economic opportunities through entrepreneurship development; and
- The development of skills supporting employment and economic development.

It is recognised that, unless LED projects are designed to be sustainable beyond the life of the mine, they can also have negative long-term impacts by increasing economic dependency on the mine. These positive and negative impacts are discussed below.

6.4.2.9.1 Positive aspects

According to the SLP, the mine aims to assist local government and community structures to implement their own development priorities and realise new economic opportunities through the profitable operation of the mine within the ALLM and MLM. The mine will continually assess the current/projected IDP and LED projects/initiatives in the ALLM and MLM. A 5-year LED project plan has been compiled. At the end of each 5-year period, the LED Plan will be reviewed and new plans compiled.

The mine’s LED Plan will focus on implementing the following mechanisms:

- Integrating the mine’s SLP activities into the ALLM and MLM IDPs and the LED Forum, once it is established;
- Implementing selected poverty eradication, infrastructure development and welfare creation projects that meet the criteria of the Company;
- Undertaking and supporting identified SMME creation initiatives in labour sending areas and affected communities, where these are feasible and appropriate;
- Addressing the priority needs of employee households (basic services, housing, road infrastructure) through:
  - Implementing infrastructure development projects;
  - Increasing the access of employee households to development credit and assets; and
  - Empowering local black businesses.
- Partnering with local government and communities, by means of public-private-partnerships, in the identification of LED initiatives; and
- Implementing a portable skills programme that could contribute to the empowerment of employee households and community members as a means to achieving sustainable development.

In addition to the Mine’s current LED Plan, focus should also be placed on identifying tourism opportunities and the development of these within the wider area.

Impact Description: Establishment/Upgrading Of Services				
Predicted For Project Phase:	**Pre-Construction**	**Construction**	**Operation**	**Decommissioning**
Dimension	**Rating**	**Motivation**		
Pre-Mitigation				
Duration	Beyond project life (6)	If adequately maintained, will extend beyond the life of the mine	Consequence: Highly beneficial (14)	Significance: Minor - positive (56)
Extent	Local (3)	Will benefit local communities		
Intensity x type of impact	High - positive (5)	Implementation of SLP and LED commitments		
Probability	Probable (4)	Implementation of LED commitments		
Mitigation				
- Diligently implement SLP and LED - Coordinate implementation of SLP/LED with municipal plans and community needs - Liaison with local municipality to determine infrastructure needs once Harwar reaches required profitability				
Post-Mitigation				
Duration	Beyond project life (6)	As for pre-mitigation	Consequence: Moderately beneficial (13)	Significance: Minor - positive (65)
Extent	Local (3)	As for pre-mitigation		
Intensity x type of impact	Moderately high - positive (4)	Recommended measures will enhance positive impact on community		
Probability	Likely (5)	As for pre-mitigation		

6.4.2.9.2 <u>Negative aspects</u>

6.4.2.9.2.1 <u>Increased economic dependency on the mine</u>

One negative aspect of the LED initiatives described above is that, unless they are planned and managed in such a way as to ensure their sustainability beyond the life of the mine, they could serve to increase rather than reduce dependency of the local economy on the mine. This impact has already been discussed in section 0.

6.4.2.9.2.2 *Impact on tourism / tourism potential*

The potential impact of the proposed project on the socio-economic aspects of tourism and tourism potential are discussed in terms of the potential loss of current and potential ecotourism opportunities, and the potential for business tourism development resulting from the project and possible other developments in the greater Chrissiesmeer area. The impact on tourism is further discussed in section 5.1.4 of this report.

Impact Description: Impact On Tourism/Tourism Potential				
Predicted For Project Phase:	**Pre-Construction**	**Construction**	**Operation**	**Decommissioning**
Dimension	**Rating**	**Motivation**		
Pre-Mitigation				
Duration	Project Life (5)	Impact will remain for the life of the project and possibly beyond	Consequence: Moderately detrimental (-13)	Significance: Minor - negative (-52)
Extent	Local (3)	Project area and surrounding settlements		
Intensity x type of impact	High - negative (-5)	Even with mitigation the impact will remain negative		
Probability	Probable (4)	Impact will probably occur if mine plan stays unchanged		
Mitigation				
- Investigate changes in mine plan to minimise impact - Interact with other lead stakeholders (e.g. NGOs) to optimise tourism development - Consider recommendations of Comparative economic study - Cooperate with local and district municipalities in line with their development plans - Look at avoiding areas with high tourism potential in terms of mine logistics				
Post Mitigation				
Duration	Project Life (5)	As for pre-mitigation	Consequence: Moderately detrimental (-11)	Significance: Minor - negative (-44)
Extent	Local (3)	As for pre-mitigation		
Intensity x type of impact	Moderate - negative (-3)	Mitigation may contribute positively to business tourism development in the area		
Probability	Probable (4)	It is probable that tourism will have the resilience to adapt to and build on changed challenges and opportunities		

6.4.3 The amount of the quantified potential impact expressed in terms of the loss in value of property or infrastructural assets that will potentially be impacted upon as a result of the mining activity

A comparative economic study was initiated to investigate and report on the definition of realistic alternative scenarios that would form the basis of a comparative assessment. It is probable that at least three such alternatives would be required for each project, namely:

- Continuation of the *status quo*;
- Developing the area's tourism potential; and
- Implementation of the proposed mining projects.

The comparative assessment will use appropriate methodologies to model the expected regional economic impacts of the proposed projects vis-à-vis those of the other identified land use/ development alternatives in terms of relevant economic indicators such as employment creation, GDP, etc. Specific properties or agricultural/business enterprises on or adjoining the proposed project footprints that are likely to experience significant economic impacts as a result of the projects will be identified. On the basis of the comparative assessment, advising the client on the economic viability and/or desirability of possible modification of the project design to exclude certain properties from the project footprint.

6.4.4 The amount of the quantified potential impact expressed in terms of the loss in net present value of commercial, economic or business activity which will be impacted upon as a result of the mining activity

The Dominant land uses involve privately owned commercial (mainly maize farming), and livestock farming (mainly cattle and sheep). The project area is located within a high agricultural potential band within the ALLM.

The potential impacts on the current socio-economic environment with reference to the existing economic activities have been quantified in Section 6.4.2 above, and include:

- Loss of farm/other labour to the mine; and
- Dependency on mine for sustaining local economy.

The above potential impacts may result the loss of economic activities. These potential impacts will occur during the construction, operational and decommissioning phases of the mining operations.

7 IMPACT ASSESSMENT AND EVALUATION

7.1 Environmental Impact Assessment Methodology

The EIA uses a rigorous, numerical environmental significance rating process which is based on the accepted impact assessment methodology that uses the probability of an event occurring and the severity of the impact, should an event occur, as factors to determine the significance of a particular environmental risk.

In order to determine the severity of any potential environmental impact, the criteria that are taken into consideration are the spatial extent of the impact, the duration of the impact and the severity of the impact. The probability of an impact occurring is determined by the frequency at which the activity takes place and by how often the type of impact in question has taken place or takes place in similar circumstances. The values assigned to these factors (weighting) are discussed as part of the EIA.

In order to clarify the purpose and limitations of the impact assessment methodology, it is necessary to address the issue of subjectivity in the assessment of the significance of environmental impacts. Even though Digby Wells and the majority of environmental impact assessment practitioners propose a numerical methodology for impact assessment, it needs to be accepted that the process of environmental significance determination is inherently subjective. The weight assigned to each factor of a potential impact, and also the design of the rating process itself, is based on the values and perception of risk by members of the assessment team, as well as that of the I&APs and authorities who provide input into the process.

Whereas the determination of the spatial scale and the duration of impacts are to some extent amenable to scientific enquiry, the severity value assigned to impacts is highly dependent on the perceptions and values of all involved. It is for this reason that it is crucial that all EIAs make reference to the environmental and socio-economic context of the proposed activity in order to reach an acceptable rating of the significance of impacts. Similarly, the perception of the probability of an impact occurring is dependent on perceptions, aversion to risk and availability of information.

It has to be stressed that the purpose of the EIA process is not to provide an incontrovertible rating of the significance of various aspects, but rather to provide a structured, traceable and defendable methodology of rating the relative significance of impacts in a specific context.

For the purpose of this study, the methodology employed for the environmental impact assessment is divided into two distinct phases, namely, impact identification and impact rating.

7.1.1 Impact Identification

Impact identification is performed by use of an Input-Output model which serves to guide the assessor in assessing all the potential impacts associated with project activities during the construction, operational, decommissioning and post-closure phases.

Outputs may generally be described as any changes to the biophysical and socio-economic environments, both positive and negative in nature, and also include the product and waste produced by the actions, activities and processes.

During the determination of outputs, the effect of outputs on the various components of the environment (e.g. topography, water quality, etc.) is considered.

7.1.2 Impact rating in terms of its nature, extent, duration, probability and significance

The impact rating process is designed to provide a numerical rating of the various environmental impacts identified by use of the Input-Output model.

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

Significance = Consequence x Probability

Where

Consequence = Severity + Spatial Scale + Duration

And

Probability = Likelihood of an impact occurring

The matrix calculates the rating out of 147, whereby Severity, Spatial Scale, Duration and Probability are each rated out of seven as indicated in Table 7-1.

Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in the EMP. The significance of an impact is then determined and categorised into one of four categories, as indicated in Table 7-3 which is extracted from Table 7-2. In accordance with Regulation 51 of the MPRDA, management actions will be assigned for all identified impacts.

Table 7-1: Impact Assessment Parameter Ratings

Rating	Severity		Spatial scale	Duration	Probability
	Environmental	Social, cultural and heritage			
7	Very significant impact on the environment. Irreparable damage to highly valued species, habitat or eco system. Persistent severe damage.	Irreparable damage to highly valued items of great cultural significance or complete breakdown of social order.	International The effect will occur across international borders.	Permanent: No Mitigation No mitigation measures of natural process will reduce the impact after implementation.	Certain/Definite. The impact will occur regardless of the implementation of any preventative or corrective actions.
6	Significant impact on highly valued species, habitat or ecosystem.	Irreparable damage to highly valued items of cultural significance or breakdown of social order.	National Will affect the entire country.	Permanent: Mitigation Mitigation measures of natural process will reduce the impact.	Almost certain/Highly probable It is most likely that the impact will occur.
5	Very serious, long-term environmental impairment of ecosystem function that may take several years to rehabilitate.	Very serious widespread social impacts. Irreparable damage to highly valued items.	Province/ Region Will affect the entire province or region.	Project Life The impact will cease after the operational life span of the project.	Likely The impact may occur.
4	Serious medium term environmental effects. Environmental damage can be reversed in less than a year.	On-going serious social issues. Significant damage to structures / items of cultural significance.	Municipal Area Will affect the whole municipal area.	Long term 6-15 years	Probable Has occurred here or elsewhere and could therefore occur.
3	Moderate, short-term effects but not affecting	On-going social issues. Damage to items of cultural	Local Local extending only	Medium term	Unlikely Has not happened yet but

Rating	Severity		Spatial scale	Duration	Probability
	Environmental	Social, cultural and heritage			
	ecosystem function. Rehabilitation requires intervention of external specialists and can be done in less than a month.	significance.	as far as the development site area.	1-5 years	could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur.
2	Minor effects on biological or physical environment. Environmental damage can be rehabilitated internally with/ without help of external consultants.	Minor medium term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Limited Limited to the site and its immediate surroundings.	Short term Less than 1 year	Rare/Improbable Conceivable, but only in extreme circumstances and/ or has not happened during lifetime of the project but has happened elsewhere. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures.
1	Limited damage to minimal area of low significance, (eg ad hoc spills within plant area). Will have no impact on the environment.	Low-level repairable damage to commonplace structures.	Very limited Limited to specific isolated parts of the site.	Immediate Less than 1 month	Highly unlikely/None Expected never to happen.

Table 7-2: Probability Consequence Matrix

Significance										
		Consequence (severity + scale + duration)								
		1	3	5	7	9	11	15	18	21
Probability / Likelihood	1	1	3	5	7	9	11	15	18	21
	2	2	6	10	14	18	22	30	36	42
	3	3	9	15	21	27	33	45	54	63
	4	4	12	20	28	36	44	60	72	84
	5	5	15	25	35	45	55	75	90	105
	6	6	18	30	42	54	66	90	108	126
	7	7	21	35	49	63	77	105	126	147

Table 7-3: Significance Threshold Limits

Significance		
High	108-147	
Medium-High	73-107	
Medium-Low	36-72	
Low	0-35	

7.1.2.1 Limitations and Uncertainty

It should be noted that even though a numerical methodology for impact assessment was utilised, the process of environmental significance determination is inherently subjective. The purpose of the EIA process is thus not to provide an incontrovertible rating of the significance of various aspects, but rather to identify and evaluate the likely extent and significance of potential impacts on identified receptors and resources.

In accordance with Regulation 51 of the MPRDA, management actions will be assigned for all impacts, irrespective of significance, but the scale of significance serves to focus attention and resources on critical environmental impacts.

7.1.3 Environmental Management Programme

This document aims to address all environmental impacts likely to occur during the execution of the project and to give a description of the general environment.

As the EIA indicates the relative significance of the various environmental impacts associated with mining activities, it serves to focus the allocation of resources on environmental aspects and specific impacts requiring mitigation. The aim of the mitigation measures is to minimise the negative impacts and enhance the positive aspects of the project, as well as to inform, involve and improve the local communities in the process. In terms of Section 39 (1) of the MPRDA, an EMP must describe the manner in which the applicant intends to:

- Modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;
- Contain or remedy the cause of pollution or degradation and migration of pollutants; and
- Comply with any prescribed waste standard or management standards or practices.

The EMP section is divided into setting objectives and planning of management measures. The monitoring and performance assessment section of the EMP details the annual monitoring and audits that will be implemented to ensure the effectiveness of mitigation measures.

7.2 Project Activities

The project activities for the Harwar Colliery Project are listed in Section 2.3 of this report.

7.3 List of all Potential Environmental Impacts

The impact assessment is described and rated according to the environments affected prior to mitigation and after mitigation. The potential impacts stem from the proposed opencast mining activities at the proposed Harwar Colliery Project Area.

7.3.1 Aquatic Ecosystem Impact Assessment

Due to the varied nature of the aquatic ecosystems associated with the project area the impact assessment has been separated into three sections per river course namely:

- The Mpuluzi River;
- The Boesmanspruit; and
- The Buffelspruit.

7.3.1.1 The Mpuluzi River

7.3.1.1.1 Issue 1: Effects of water quality on aquatic biota

Criteria	Details/ Discussion
Mining phase/s	Construction Phase, Operational Phase and Decommissioning Phase
Description of impact	The increase in activities and the use of machinery and explosives within the catchment area creates the potential for harmful/modifying substances to enter into the aquatic ecosystems and the subsequent modification of water quality exists (Winterbourn et al., 2000; Kloppel et al., 1997; Zhou et al., 2008). Additionally, mining activities have the potential to increase sedimentation thereby resulting in the loss of aquatic habitat due to reduced water quality. Although the results of the acid generating capacity as well as several infrastructure planning of the mining operation has not been determined for the purposes of this assessment (however this is currently being undertaken) the precautionary principle will be applied. After closure and rehabilitation the potential for Acid Mine Drainage exists and has been included in the impact assessment on water quality.
Mitigation required	If mining is granted within the Mpuluzi River catchment the following mitigation actions are proposed: ▪ Due to the sensitive nature of the W55A catchment, all stockpiles should be located in the X11B quaternary catchment to avoid contamination in the W55A quaternary catchment; ▪ A cut-off trench should be constructed around any stockpiles of overburden and topsoil; ▪ All hydrocarbons and hazardous materials should be stored within a bundered area, spill kits should be provided in areas where any handling of hydrocarbons/hazardous materials is occurring; ▪ Although the systems are considered channelled valley bottom wetlands, based on the sensitivity of the system a 500m buffer from nearest wetland zone should be established to ensure the riparian integrity of the associated river courses remains intact; ▪ Only remove vegetation that is within the project footprint area to ensure that runoff and seepage around the project area is maintained; ▪ Ensure effective storm water management to capture dirty water in lined PCDs and silt traps and oil traps to capture and remove potential pollutants; ▪ Ensure quality of discharged water is within a similar state as the current state (baseline); ▪ Ensure that any acid generating rock is encapsulated and that no contaminated water reaches the associated aquatic ecosystems; and ▪ Manage/treat the potential decant of AMD through artificial wetland systems or through the implementation of a water treatment plant. Additionally, the following conditions are proposed: ▪ A contribution in the form of a study into the threatened species *Varicorhinus nelspruitensis* with the potential establishment of a reserve

	for the species. ▪ Due to the irreplaceable nature of the associated river course it is recommended SASS5 is conducted on a quarterly basis at selected points and results are reported back to the Department of Water Affairs. If the SASS5 scores drop more than 10% an investigation into the probable reasons for this should be investigated by the mine and reported back to the DWAF. ▪ Toxicity analysis should occur on a quarterly basis.

Impact 1: Introduction of hydrocarbons from oil/lubricants and nutrients from explosives and sewage treatment facilities					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	6	3	5	6	84 (Medium-high)
Post-Mitigation	5	3	5	3	39 (Medium-low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	6	3	5	6	84 (Medium-high)
Post-Mitigation	5	3	5	3	39 (Medium-low)
Impact 2: Introduction of dissolved salts and metals from stockpiles and exposure of contaminated soil					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	3	5	6	90 (Medium-high)
Post-Mitigation	7	3	5	3	45 (Medium-low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	4	5	6	96 (Medium-high)
Post-Mitigation	7	4	5	3	48 (Medium-low)
Decommissioning Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	4	7	6	108 (High)

Post-Mitigation	7	4	7	5	90 (Medium-high)
Impact 3: Alteration of pH from contaminated soil and exposed coal seam					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	3	5	5	75 (Medium-high)
Post-Mitigation	7	3	5	3	45 (Medium-low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	3	5	6	90 (Medium-high)
Post-Mitigation	7	3	5	4	60 (Medium-low)
Decommissioning Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	4	7	7	126 (High)
Post-Mitigation	7	4	7	5	90 (Medium-high)

7.3.1.1.2 Issue 2: Effects of water quantity on aquatic biota

Criteria	**Details/ Discussion**
Mining phase/s	Construction Phase and Operational Phase
Description of impact	The modification of the drainage area within the W55A quaternary catchment through the removal of vegetation and the creation of an opencast has implications on the quantity of water entering into the Mpuluzi River system (Grunewald, 2001). Additionally, baseflow volumes are altered during the mining procedure resulting in less water being available in the affected river system.
Mitigation required	Based on the findings of the impact assessment on water quantity the following mitigation measures should be implemented in order to minimise the impact of the proposed mining operation on the associated aquatic ecosystems: ▪ Only dirty water should be managed in the storm water management plan; ▪ No clean water should be stored; ▪ Runoff should be managed in such a manner that channel straightening and erosion does not result in habitat loss; ▪ Water abstraction and effluent should be managed so as to replicate the volumes of local aquatic ecosystems; ▪ If for the treatment of AMD a water treatment plant is implemented the following mitigation actions and requirements would be required: ▪ A contribution in the form of a study into the threatened species

	Varicorhinus nelspruitensis with the potential establishment of a reserve for the species. ▪ Due to the irreplaceable nature of the associated river course it is recommended SASS5 is conducted on a quaterly basis at selected points and results are reported back to the Department of Water Affairs. If the SASS5 scores drop more than 10% an investigation into the probable reasons for this should be investigated by the mine and reported back to the DWAF. ▪ Habitat lost during the implantation should be reconstructed artificially.

Impact 1: Reduced water quantity of the Mpuluzi River					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	3	5	5	60 (Medium-low)
Post-Mitigation	4	3	5	4	48 (Medium-low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	3	5	5	60 (Medium-low)
Post-Mitigation	4	3	5	4	48 (Medium-low)

7.3.1.2 The Boesmanspruit

7.3.1.2.1 Issue 1: Effects of water quality on aquatic biota

Criteria	**Details/ Discussion**
Mining phase/s	Construction Phase, Operational Phase and Decommissioning Phase
Description of impact	The aquatic biota of the Boesmanspruit consists of primarily moderately pollution tolerant species, the impact of activities would therefore not be as large as in a sensitive ecosystem like the Mpuluzi River. However, the aquatic biodiversity as seen in the NFEPA report is considered highly significant and the impacts of the proposed project is seen in light of this. The increase in activities and the use of machinery and explosives within the catchment area creates the potential for harmful/modifying substances to enter into the aquatic ecosystems and the modification of water quality exists (Winterbourn et al., 2000; Kloppel et al., 1997; Zhou et al., 2008). Although the results of the acid generating capacity of the mining operation has not been determined for the purposes of this assessment the precautionary principle will be applied. After closure and rehabilitation the potential for Acid Mine Drainage exists and has been included in the impact assessment on water quality.

Mitigation required	Based on the findings of the impact assessment on water quality the following mitigation measures should be implemented in order to minimise the impact of the proposed mining operation on the associated aquatic ecosystems: ▪ A cut-off trench should be constructed around any stockpiles of overburden and topsoil; ▪ All hydrocarbons and hazardous materials should be stored within a bundered area, spill kits should be provided in areas where any handling of hydrocarbons/hazardous materials is occurring; ▪ A sufficient buffer zone from nearest wetland zone should be established to ensure the riparian integrity of the associated river courses remains intact; ▪ Only remove vegetation that is within the project footprint area to ensure that runoff and seepage around the project area is maintained; ▪ Ensure effective storm water management to capture dirty water; ▪ A lined pollution control dam to capture any contaminated water ▪ A silt trap and oil trap to capture and remove potential pollutants ▪ Ensure quality of discharged water is within a similar state as the current state (baseline); ▪ Ensure that any acid generating rock is encapsulated and that no contaminated water reaches the associated aquatic ecosystems; and ▪ Manage/treat the potential decant of AMD through artificial wetland systems or through the implementation of a water treatment plant.				
Impact 1: Introduction of hydrocarbons from oil/lubricants and nutrients from explosives and sewage treatment facilities					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	3	5	4	52 (Medium-low)
Post-Mitigation	5	3	5	3	39 (Medium-low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	3	5	5	65 (Medium-low)
Post-Mitigation	5	3	5	3	39 (Medium-low)
Impact 2: Introduction of dissolved salts and metals from stockpiles and newly exposed soils					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	3	5	4	52 (Medium-low)

Post-Mitigation	5	3	5	3	39 (Medium-low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	3	5	5	65 (Medium-low)
Post-Mitigation	5	3	5	3	39 (Medium-low)
Decommissioning Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	7	133 (High)
Post-Mitigation	7	5	7	3	57 (Medium-low)
Impact 3: Alteration of pH from exposed coal and contaminated overburden					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	3	5	4	52 (Medium-low)
Post-Mitigation	5	3	5	3	39 (Medium-low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	3	5	5	65 (Medium-low)
Post-Mitigation	5	3	5	3	39 (Medium-low)
Decommissioning Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	7	133 (High)
Post-Mitigation	7	5	7	3	57 (Medium-low)

7.3.1.2.2 Issue 2: Effects of water quantity on aquatic biota

Criteria	**Details/ Discussion**
Mining phase/s	Construction Phase and Operational Phase
Description of impact	The aquatic biota of the Boesmanspruit was determined to be affected by low flow conditions during the current survey. Impacts on water quantity would therefore be guided by this. The modification of the drainage area within the X11B quaternary catchment through the removal of vegetation and the creation of an opencast has

	implications on the quantity of water entering into the Boesmanspruit system (Grunewald, 2001).				
Mitigation required	Based on the findings of the impact assessment on water quantity the following mitigation measures should be implemented in order to minimise the impact of the proposed mining operation on the associated aquatic ecosystems: ▪ Only dirty water should be managed in the storm water management plan; ▪ No clean water should be stored; and ▪ Runoff should be managed in such a manner that channel straightening and erosion does not occur.				
Impact 1: Reduced water quantity of the Boesmanspruit					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	6	3	5	5	70 (Medium-low)
Post-Mitigation	6	3	5	4	56 (Medium-low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	6	3	5	6	84 (Medium-high)
Post-Mitigation	6	3	5	5	70 (Medium-low)

7.3.1.3 The Buffelspruit

Although the project area does not fall within this quaternary catchment (X12A), the impacts on the aquatic ecology of this quaternary catchment was assessed as it is anticipated that the project could affect this catchment.

7.3.1.3.1 Issue 1: Effects of water quality on aquatic ecology

Criteria	**Details/ Discussion**				
Mining phase/s	Construction Phase, Operational Phase and Decommissioning Phase				
Description of impact	Although the project area does not cover the X12A catchment it is hypothesised that the activities of the proposed mine will still affect the quaternary catchment (X12A). The aquatic biota of the Buffelspruit consists of wide diversity of sensitive and moderately pollution tolerant species, the impact of activities are therefore guided by this. The increase in activities and the use of machinery and explosives within the catchment area the potential for harmful/modifying substances to enter into the aquatic ecosystems and the modification of water quality exists (Winterbourn et al., 2000; Kloppel et al., 1997; Zhou et al., 2008). Although the results of the acid generating capacity of the mining operation has not been determined for the purposes of this assessment the precautionary principle will be applied. After closure and rehabilitation the potential for Acid Mine Drainage exists and has been included in the impact assessment on water quality.				
Mitigation required	Based on the findings of the impact assessment on water quality the following mitigation measures should be implemented in order to minimise the impact of the proposed mining operation on the associated aquatic ecosystems: ▪ An accurate delineation of the quaternary catchment X12A should be done and no activities should occur in this catchment; ▪ A cut-off trench should be constructed around any stockpiles of overburden and topsoil; ▪ All hydrocarbons and hazardous materials should be stored within a bundered area; ▪ Sufficiant buffer zone from nearest riparian zone should be established to ensure the riparian integrity of the associated river courses remains intact; ▪ Only remove vegetation that is within the project footprint area to ensure that runoff and seepage around the project area is maintained; ▪ Ensure effective storm water management to capture dirty water; ▪ Ensure quality of discharged water is within regulation (ecosystems) limits; and ▪ Manage/treat the potential decant of AMD through artificial wetland systems or a water treatment plant.				
Impact 1: Introduction of hydrocarbons from oil/lubricants and nutrients from explosives and sewage treatment facilities					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	6	3	5	6	84 (Medium-high)
Post-Mitigation	5	3	5	3	39 (Medium-low)
Operational Phase					

Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	6	3	5	6	84 (Medium-high)
Post-Mitigation	5	3	5	3	39 (Medium-low)
Impact 2: Introduction of dissolved salts and metals from stockpiles and newly exposed soils					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	3	5	6	90 (Medium-high)
Post-Mitigation	7	3	5	3	45 (Medium-low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	4	5	6	96 (Medium-high)
Post-Mitigation	6	5	7	5	39 (Medium-low)
Decommissioning Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	4	7	6	108 (High)
Post-Mitigation	5	3	5	3	39 (Medium-low)
Impact 3: Alteration of pH from exposed coal and contaminated overburden					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	3	5	5	75 (Medium-high)
Post-Mitigation	7	3	5	3	45 (Medium-low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	3	5	6	90 (Medium-high)
Post-Mitigation	5	3	5	3	39 (Medium-low)
Decommissioning Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*

Pre-Mitigation	7	4	7	7	126 (High)
Post-Mitigation	5	3	5	3	39 (Medium-low)

7.3.1.3.2 Issue 2: Effects on water quantity on aquatic biota

Criteria	**Details/ Discussion**				
Mining phase/s	Construction Phase and Operational Phase				
Description of impact	The aquatic biota of the Buffelspruit was determined to be reliant on high flow conditions. Any alterations of water quantity would therefore negatively affect these flow-dependent species. Impacts on water quantity would therefore be guided by this. The modification of the drainage area within the X12A quaternary catchment through the removal of vegetation and the creation of an opencast has implications on the quantity of water entering into the Buffelspruit system (Grunewald, 2001).				
Mitigation required	Based on the findings of the impact assessment on water quantity the following mitigation measures should be implemented in order to minimise the impact of the proposed mining operation on the associated aquatic ecosystems: ▪ Only dirty water should be managed in the storm water management plan; ▪ No clean water should be stored; and ▪ Runoff should be managed in such a manner that channel straightening and erosion does not occur.				
Impact 1: Reduced water quantity of the Buffelspruit River					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	3	5	5	75 (Medium-high)
Post-Mitigation	7	3	5	3	45 (Medium-low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	3	5	5	75 (Medium-high)
Post-Mitigation	7	3	5	3	45 (Medium-low)

7.3.2 Flora and Fauna Impact Assessment

7.3.2.1 Issue 1: Loss of Habitat Types

Criteria	**Details/ Discussion**
Mining phase/s	Construction Phase
Description of impact	The removal of vegetation/habitat types for the proposed mining activity and associated infrastructure will result in the definite loss of habitat, of special concern

	is the wetland areas and the pan areas. The destruction of the vegetation/habitat will result in the permanent reduction of natural habitat of reptiles, birds, frogs, insects and mammals present within the areas. The birds, reptiles, frogs, insects and mammals that currently inhabit this area will be directly affected through habitat destruction and indirectly through noise dust and vibration.				
Mitigation required	The mining infrastructure should be moved into an area of low sensitivity (disturbed or degraded land), rather than being built near any grassland or riparian/wetland/pan habitat types. The actual opencast area cannot be moved and as such mitigation will include minimising the actual footprint. The natural grasslands wetlands/pans should be conserved. This entails restricting access, and keeping clearing to a minimum. Rehabilitation of small areas disturbed during construction and not needed for operation should take place concurrent to mining activity. Considering there are no areas of low sensitivity within the site, mitigation measures are not possible.				
Impact 1: Loss of Primary Grassveld habitat					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	7	133 (High)
Post-Mitigation	N/A				
Impact 2: Loss of Riparian/Wetland habitat type					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	7	133 (High)
Post-Mitigation	N/A				

7.3.2.2 Issue 2: Loss of Biodiversity

Criteria	**Details/ Discussion**				
Mining phase/s	Construction Phase and Operational Phase				
Description of impact	Loss of biodiversity will occur in the construction phase of the development as a result of clearing of the vegetation/habitat types, and the operational phase as a result of trampling and increased access to the natural areas of the Primary grassveld and riparian areas. The destruction of the vegetation/habitat will result in the permanent reduction of natural habitat of reptiles, birds, frogs, insects and mammals present within the areas. The birds, reptiles, frogs, insects and mammals that currently inhabit this area will be directly affected through habitat destruction and indirectly through noise dust and vibration.				
Mitigation required	The footprint of the mine should be kept as small as possible, and no mine infrastructure or opencast area located in areas of very high sensitivity. As no such areas exist on the Harwar study site, mitigation is not possible.				
Impact 3: Loss of Biodiversity (general)					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	7	133 (High)
Post-Mitigation	N/A				
Impact 4: Loss of Floral Species of Special Concern					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	7	133 (High)
Post-Mitigation	N/A				
Impact 5: Loss of Faunal Species of Special Concern					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	7	133 (High)
Post-Mitigation	N/A				

7.3.2.3 Issue 3: Loss of Ecosystem Function

Criteria	**Details/ Discussion**				
Mining phase/s	Construction Phase				
Description of impact	The general functioning and provision of ecosystem services in the greater area ecosystem will be reduced and impaired. Fragmentation occurs with the breaking-up of continuous tracts of vegetation providing corridors for faunal movement and habitat as well as plant dispersal. The position of the proposed open cast mining and associated infrastructure is located in an already heavily fragmented landscape.				
Mitigation required	The footprint of the mine should be as small as possible; and should be located in areas of low sensitivity. As no areas of low sensitivity can be found on the Harwar site, mitigation is not possible.				
Impact 6: Fragmentation and Edge Effects					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	6	4	6	7	112 (High)
Post-Mitigation	N/A				
Criteria	**Details/ Discussion**				
Mining phase/s	Construction Phase, Operational Phase and Decommissioning Phase				
Description of impact	The introduction of alien species will occur, but if managed properly, can be adequately controlled. The general functioning and provision of ecosystem services in the greater area ecosystem will be reduced and impaired.				
Mitigation required	Alien plants must be identified and removed throughout the construction, operation and decommissioning phases.				
Impact 7: Influx of alien invasive species					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	7	133 (High)
Post-Mitigation	2	3	3	4	32 (Low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	7	133 (High)
Post-Mitigation	2	3	6	4	44 (Medium-low)
Decommissioning Phase					

Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	7	133 (High)
Post-Mitigation	2	3	6	4	44 (Medium-low)

7.3.3 Soils, Land Use and Land Capability Impact Assessment

7.3.3.1 Reduced Agricultural Potential and Land Capability

Criteria	**Details/ Discussion**
Mining phase/s	Construction Phase
Description of impact	Activities during early works and construction in the Proposed Harwar Project area could lead to the following impacts on soils: ▪ Soil compaction and topsoil loss leading to reduced agricultural potential; and ▪ Soil erosion (sediment release to land and surface water). Opencast areas and infrastructure sites need to be stripped of soil and vegetation. The general depth of topsoil to be stripped within mine infrastructure site areas need to be determined because the exact locations are not yet known. The topsoil and subsoil must be stripped and stockpiled separately from the opencast areas. Compaction and increased erosion from increased exposure to wind and water are likely to cause changes in the soil structure and degradation of soil quality. The extent to which these occur is dependent on the properties of the soils. In the case of Harwar the extent will be significant due to the sandy nature of the topsoil. Water erosion may happen when water (for example runoff) comes in contact with bare soil on cleared patches, especially on sloped terrain or in addition running down steeply sloped stockpiles. An occasional heavy rainstorm during the rainy season can initiate erosion on bare patches. The impact of erosion through water runoff can play a significant role because the annual rainfall is high however most of the erosion is expected to occur along main unpaved compacted roads.
Mitigation required	Proposed mitigation measures per phase include: ***Construction Phase (including site preparation)*** ▪ Plan site clearance and alteration activities for the dry season (May to October); ▪ Restrict extent of disturbance within the proposed Harwar project area and minimise activity within designated areas of disturbance; ▪ Minimise the period of exposure of soil surfaces through dedicated planning; ▪ Stripping operations should only be executed when soil moisture content will minimise the risk of compaction (during dry season); ▪ During stockpiling, preferably use the 'end-tipping' method to keep the stockpiled soils loose; ▪ Ensure stockpiles are placed on a free draining location to limit

	waterlogging; and ▪ Limit stockpile height – a safe height can be regarded as the height at which material can be placed without repeated traffic over already placed material. ***Operational Phase*** ▪ Re-vegetate cleared areas and stockpiles to avoid water erosion losses; ▪ Preserve looseness of stockpiled soil by executing fertilisation and seeding operations by hand; ▪ Soil stockpiles should be monitored for fertility via sampling and testing; and ▪ Monitoring of the condition of all unpaved roads is necessary due to the high rainfall and potential water runoff and erosion of the soils present in the proposed Harwar project area. Water runoff from compacted road surfaces may cause erosion of road shoulders degrading the road surface. Weekly inspections need to be carried out of all unpaved roads during the rainy season.				
Impact 1: Soil compaction and topsoil loss					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	3	7	7	119 (High)
Post-Mitigation	4	3	6	7	91 (Medium-high)
Impact 2: Soil erosion (sediment release to land and surface water)					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	3	7	7	119 (High)
Post-Mitigation	4	3	6	7	91 (Medium-high)
Criteria	**Details/ Discussion**				
Mining phase/s	Construction Phase and Operational Phase				
Description of impact	Impacts to soil resources are dependent on the size of the spill and the speed with which it is addressed and cleaned up. If contaminated, the ability of soil to carry out its essential functions can be compromised, thus affecting the land capability of the soil. Contaminants transported by water would very rapidly run off due to the clay soils, but infiltrate slow in clays decreasing the risk of groundwater contamination but increasing the risk of surface water contamination. The potential for contamination of soil resources exists during site preparation and construction as a result of spills and/or leaks of fuels, oils and lubricants from construction or operational vehicles or machinery. Fluids used for vehicles and machinery may spill during filling, or leak directly in the event that damage to the				

	fluid system goes unnoticed. Soil contamination associated with leaks and spills from machinery are reduced during the operation phase since site activities will be reduced.
Mitigation required	Proposed mitigation measures per phase include: ***<u>Construction Phase</u>*** ▪ Construction vehicles and equipment should be serviced regularly, in a designated area; ▪ Service areas must be paved; ▪ Construction vehicles should remain on designated and prepared compacted gravel roads; ▪ Areas that are used to store hydrocarbons must be bunded and be able to contain the spillage in the event of a spillage occurring; ▪ Drip trays must be used when machinery and/or vehicles are serviced; and ▪ Spill containment and clean up kits should be available onsite and clean-up from any spill must be in place and executed at the time of a spillage with appropriate disposal as necessary. ***<u>Operational Phase</u>*** ▪ Operations vehicles and equipment should be serviced regularly; ▪ Service and parking areas must be paved; ▪ Operations vehicles should remain on designated and prepared compacted gravel roads; ▪ Spill containment and clean up kits should be available onsite and clean-up from any spill must be in place and executed at the time of a spillage with appropriate disposal as necessary; ▪ Drip trays must be used when machinery and/or vehicles are serviced; ▪ Fuel and heavy hydrocarbon products storage on site should be secured by bunded facilities; and ▪ It is advisable to develop a soil monitoring plan and implement it after construction through collecting and analysis of soil samples within the Harwar project area.

Impact 3: Soil contamination (hydrocarbon leaks/spills)					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	3	2	5	6	60 (Medium-low)
Post-Mitigation	3	2	5	5	50 (Medium-low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	3	2	5	6	60 (Medium-low)
Post-Mitigation	3	2	5	5	50 (Medium-low)

Criteria	**Details/ Discussion**				
Mining phase/s	Decommissioning Phase				
Description of impact	During the decommissioning activities, impacts to soil resources may include compaction and contamination which may be significant.				
Mitigation required	The following mitigation or enhancement measures should be implemented during the decommissioning phase to increase the success of the rehabilitation of the soil resource and land capability: ▪ Demolition and removal of infrastructure should be restricted to the dry season (May to October); ▪ Shaft and opencast areas must be filled and reshaped and the soil replaced. Subsoil first then topsoil; ▪ All opencast areas must be filled in using spoil and reshaped to imitate the pre-mining landscape; ▪ Total soil thickness must at least be 1 m for the arable areas and 0.35 m (topsoil) for grazing land. The pre-mining arable and grazing land capabilities should be proportionally emulated during rehabilitation of the opencast and mine infrastructure sites; ▪ Minimize the period of exposure of soil surfaces through dedicated planning; and ▪ Foundation excavations should be filled, fertilised and re-vegetated using local vegetation.				
Impact 4: Compaction and contamination of soil					
Decommissioning Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	3	7	7	119 (High)
Post-Mitigation	5	3	6	6	84 (Medium-high)
Criteria	**Details/ Discussion**				
Mining phase/s	Decommissioning Phase and Post Closure Phase				
Description of impact	During the post closure monitoring the post closure impacts to soil resources may include compaction and low fertility which may be significant in the short to medium term.				
Mitigation required	The following mitigation or enhancement measures should be implemented during the post closure phase to increase the success of the rehabilitation of the soil resource and land capability: ▪ Land capability and compaction should be assessed on all rehabilitated opencast areas; ▪ Representative soil samples should be collected and analysed for pH and soil fertility annually; ▪ Any problems and or deficiencies should be corrected through ripping, organic matter inputs, liming and or fertilisation by evaluating the soil				

	analytical results; ▪ Re-vegetation should take place using appropriate rehabilitation seed mixes; ▪ Post mining land use is dependent on land capability and must be planned for throughout the rehabilitation process; and ▪ The yields (performance) of re-vegetated areas must be assessed annually. Problem areas must be identified and reclaimed immediately.

Impact 5: Soil compaction and low fertility					
Decommissioning Phase and Post Closure Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	3	7	7	119 (High)
Post-Mitigation	3	3	6	7	84 (Medium-high)

7.3.4 Noise Impact Assessment

During the construction and decommissioning phases of the proposed project, the significance of the noise on receptors within the area is of low significance. The significant ratings for these two phases are included in the impact assessment section of the Noise Assessment Report. The significance rating of the impacts during the operational phase is given in the table below.

Criteria	**Details/ Discussion**
Mining phase/s	Operational Phase
Description of impact	The equipment and machinery involved such as excavators, bulldozers, and haul trucks as well as the blasting activities may impact on the surrounding ambient noise levels at the noise sensitive receptors near the project area.
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Mining-related machines and vehicles must be serviced on a regular basis to ensure noise suppression mechanisms are effective e.g. installed exhaust mufflers; ▪ Broad band directional reverse hooters fitted to mining vehicles; ▪ Keep as much vegetation as possible to aid in noise absorption of the operational activities; ▪ Switching off equipment when not in use; and ▪ Fixed noise producing sources such as generators to be either housed in enclosures or barriers put up around the noise source. ▪ As for the blasting operations it is generally intermittent and should be limited to daylight hours when ambient noise levels are highest; ▪ The following with regards to blasting operations is recommended: ▪ The use of millisecond delays between rows of blast holes in a given blasting pattern in order to reduce the amount of explosive charge

	detonated at any given instant is recommended (Sengupta, 1993); ▪ Reduction of the powder factor, that is, use of less explosive per cubic yard of overburden (Sengupta, 1993); and ▪ Maintaining good public relations with the surrounding communities, i.e. warning the local communities in advance before blasts.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	3	5	6	78 (Medium-high)
Post-Mitigation	4	3	5	4	44 (Medium-low)

7.3.5 Wetland Impact Assessment

7.3.5.1 Issue1: Direct Loss of Wetland Areas

Criteria	**Details/ Discussion**
Mining phase/s	Construction Phase and Operational Phase
Description of impact	During the construction phase the clearing of wetland areas will occur during the development phase of the opencast areas. Clearing of vegetation will result in the removal of wetland vegetation as well as the associated habitat. During the operational phase the removal of the top soil and the overburden will disturb the natural the natural rock layering and therefore disturb the hillslope wetland drivers. The loss of wetland areas as a result of mining is regarded as very significant. Clearing of wetland areas will result in the direct loss of irreplaceable habitat such as hillslope wetland habitat. According the MBCP and the NFEPA wetlands, the habitat provided by the wetland areas within the project area is irreplaceable. Clearing of vegetation will result in the removal of wetland vegetation as well as the associated habitat.
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Mining of hillslope wetland areas as well as the recharge areas that function as recharge areas for the hillslope seeps must be avoided at all costs; ▪ Mining of wetland areas and the associated 100m buffer zone should be avoided at all costs in order to protect the integrity of the wetland area. ▪ Failure to avoid mining in the hillslope seepage wetlands then the mine should develop a wetland rehabilitation and off-set strategy for the operation, however it should be noted that the area is irreplaceable according to the Mpumalanga C-plan
Impact 1: Direct loss of hillslope seepage wetlands	
Construction Phase	

Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	7	133 (High)
Post-Mitigation	6	5	6	6	102 (Medium-high)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	7	133 (High)
Post-Mitigation	6	5	6	7	119 (High)
Impact 2: Loss of hillslope seepage wetland habitat					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	7	133 (High)
Post-Mitigation	6	5	6	6	102 (Medium-high)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	7	133 (High)
Post-Mitigation	6	5	6	7	119 (High)

7.3.5.2 Issue 2: Indirect Loss of Wetland Areas

Criteria	**Details/ Discussion**
Mining phase/s	Construction Phase and Operational Phase
Description of impact	Mining and the establishment of mining infrastructure in the grasslands outside the wetland areas will restrict the perched water table recharge. The hillslope seepage wetland areas as well as the pans within the project area are maintained by infiltration, lateral seepage and interflow. The loss of non-wetland perched water table recharge areas will result in the desiccation of wetland areas. This is regarded as significant. A number of springs were identified during the site investigations. The identified springs feed into the rivers and wetlands with very clean water. The loss of non-wetland perched water table recharge areas will result in the desiccation of the identified springs. The desiccation of springs is regarded as very significant since a number of households located within the project area are dependent on the springs for potable water.
Mitigation	Project-related mitigation measures and site management should be implemented

required	in order to reduce the significance of the impact: ▪ The mine should develop a wetland rehabilitation and off-set strategy for the operation in order to rehabilitate wetland areas somewhere else; and ▪ The mine wetland offset strategy must take into consideration desiccation of the indirectly impacted wetlands areas.				
Impact 1: Loss of non-wetland perched water table recharge areas					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	6	3	6	6	90 (Medium-high)
Post-Mitigation	4	2	2	4	32 (Low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	6	3	6	6	90 (Medium-high)
Post-Mitigation	3	2	6	4	44 (Medium-low)
Impact 2: Desiccation of springs					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	2	6	7	105 (Medium-high)
Post-Mitigation	6	2	6	5	70 (Medium-low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	2	6	7	105 (Medium-high)
Post-Mitigation	6	2	6	5	70 (Medium-low)

7.3.5.3 Issue 3: Loss of Wetland Integrity

Criteria	**Details/ Discussion**
Mining phase/s	Construction Phase and Operational Phase
Description of impacts	During construction, heavy earth moving machinery will be used and therefore temporary storage of hazardous chemicals will be stored in strategic areas within the project area. Failure to manage these areas may lead to extensive contamination of wetland areas within the project area. Failure to contain contaminated water originating from the proposed opencast

	areas, ROM pads, temporary storage facilities, waste disposal facilities, contaminated water dams, storm water drains, and workshops will result in the contamination of water resources within the project area. Furthermore spills and overtopping the pollution control dam will impact on the water quality of wetlands within the project area. Chemical contamination of wetland areas within the project area is regarded as very significant. During the construction process the entire footprint of the opencast area areas will be cleared of vegetation and the topsoil will be stripped off and stock pilled. The removal of vegetation and the disturbance of the soil profile will expose the soils to erosion by wind (dust) and water (from surface run-off). Eroded soil is likely to enter downstream wetland areas, increasing sedimentation within these wetlands and leading to changes in vegetation composition and aquatic fauna. Erosion is likely to be highest during the summer months when high intensity storm events are likely to result in significant surface runoff. The steep side slopes of the stockpiles will be prone to erosion, increasing sediment loads in adjacent wetlands. Disturbances to the wetlands on site will provide opportunity for invasion by alien and weedy species. Increased concentrations of people, noise, heavy machinery and blasting may result in the loss of sensitive wetland faunal species. This may result in reduced population sizes or a complete removal of some species.
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Construction of dirty water containment structures such as pollution control dams outside of the wetland areas; ▪ Have spill procedures in place and specific awareness training. Spill kits from Dritzit or Enertech or Supazorb so if there is a spill it can be cleaned and treated as much as possible as soon as possible and report to authorities in 24 hours; ▪ Hazardous chemical materials should be stored in bunded areas to prevent leakage into the environment; and the overflow of contaminated water into the surrounding wetland areas should be prevented at all costs; ▪ Erosion of the footprint should be minimised at all costs by limiting the extent of the foot print to only the required extent; ▪ Construction and major earthworks should be undertaken during the dry season to ensure minimum water driven erosion impacts; ▪ Dust suppression should be ensured by watering the disturbed areas; ▪ Following the end of the construction process all the disturbed soils should be re-stabilised by planting appropriate grasses; ▪ Some of the eroded sediments from the side slopes are likely to be captured by the dirty water management system which is already available on site; and ▪ Prior to the start of construction process an onsite alien vegetation management plan should be compiled for use during the construction and operational phase.

Impact 1: Chemical contamination of surface water resources					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	6	3	3	6	72 (Medium-low)
Post-Mitigation	4	2	2	4	32 (Low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	6	114 (High)
Post-Mitigation	3	2	6	4	44 (Medium-low)
Impact 2: Sedimentation of surface water resources					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	3	3	7	70 (Medium-high)
Post-Mitigation	2	2	2	4	24 (Low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	4	6	6	84 (Medium-high)
Post-Mitigation	3	2	6	4	44 (Medium-low)
Impact 3: Alien invasive species encroachment					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	2	3	5	45 (Medium-low)
Post-Mitigation	2	3	2	5	35 (Low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	4	5	6	78 (Medium-high)
Post-Mitigation	3	3	6	4	48 (Medium-low)

Impact 4: Loss of biodiversity					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	6	114 (High)
Post-Mitigation	N/A				
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	6	114 (High)
Post-Mitigation	N/A				

7.3.5.4 Issue 4: Loss of wetland functionality

Criteria	**Details/ Discussion**
Mining phase/s	Construction Phase and Operational Phase
Description of impacts	The hillslope seepage wetlands and the valley bottom wetland areas are known for their ability to purify water. The loss of these wetland types as a result of mining will result in the loss of this function. Furthermore excessive contamination of these wetland types may convert them into sources of contamination. The loss of water quality enhancement capacity is regarded as very significant since the associated impacts may be carried throughout the entire catchment. The wetland areas within the project area fall within the MLD. The Endangered Wildlife Trust (EWT) is currently involved in an application for the MLD to be considered as a biodiversity conservation projects under the (MTPA). Furthermore an application has been placed with RAMSAR Convention for the area to be declared as a Wetland of International Importance. These applications have been placed the area supports unique and biodiversity. The loss of biodiversity support associated with mining and the contamination of wetlands is regarded as very significant. The Groot and the Klein Tevrede se Pan located within the mineral rights area are regarded as very unique wetland systems within the southern hemisphere. Any mining activities within the catchment areas of these systems will result in an irreparable degradation of these systems. Increased concentrations of people, noise, heavy machinery and blasting may result in the loss of sensitive wetland faunal species. This may result in reduced population sizes or a complete removal of some species.
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ The mine has to consider environmentally friendly water treatment technologies in order to avoid the contamination of surface water

	resources. These technologies may include construction of wetland areas with the objectives for sequestering specific contaminants; and ▪ Construction of dirty water containment structures such as pollution control dams outside of the wetland areas; ▪ Establishment of vegetated buffer strips between the delineated wetland areas especially the valley bottom without a channel wetland. The establishment of vegetated buffer strips must be constructed to function as a protective barrier between the dirty water containment structures and the delineated wetland areas in order to protect the integrity of wetlands. The vegetated buffer strips will function as filters that intercept overland spill overs, trap sediments and other contaminants, reduce overland flow velocities thus enhancing sedimentation and infiltration; ▪ The overflow of contaminated water into the surrounding wetland areas should be prevented at all costs; and ▪ The mine should develop a wetland rehabilitation and off-set strategy for the operation.				
Impact 1: Loss of water quality enhancement capacity					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	6	114 (High)
Post-Mitigation	6	3	6	6	90 (Medium-high)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	5	7	6	114 (High)
Post-Mitigation	6	3	6	6	90 (Medium-high)
Impact 2: Loss of biodiversity support					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	7	7	6	126 (High)
Post-Mitigation	N/A				
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	7	7	6	126 (High)
Post-Mitigation	N/A				

Impact 3: Degradation of unique wetland types					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	7	7	6	126 (High)
Post-Mitigation	N/A				
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	7	7	6	126 (High)
Post-Mitigation	N/A				
Impact 4: Loss of sensitive species					
Construction Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	3	3	7	91 (Medium-high)
Post-Mitigation	4	2	2	4	32 (Low)
Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	6	5	7	7	126 (High)
Post-Mitigation	4	5	6	4	60 (Medium-low)

7.3.6 Groundwater Impact Assessment

The impact on the groundwater quality and quantity during the construction phase are rated to be of low significance and is only provided in the impact assessment section of the Interim Hydrogeological Assessment Report. The impact on groundwater quality and quantity during the operational, decommissioning and post-closure phase will be significant and is given in the table below.

7.3.6.1 Operational Phase

Criteria	Details/ Discussion
Mining phase/s	Operational Phase
Description of impact	The impacts on groundwater quantity relates to the following: ▪ The proposed opencast areas area falls on the groundwater divide between quaternary catchments X11B and W55A. Excavation of these

<table>
<tr><td></td><td colspan="5">opencast areas will change the topography, creating a cone of depression with a hydraulic gradient toward the opencast areas centres. As a result groundwater from both catchments will flow towards opencast area centres in response to the hydraulic gradient. Therefore the boundary between the two catchments (groundwater divide during pre-mining) will no longer be a no-flow boundary during mining;
When groundwater flow towards the opencast areas during mining it inevitably dewaters and lowers groundwater levels in the surrounding mining area. The lowering of the water table in the vicinity of water supply or irrigation boreholes, as result of mine dewatering may lead to an increased in the pumping head (and therefore pumping cost), if not complete drying of boreholes, and a decrease in borehole yield. Dewatering may impact the very little inflow from the weathered and fractured aquifer that ends up in the pans; and
If the pan influenced groundwater resulted due the pumping of groundwater from water supply or irrigation boreholes, then large scale mine dewatering may cause pan water to be drawn in to fresh water weathered and fractured aquifers. This may lead to an increase in the pan influenced groundwater zone.
The impacts on groundwater quality relates to the following:
During the operational phase, the groundwater will deteriorate with time. The potential threat to the groundwater quality from the chemical characteristics of the natural rock material that will be excavated and exposed to oxidation processes include AMD formation from spoil piles, exposed shale and backfilled spoils and discard in rehabilitated areas;
Operational groundwater flow directions will be directed towards the opencast areas. The portions of poor quality leachate emanating from the discard area which eventually joins the underlying saturated zone will migrate towards the mine opencast areas. Contaminant migration away from the mining area is expected to be limited as groundwater flow direction will be towards the opencast area centres; and
The anticipated impact on groundwater quality during the operational phase is minor.</td></tr>
<tr><td>Mitigation required</td><td colspan="5">Specific mitigation measures will be available once the hydrogeological model for the project area is complete.</td></tr>
<tr><td colspan="6">Impact 1: Grounwater Quantity</td></tr>
<tr><td colspan="6">Operational Phase</td></tr>
<tr><td>Parameters</td><td>Severity</td><td>Spatial scale</td><td>Duration</td><td>Probability</td><td>Significant rating</td></tr>
<tr><td>Pre-Mitigation</td><td>5</td><td>3</td><td>5</td><td>7</td><td>91 (Medium-high)</td></tr>
<tr><td>Post-Mitigation</td><td colspan="5">N/A</td></tr>
<tr><td colspan="6">Impact 2: Groundwater Quality</td></tr>
</table>

Operational Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	3	5	7	91 (Medium-high)
Post-Mitigation	N/A				

7.3.6.2 Closure Phase and Post-Closure Phase

Criteria	Details/ Discussion
Mining phase/s	Closure Phase and Post-Closure Phase
Description of impact	The impacts on groundwater quantity relates to the following: ▪ Groundwater levels will recover during the decommissioning and post-closure phase, due to the cessation of mine dewatering. This will lead to the re-establishment of groundwater levels, flow directions and flow gradients to near pre-mining levels; ▪ The rehabilitated opencast areas may decant if recharge to the opencast areas exceeds seepage rates to the weathered aquifer; and ▪ Through proper planning, catchments could be selected into which water can be allowed to decant. The interconnection of collieries may be considered to channel mine water to specific points for treatment or utilisation, rather than having numerous small uncontrolled decants into streams. The impacts on groundwater quality relates to the following: ▪ If decant occurs, the decant water in the rehabilitated opencast areas will be exposed to oxygen, hence producing more acidic waters. The decant water will be saline. The decant waters may flow and contaminate nearby springs through seepage to the perched aquifer, and eventually the nearby Tevrede se pan. ▪ In the event the pans are impacted by AMD, carrying heavy metals, the acid water would slowly filter into the pans concentrating metals through evaporation and making pans toxic pools. The majority of the pans would initially be able to resist the change in pH as the AMD moves into them due to the high alkalinity and good buffering capacity but eventually this would be exhausted.
Mitigation required	Specific mitigation measures will be available once the geohydrological model for the project area is complete.

Impact 1: Grounwater Quantity					
Decommissioning and Post-Closure Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	6	3	4	5	65 (Medium-low)

Post-Mitigation	N/A				
Impact 2: Groundwater Quality					
Closure Phase and Post-Closure Phase					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	3	5	6	90 (Medium-high)
Post-Mitigation	N/A				

7.3.7 Topography Impact Assessment

The impact assessment on the topography of the area is based on each activity associated with the various mining phases. The significance of each activity per mining phase is described in the table below.

7.3.7.1 Construction Phase

Criteria	**Details/ Discussion**				
Mining phase/s	Construction Phase				
Activity 1: Removal of topsoil and vegetation					
Description of impact	The removal of vegetation and topsoil will change the surface of the study area and therefore the topography.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Topsoil and vegetation removal should be kept to a minimum; ▪ Areas where vegetation and topsoil is removed for site clearing should be contoured appropriately. This will assist to prevent soil erosion from occurring, especially during extreme rainfall events; and ▪ It is advised that vegetation on slopes be left intact. This will further combat soil erosion.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	1	6	6	66 (Medium-low)
Post-Mitigation	2	1	5	5	40 (Medium-low)
Activity 2: Construction of any surface infrastructure					
Description of impact	Vehicular activity to transport construction material could damage the surface of roads and impact on the topography. Piles of construction material will temporarily change the topography of the study area. The construction of surface infrastructure e.g. access roads, pipes, storm water diversion berms, change houses, admin blocks etc. (including transportation of materials and stockpiling) will add features to the topography thereby changing it.				

Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Stockpiles should be contoured appropriately and vegetated where possible; ▪ If possible, stockpiles should not be placed on slopes above drainage lines and pans; ▪ Access and haul roads should be contoured appropriately so that erosion due to surface water runoff is limited. ▪ Appropriate culverts and drains should be implemented to deal with surface water runoff. This applies to runoff generated from dirt and impermeable roads as well as from other surface infrastructure constructed onsite.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	2	5	6	66 (Medium-low)
Post-Mitigation	4	2	5	5	55 (Medium-low)
Activity 3: Drilling, blasting and development of infrastructure for mining					
Description of impact	Rock will be removed to create the box cut and expose the coal. This will result in a void in the topography. Topsoil and overburden stockpiling involves adding to the surface and will thereby change the topography of the study area. Onsite surface water drainage patterns will be altered.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Only remove overburden when and where necessary; ▪ Store overburden away from surface water and drainage lines; ▪ Ensure topsoil is stored away from surface water and drainage lines; and ▪ Ensure stockpiles are contoured and not too steep.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	3	6	6	84 (Medium-high)
Post-Mitigation	5	3	5	6	78 (Medium-high)

7.3.7.2 Operational Phase

Criteria	**Details/ Discussion**
Mining phase/s	Operational Phase
Activity 7: Removal of overburden and ore (mining process) and backfilling when possible	
Description of impact	The removal of overburden and ore will increase the size of the void and significantly change the topography of the study area. Overburden and coal stockpiling involves adding to the surface and will thereby change the topography of the study area.

Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Only remove overburden when and where necessary; ▪ Store overburden away from surface water drainage lines. This will decrease soil erosion and consequent sedimentation; ▪ Ensure overburden stockpiles are contoured appropriately and are not too steep. This will reduce erosion; ▪ Store extracted coal away from pans and surface water drainage lines. Stockpiles placed on slopes have the potential to contaminant water resources especially in the vicinity of Tevrede se Pan. It is recommended that all dumps should not be placed on slopes surrounding pans and drainage lines; and ▪ Roads should be contoured appropriately to ensure that surface water drains off. Thereafter, surface water that has drained off needs to managed appropriately				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	7	3	6	6	96 (Medium-high)
Post-Mitigation	6	3	5	6	84 (Medium-high)
Activity 10: Concurrent rehabilitation by replacement of overburden, subsoil, topsoil and re-vegetation as mining progresses					
Description of impact	Con-current rehabilitation as mining progresses via backfilling of overburden (where possible) will remove rock from the overburden stockpile and place it in the void. The overburden stockpile will be decreased and the void will be filled thereby changing the topography of the study area. This will assist to return the topography to a state similar to the pre-mining topography; however, the topography will never be the same as the pre-mining state.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Backfill as much of opencast area area as possible in order to remove the overburden stockpile. This will assist in restoring the topography to a pre-mining state; and ▪ In cases where excess overburden material is avaiable, the stockpiles should be contoured to fit in with the natural topography of the area.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	2	5	7	77 (Medium-high)
Post-Mitigation	3	2	5	6	60 (Medium-low)

7.3.7.3 Decommissioning Phase

Criteria	**Details/ Discussion**

Mining phase/s	Decommissioning Phase				
Activity 12: Demolition and removal of all infrastructure (incl. transportation off site)					
Description of impact	Removal of all infrastructure will remove features from the surface and thereby change the topography. This will help to reverse some of the changes that occurred when the infrastructure was constructed.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Ensure all unnecessary infrastructure is removed. This will assist in returning the topography to a pre-mining state; and ▪ All remaining stockpiles should be contoured and vegetated as far possible and according to the surrounding natural environment				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	3	6	5	70 (Medium-low)
Post-Mitigation	3	2	6	5	55 (Medium-low)
Activity 13: Rehabilitation (spreading of soil, re-vegetation & profiling/contouring)					
Description of impact	Rehabilitation of the void will change the topography of the study area. The aim of the rehabilitation is to return the topography to a state similar to the pre-mining topography.. Spreading of sub-soils and topsoil will change the topography of the study area. Profiling and contouring to assist in maintaining drainage lines and will change the topography of the study area. Re-vegetation of areas disturbed by infrastructure will help prevent soil erosion and change the topography.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Fill the opencasts with as much overburden as possible to reduce the overburden stockpiles and reduce the voids; ▪ Ensure that the area to be rehabilitated is contoured to a topography similar to the pre-mining topography; ▪ Soils should be spread over appropriate areas; and ▪ Re-vegetate disturbed areas with appropriate indigenous vegetation.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	3	6	6	84 (Medium-high)
Post-Mitigation	4	2	5	6	66 (Medium-low)

7.3.7.4 Post-Closure Phase

Criteria	**Details/ Discussion**
Mining phase/s	Post-Closure Phase
Activity 14: Post-closure monitoring and rehabilitation	

Description of impact	After mining the topography of the study area will never be the same as the pre-mining topography. There will therefore be a permanent and irreversible change to the topography of the study area. Post-closure monitoring and rehabilitation will ensure that the topography is maintained in a state similar to the pre-mining topography				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Ensure that the post-mining topography is as close as possible to the pre-mining topography by re-contouring the study area; and ▪ Ensure that surface water and drainage lines are rehabilitated to pre-mining condition. This will prevent soil erosion and consequent sedimentation.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	6	3	6	6	90 (Medium-high)
Post-Mitigation	5	3	6	6	84 (Medium-high)

7.3.8 Visual Impact Assessment

The visual impact assessment of the area is based on each activity associated with the various mining phases. The significance of each activity per mining phase is described in the tables below.

7.3.8.1 Construction Phase

Criteria	**Details/ Discussion**				
Mining phase/s	Construction Phase				
Activity 1: Removal of topsoil and vegetation					
Description of impact	The removal of topsoil and vegetation will have a negative visual impact on the receiving environment. The project area will become noticeable to the nearby visual receptors as it will contrast the surrounding areas. Dust will be generated during this phase which will have a negative visual impact on visual receptors.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Topsoil and vegetation should only be removed where necessary; and ▪ Dust suppression techniques should be implemented.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	3	5	7	84 (Medium-high)
Post-Mitigation	3	3	5	6	66 (Medium-low)
Activity 2: Construction of any surface infrastructure					

Description of impact	The transport of construction material will have a negative visual impact on the receiving environment. Vehicular activity and the resulting dust will draw attention to the project area. The construction of surface infrastructure e.g. access roads, pipes, storm water diversion berms, change houses, admin blocks etc. (including transportation of materials and stockpiling) will have a negative visual impact on the receiving environment. Infrastructure lighting will be visible at night and will have a negative visual impact on the receiving environment.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Stockpiles should be vegetated and positioned to reduce visual disturbance where possible; ▪ Access roads should be moistened frequently by means of a water bowser to suppress dust; ▪ The area of surface infrastructure should be limited where possible; ▪ Surface infrastructure should be painted with natural hues so as to blend into the surrounding landscape where possible; ▪ Down lighting should be implemented to minimise light pollution at night; ▪ Pylons and metal structures should be galvanised so as to weather to a matt grey finish rather than be painted silver. If the pylons and metal structures are to be painted it is recommended that a neutral matt finish be used; and ▪ Construction of vegetation berms should be implemented close to infrastructure so that vegetation can be established.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	3	5	7	84 (Medium-high)
Post-Mitigation	3	3	5	6	66 (Medium-low)
Activity 3: Drilling, blasting and development of infrastructure for mining					
Description of impact	The box cut will dramatically contrast the surrounding grassland area. This will leave a permanent scar on the landscape. Dust resulting from the blasting will have a negative visual impact on the receiving environment. Topsoil and overburden stockpiling will have a negative visual impact on the receiving environment. Dust from stockpiles will have a negative visual impact on the receiving environment.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Overburden should only be removed when and where necessary; ▪ Overburden stockpiles should be positioned to reduce visual disturbance where possible; ▪ Reduce the height of stockpile and overburden dumps where possible; ▪ Plant and fertilise fast growing endemic vegetation in areas where they can conceal the stockpiles and overburden; and ▪ Ensure vegetation screens are maintained.				

Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	3	5	7	91 (Medium-high)
Post-Mitigation	5	3	4	6	72 (Medium-low)

7.3.8.2 Operational Phase

Criteria	**Details/ Discussion**				
Mining phase/s	Operational Phase				
Activity 6: Use and maintenance of roads and infrastructure					
Description of impact	The use and maintenance of haul roads will have a negative visual impact on the receiving environment. Dust from vehicle movement will add to this visual impact. This visual impact will occur for the life of the project.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Numerous haul roads should not be created alongside each other; ▪ Vehicles must be roadworthy and obey the recommended speed limits at all times; and ▪ Haul roads should be moistened frequently by means of a water bowser to suppress dust.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	3	5	7	84 (Medium-high)
Post-Mitigation	3	2	5	7	70 (Medium-low)
Activity 7: Removal of overburden and ore (mining process) and backfilling when possible					
Description of impact	Overburden stockpiling and coal stockpiling will have a negative visual impact on the receiving environment. This will leave a permanent scar on the landscape.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Overburden and coal stockpiles should only be removed when and where necessary; ▪ Overburden stockpiles should be positioned to reduce visual disturbance where possible; ▪ Plant fast growing endemic vegetation in areas where they can conceal the stockpiles; ▪ Ensure vegetation screens are maintained; and ▪ Coal stockpiles should be positioned to reduce visual disturbance where possible.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*

Pre-Mitigation	6	3	6	7	105 (Medium-high)
Post-Mitigation	5	3	4	6	72 (Medium-low)
Activity 10: Concurrent rehabilitation by replacement of overburden, subsoil, topsoil and re-vegetation as mining progresses					
Description of impact	Con-current rehabilitation as mining progresses via backfilling of overburden (where possible) will decrease the negative visual impact on the receiving environment. Rehabilitation will assist to reduce the negative visual impact of mining on the receiving environment.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Backfill as much of the opencast area area as possible to reduce the size of the overburden dumps. This will also reduce the visual impact of the overburden dumps and opencasts.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	6	3	6	6	90 (Medium-high)
Post-Mitigation	5	3	5	5	65 (Medium-low)

7.3.8.3 Decommissioning Phase

Criteria	**Details/ Discussion**				
Mining phase/s	Decommissioning Phase				
Activity 12: Demolition and removal of all infrastructure (incl. transportation off site)					
Description of impact	The removal of infrastructure will assist in removing the negative visual impacts on the receiving environment.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Ensure all unnecessary infrastructure is removed.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	2	3	7	70 (Medium-low)
Post-Mitigation	5	2	2	6	54 (Medium-low)
Activity 13: Rehabilitation (spreading of soil, re-vegetation & profiling/contouring)					
Description of impact	Rehabilitation of the void will assist to reduce the negative visual impact on the receiving environment. The aim of the rehabilitation is to return the project area to a state similar to the pre-mining state. The spreading of sub-soils and topsoil will reduce the visual impact on the receiving environment. Profiling and contouring will decrease the visual impact on the receiving environment. Re-vegetation of areas disturbed by infrastructure will have a neutral visual impact on the receiving				

	environment. These visual impacts will be permanent.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Fill the opencasts with as much overburden as possible; ▪ Spread soils over appropriate areas; ▪ Ensure all areas to be rehabilitated are re-contoured to a topography similar to the pre-mining topography; and ▪ Re-vegetate disturbed areas.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	2	3	7	70 (Medium-low)
Post-Mitigation	5	2	2	6	54 (Medium-low)

7.3.8.4 Post-Closure Phase

Criteria	**Details/ Discussion**				
Mining phase/s	Post-Closure Phase				
Activity 16: Post-closure monitoring and rehabilitation					
Description of impact	Post-closure monitoring will reduce the visual impact on the receiving environment. Although the visual impacts of the proposed mine will be reduced, the remaining visual impacts will always be present. Post-closure monitoring and 'touch-up' work where neccesary will ensure that dumps remain vegetated and that the visual impacts of the mine are as small as possible.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Ensure that all disturbed areas are rehabilitated to a state as close as possible to the pre-mining state.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	6	3	6	6	90 (Medium-high)
Post-Mitigation	5	2	6	5	65 (Medium-low)

7.3.9 Air Quality Impact Assessment

7.3.9.1 Construction Phase

Criteria	**Details/ Discussion**				
Mining phase/s	Construction Phase				
Activity 1: Removal of topsoil and vegetation					
Description of impact	Fugitive dust generated in the form of dust fallout (total suspended particulate, will give rise to nuisance impacts), as well as PM_{10} and $PM_{2.5}$ (dust with a size less than 10 micron, and dust with a size less than 2.5 micron giving rise to health impacts). It is anticipated that the extent of dust emissions would vary substantially from day to day depending on the intensity of activity, the specific operations, and the prevailing meteorological conditions. This activity will be short-term and localised, seizing after construction phase.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Removal of topsoil be limited to non-windy months, as the winds peak during August, September and October with the suspension of loose dust particles; ▪ Disturbed areas must be kept to a minimum and no unnecessary clearing of vegetation must occur; ▪ Topsoil should be re-vegetated to reduce the areas open to wind erosion; ▪ During the loading of topsoil onto trucks or stockpiles, the dropping heights should be minimised; ▪ Water or other binding agents such as (petroleum emulsions, polymers and adhesives) can be used for dust suppression on roads; ▪ When using bulldozers and graders, there is need to minimise travel speed and distance and volume of traffic on the roads; and ▪ The use of speed bumps to reduce speed and the levels of re-suspended dust.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	2	2	7	56 (Medium-low)
Post-Mitigation	3	2	2	5	35 (Medium-low)
Activity 2: Construction of any surface infrastructure					
Description of impact	The movement of workforce, vehicle activity on access roads, levelling and compacting of surfaces will result in the generation of fugitive dust and poor ambient air quality.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact:				

	▪ Use of water to dampen dust generating areas such as access roads, and haul roads or exposed soil, use of chemical dust suppressant and speed bumps; and ▪ Avoid the use of friable materials on roads with good housekeeping practice to minimise the accumulation of loose dust piles on roads.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	3	5	7	91 (Medium-high)
Post-Mitigation	3	3	5	6	66 (Medium-low)
Activity 3: Drilling, blasting and development of infrastructure for mining					
Description of impact	Fractions of the dust generated during drilling are respirable (PM_{10} and $PM_{2.5}$) with health implications for drill operators, drill helpers and other personnel's in the vicinity. Drilling and blasting can also result in increased fugitive dust load and nuisance impacts as a result of dust fallout. This activity will be intermittent, short-term and localised, and will continue for the project lifetime.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Limit blasting to non-windy days i.e. avoid unfavourable weather conditions, where practical drilling and blasting should be performed during daylight hours and in favourable weather conditions; ▪ There is need to minimise blast area and when drilling use of water sprays and dust curtains; ▪ When blasting, it is advised to wet the proposed blasting area through the use of water catridges alongside the explosives ▪ Filtration systems can be utilised to remove the pollutants from the air after the blasting exercise; and ▪ The blast area needs to be minimised.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	3	4	5	7	84 (Medium-high)
Post-Mitigation	2	3	5	6	60 (Medium-low)
Activity 4: Temporary storage of hazardous products (fuels, explosives) and waste (sewage)					
Description of impact	The impacts of the hazardous materials and waste management are related to the types and amount of equipment and machinery used during construction and the waste produced. Impacts anticipated include evaporation of diesel fuel and heavy fuel from temporary storage tanks and possible spills on site during re-fuelling of heavy machinery and trucks. Also, unpleasant releases from sewage pipes due to leakages. Accidental discharges associated with stored explosives used for blasting.				
Mitigation	Project-related mitigation measures and site management should be implemented				

required	in order to reduce the significance of the impact: ▪ Hazardous products and waste management plan should be in place; and ▪ Addressing, inspection updating procedures on storage efficiency, waste-specific management and disposal requirements.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	3	3	2	7	56 (Medium-low)
Post-Mitigation	2	3	2	6	42 (Medium-low)

7.3.9.2 Operational Phase

Criteria	**Details/ Discussion**				
Mining phase/s	Operational Phase				
Activity 6: Use and maintenance of roads and infrastructure					
Description of impact	There is transportation of machinery, materials and workforce and exhaust fumes from vehicles and leakages of fuel. Fugitive dust generation and volatile emissions will impacts on ambient air quality in the area.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Water sprays on the road and dust suppressants on the well-defined truck routes; ▪ Waste management plan should be in place; and ▪ Addressing, inspection and updating procedures on storage efficiency, waste-specific management and disposal requirements.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	3	3	5	5	55 (Medium-low)
Post-Mitigation	2	3	5	5	50 (Medium-low)
Activity 7: Removal of overburden and ore (mining process) and backfilling when possible					
Description of impact	Impacts will be shaped by the blasting frequency and area blasted. There will be fumes from diesel trucks when the coal is loaded onto the trucks and transported 40 km to the Spitzkop Colliery. The coal is deposited onto the crusher and followed by further beneficiation processes, the crushing process releases fugitive dust. Main sources of dust emissions are through spillage, carry back and stockpiling of overburden. The dust generated encompasses TSP, PM_{10} and $PM_{2.5}$. The PM_{10} and $PM_{2.5}$ fractions are capable of likely health implications due to the depth of penetration in the human respiratory system.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Use of speed bumps to check overspeeding and the levels of re-				

	suspended dust; and ▪ Water or other binding agents such as (petroleum emulsions, polymers and adhesives) can be used for dust suppression on roads.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	3	5	6	78 (Medium-high)
Post-Mitigation	4	2	5	5	55 (Medium-low)
Activity 10: Concurrent rehabilitation by replacement of overburden, subsoil, topsoil and re-vegetation as mining progresses					
Description of impact	The movement of overburden subsoil and topsoil to fill voids and return the surface to near pre-mining landscape will result in elevated dust suspension and deposition.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Re-vegetation of such surfaces will suppress the dust generating potential and impact on ambient air quality.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	3	2	5	55 (Medium-low)
Post-Mitigation	3	3	2	4	32 (Medium-low)

7.3.9.3 Decommissioning Phase

Criteria	**Details/ Discussion**				
Mining phase/s	Decommissioning Phase				
Activity 12: Demolition and removal of all infrastructure (incl. transportation off site)					
Description of impact	Potential for impacts during this phase will depend on the extent of demolition and rehabilitation efforts during closure as well as features which will remain. The impacts on the atmospheric environment during the decommissioning phase will be similar to the impacts during the construction phase. Demolition and removal of all infrastructureswill cause fugitive dust emissions.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Demolition should not be performed during windy periods (August, September and October), as dust levels and the area affected by dust fallout will increase.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	2	3	2	6	42 (Medium-low)

Post-Mitigation	2	3	2	5	35 (Low)
Activity 13: Rehabilitation (spreading of soil, re-vegetation & profiling/contouring)					
Description of impact	There is movement and transfer of soil from one area to other within the mined area, therefore high chances of dust generation if conducted during windy season.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Spreading of soil must be performed on less windy days; ▪ The bare soil will be prone to erosion there is need to introduce surface vegetation cover to check erosion; ▪ Leaving the surface of the soil in a coarse condition reduces wind erosion; ▪ Keep the soil moist using sprays or water tanks, using wind breaks; and ▪ Re-vegetation of the area must be linked to the distribution and reliability of the rainfall.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	2	3	2	6	42 (Medium-low)
Post-Mitigation	2	3	2	5	35 (Low)

7.3.9.4 Post Closure Phase

Criteria	**Details/ Discussion**				
Mining phase/s	Post-Closure Phase				
Activity 16: Post-closure monitoring and rehabilitation					
Description of impact	Re-vegetation of the remaining footprint of the mine must be done after the reclamation. The impacts on the atmospheric environment during rehabilitation will be limited to the vehicular activity during spreading of soil and profiling/contouring.				
Mitigation required	It is recommended that the rehabilitation by vegetating should begin during the operational phase. The objective is to minimise the erosion. These measures should reduce the potential for fugitive dust generation and render the impacts negligible.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	2	1	3	6	36 (Medium-low)
Post-Mitigation	2	1	3	6	36 (Medium-low)

7.3.10 Surface Water Impact Assessment

For the purpose of the surface water impact assessment the Hawar project timeframe has been subdivided into Construction, Operational and Decommissioning/Post Closre phases.

The impact assessment was conducted by assessing the three catchments, i.e. Tevrede se Pan, Boesmanspruit and Mpuluzi. The cathments can be described as follows:

- Tevrede se Pan catchment is a closed system, thus the surface water environment is highly sensitive;
- Boesmanspruit catchment has already been impacted by mining activities, particularly at the lower parts of the catchment. Therefore, surface water impacts to these already impacted environments may not be regarded as highly sensitive.
- Mpuluzi catchment is considered to be pristine surface water environment. Again, the impacts will be at the headwaters, thus appropriate mitigation measures must be implemented and managed.

7.3.10.1 Construction Phase

7.3.10.1.1 <u>Surface Water Quality</u>

During the construction phase the impacts on the surface water quality of the Boesmanspruit and Mpuluzi catchments is rated to be of low significance and is not included below, however the impact rating table for these catchments are given in the Surface Water Impact Assessment report. The impacts are rated to be of higher significance at the Tevrede se Pan cathment and are given in the table below.

Criteria	**Details/ Discussion**
Mining phase/s	Construction Phase
Activity 1: Removal of topsoil and vegetation	
Description of impact	Dust created may be deposited on the immediate surface water environments Accumulation of dust particles to the surface water environment could result in an increase of suspended solids. This may increase the turbidity of the surface water impacting on the quality. The stockpiling and use of soils to create berms will result in potential erosion particularly in the wet season. The surface water quality impacts will impact on the tributary of the Boesmanspruit which is pristine water quality (HSW02 and HMF) and the Pan which has ecological importance. During the construction phase, large areas of the site will be stripped of vegetation which will increase erosion and sedimentation. It must be emphasised that the impact rating for Tevrede se Pan Catchment should consider a high significance rating. The surface water is within a closed environment, thus limiting the scale (parameter) to Limited (2). Cognisance must be taken of the sensitivity of the surface water environment as any impacts to

	Tevrede se Pan will be rated potentially detrimental to the system.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Dust suppression measures such as spraying with water bowsers should be implemented; ▪ The stockpiles and berms must be vegetated to reduce potential soil erosion; ▪ The mitigation of the impact is the construction of Stormwater collection channels conveying the runoff to sediment control dams. The sediment control dams will settle out the sediment before the runoff is discharged to the environment. The separation of clean and dirty areas by means of berms should ensure that all dirty water is contained in the dirty area which should be minimised, while the clean water is allowed to flow to the catchment; and ▪ In the case of Hill A, there may be a requirement to isolate the pan using constructed concrete slab that will be in place.				
Tevrede se Pan					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	2	6	5	65 (Medium-low)
Post-Mitigation	4	2	5	4	44 (Medium-low)
Activity 3: Drilling, blasting and development of infrastructure for mining					
Description of impact	▪ Drilling and blasting uses the explosives which may result in surface water impacts if not handled and disposed properly. ▪ The removal of soils and overburden and stockpiling thereof may generate dust and erosion potential. ▪ The overburden removed may have acid generating potential and result in acid mine water generation when stockpiled on surface resulting in negative water quality. ▪ Groundwater seepage will accumulate in the opencast and will require pumping and storage to the surface to enable the continuation of mining.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ The storage and handling of explosives must be by trained and authorized personnel only. The post blasting inspection should be conducted to collect all waste and the explosives that did not successfully detonate. The storage of the explosives waste must be in an explosives magazine located on a hard park that is compacted and impermeable with restricted access. ▪ Dust generated should be suppressed using water bowsers. ▪ The pre-mining assessment should include acid base geochemical assessment (Currently being conducted) which will determine the acid generation potential of the overburden. If acid generating, mitigation				

	measures must be applied to prevent the exposure of the material to water (e.g. cover with limestone). The stockpile areas for the overburden must be isolated using vegetated topsoil berms and the water associated with these stockpiles must be filtered through silt traps and conveyed to a pollution control facility for evaporation or dust suppression in the opencast area. ▪ Measures must be put in place to pump out groundwater seepage to surface, to a lined pollution control facility for evaporation and other uses on site. ▪ The drilling and opencast development must be carried out in series implementing roll-over mining and concurrent rehabilitation. The isolation of the pan should be in the form of a high wall structure that can prevent dust deposition into the pan. The proposed distance between the pan and opencast berm should be 500 m.

Tevrede se Pan					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	2	6	5	65 (Medium-low)
Post-Mitigation	3	2	4	4	36 (Medium-low)

7.3.10.1.2 Surface Water Quantity

Criteria	**Details/ Discussion**
Mining phase/s	Construction Phase
Description of impact	The construction of upslope diversion berms will result in surface runoff being prevented from reporting to the catchment. In this case, flow reduction to the Carolina Dam and the pan will be observed. The flow reduction to the Boesmanspruit and Carolina Dam will have social implications as this dam is used for urban supply. The areas with an isolated area in excess of more than ten per cent can be considered to start having an influence on the flow patterns and volumes in the receiving catchment. The catchment area runoff into Tevrede se Pan will have its catchment area reduced significantly if the mining methods do not consider concurrent rehabilitation of the mine opencast areas. The hydrology of the project area is seen to be dominated by hillslope processes. It can be concluded that hillslope seepage wetlands are the result of the hydrological processes. It however, must be recognised that some of these areas have been converted into crop plantations, mainly maize crops, which may already have impacted on these flows, hence the hydrology. Impact resulting from of this activity may have serious detrimental impacts on the hydrology due to site clearance (specifically in the Tevrede se Pan Catchment). The processes hydrology within the soil profile is unknown at this present time, however, it may be expected that these processes are difficult or almost impossible to mimic once destroyed.
Mitigation	Project-related mitigation measures and site management should be implemented

required	in order to reduce the significance of the impact: ▪ The dirty area isolated from the catchment must be minimised to reduce the volume of runoff prevented from reporting to the catchment. ▪ The mining of the two opencast areas (5 and 6) must be carried out in series where one opencast area is mined by rollover method followed by on-going rehabilitation, thus constantly returning runoff to the catchment. The mining program can be adjusted to ensure the area of opencast is larger in the dry season than in the wet season. ▪ The contouring and slope of the isolation berms must be representative of the pre-mining conditions to reduce the changes in flow regime of the Boesmanspruit and mixing of the pan water and sediment (mobilization of elements in the soil sediment, increased turbidity and decreased sunlight penetration for the ecological requirements). ▪ The significant role of the Boesmanspruit and the pan makes them more sensitive in terms of the impact assessment.

Tevrede se Pan					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	5	2	5	5	60 (Medium-low)
Post-Mitigation	3	2	2	4	28 (low)

7.3.10.2 Operational Phase

7.3.10.2.1 Surface Water Quality

The impact assessment on the surface water quality conducted for the operational phase is combined to cover the entire project area (all associated catchment areas). Impacts on the surface water quality will be consistent throughout the operational phase.

Criteria	**Details/ Discussion**
Mining phase/s	Operational Phase
Activty: The use and maintenance of the roads and infrastructure	
Description of impact	The berms will get eroded after the rainy season and when moving them to minimise the dirty area after rehabilitation has been implemented. This will result in potential erosion. While the mining moves from one opencast area to the next, the decommissioning of infrastructure and moving to the next will result in increased site activity with potential accidental spillages. Also there may be mobilization of contaminants (used oils, grease and chemicals) as the site is relocated to be closer to the mining opencast area.
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ The maintenance of the roads will be required to reduce potential for

	accidents and subsequent spillage of materials being transported. The demolition of the road must be followed by backfilling, soil cover and vegetation in line with on-going rehabilitation. ▪ Berms must be maintained including re-contouring and application of vegetation and irrigation as a means to reduce soil erosion potential. ▪ The movement of mining from on opencast area to the next must be followed by final void backfilling, application of soil cover and re-vegetation to reduce potential erosion and water quality deterioration. ▪ The surface dams and water conveyances must be maintained including de-silting to reduce potential for overflow and surface water quality deterioration.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	3	3	3	4	36 (Medium-low)
Post-Mitigation	2	2	2	3	18 (Low)
Activity: Removal and use of overburden during backfilling					
Description of impact	The relocation of mining activities from one opencast area to the next will require the use of overburden stockpile to backfill in the opencast area. This may require blasting of the hard overburden. The associated impacts include dust generation, erosion, nitrate and nitrite contamination and mobilization of the contaminants and leachate into the surface water environment. The disturbance of the overburden may also kick-start the generation of acid mine water generation as pyritic material is exposed to air and water. Similarly, when the mining moves from one location to the next, there is a requirement for overburden basting, removal and stockpiling with similar impacts.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ The stockpiling/ removal of the overburden stockpile must be performed over a short period. All material is to be re-used and the excess material (as a result of bulking) must be covered with topsoil and left for the final void rehabilitation. The overburden that is blasted from a new opencast area should be used to backfill the previously mined opencast area in-line with the roll- over opencast mining principles.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	3	3	4	40 (Medium-low)
Post-Mitigation	2	2	2	3	18 (Low)
Activity: Water use on site (portable, domestic waste, runoff/ stormwater)					
Description of impact	Potable water use will increase on site depending on the water source there must be efficient use that is adequate for the number of people on site. If groundwater is abstracted and treated, the waste from the water treatment must be disposed in				

	a lined brine pond for evaporation subsequent closure. The sewage generated must be handled by approved and authorised service providers. Should a sewage works be constructed, its capacity should be at least 1.5 times the required capacity to ensure that the effluent is always within the required quality. Surface runoff associated with the clean area must report to the catchment while that associated with the dirty area could result in water quality deterioration.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Water usage (portable) must be efficient and adequate for the number of people on-site and it must only be used for human consumption. All other uses such as wash bays may use groundwater which does not need to be treated to portable quality. ▪ The effluent of the sewage works should be disposed to the PCD to prevent the potential water quality impacts to surface water resources. ▪ The contaminated stormwater/ runoff must be conveyed to the PCD for evaporation and used for dust suppression. The design, operation and maintenance of the water conveyances and containment areas must be in line with the appropriate Schedules of GN R 704.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	3	4	5	5	60 (Medium-low)
Post-Mitigation	2	3	5	3	30 (Low)
Activity: Storage and handling of waste and hazardous materials					
Description of impact	Improper storage, handling and disposal of waste and hazardous material could result in accidental spillage that may cause water quality impacts. The disposal of waste must be in clearly labelled and appropriate skip bins for off-site transportation by approved service providers. This will prevent the disposal at inappropriate sites and subsequent water quality impacts. These areas may be prone to leaks from loose valves and daily drips. This may create cumulative impacts where the material has leached onto the surface and can cause water quality deterioration in the wet season when they get into contact with surface runoff. Furthermore, if contaminated water from the PCD is used for dust suppression, it may be contaminated by such materials.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Only authorised personnel are to have access to workshops and storage areas of hazardous materials. The management, handling and disposal of waste must be carried out by an accredited contractor. When full the waste bins are to be disposed at appropriate sites and disposal certificate to be issued to the mine for record keeping. ▪ In terms of accidental spillages, on-site clean-up kits must be available for				

	use by trained personnel to prevent the mobilization of impacts for the source of the spillage. ▪ On-going inspections of valves and full bins as well as leaks must be carried out periodically and where required the contaminants must be cleaned out.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	2	2	5	40 (Medium-low)
Post-Mitigation	3	2	1	2	12 (Low)
Activity: Rehabilitation and Monitoring					
Description of impact	The rollover mining method implements concurrent/ on-going rehabilitation (backfill, soil cover and vegetation application). The associated impacts of rehabilitation include soil erosion and surface water quality impacts. However, the implementation of concurrent rehabilitation and monitoring the vegetation growth will result in positive impact overall. Monitoring of surface water could detect negative surface water quality impacts.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ On-going rehabilitation must be implemented to prevent the contact of rainfall with spoils/ overburden material on surface as this may produce acidic runoff. The application of soil and vegetation is a key part of rehabilitation that prevents runoff ingress into the mined out area, reduce potential for acid mine water generation and decant, reduce erosion potential and restores the mined out area to the pre-mining conditions. It is essential the mine and rehab plan area linked to ensure that pre-rainy season, soil cover and vegetation are applied and that the vegetation can grow in the wet season. ▪ Monitoring of vegetation growth should detect areas where vegetation did not grow and that are prone to erosion. Water quality impacts detected during monitoring must be appropriately mitigated				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	3	4	4	44 (Medium-low)
Post-Mitigation	2	2	2	2	12 (Low)

7.3.10.2.2 Surface Water Quantity

The impacts on surface water quantity have been assessed at the Tevrede se Pan Catchment and combined, Boesmanspruit and Mpuluzi catchments, due to the variabilities associated with the location of the two areas.

Criteria	**Details/ Discussion**

Criteria	**Details/ Discussion**				
Mining phase/s	Operational Phase				
Description of impact	As the concurrent rehabilitation is implemented and the isolation berms are moved in line with reducing the size of the dirty area, it is expected that the impact will be reduced. Monitoring of surface water quantity (stream flow characteristic) can detect negative water quantity impact. The inspection on site in the rainy season can also be used to detect the profile and contouring where the drainage lines are not free draining and there is surface water damming.				

Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact:
	▪ A topographic surveyor must be part of the project team. The backfilling, compacting and contouring during concurrent rehabilitation must be in line with the topographical survey and must return the site to a state that is as close as possible to the pre-mining conditions.
	▪ The dry-season mining must be followed by rehabilitation and moving of the isolation berm. This includes the demolition of the old berms, and using the topsoil cover for rehabilitation while the topsoil for the new opencast area is used to create the new berms.
	▪ The water quantity impacts detected in the rainy season should be mitigated in the dry season. These may include:
	  ▪ Vegetation application;
	  ▪ Reshaping of slopes;
	  ▪ Re-contouring and profiling of the surface; and
	  ▪ Re- application of soil cover and vegetation.				

Tevrede se Pan					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	2	3	5	45 (Medium-low)
Post-Mitigation	3	2	2	4	28 (low)
Boesmanspruit and Mpuluzi					
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	3	3	3	4	36 (Medium-low)
Post-Mitigation	2	2	2	3	18 (Low)

7.3.10.3 Decommissioning Phase

7.3.10.3.1 <u>Surface Water Quality</u>

Criteria	**Details/ Discussion**				
Mining phase/s	Decommissioning Phase				
Activty: Demolition of infrastructure and rubble removal/ disposal					
Description of impact	Accidental spillages could occur as a result of increased activity on the mine and use of inexperienced contractors. The improper disposal of demolished material could impact negatively on the surface water environment and resources.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Only accredited and experienced contractors should be employed to decommission and dispose of the infrastructure and rubble at designated disposal areas. Disposal certificates must also be submitted to the mine for record keeping.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	4	3	3	4	40 (Medium-low)
Post-Mitigation	3	2	2	2	14 (Low)
Activity: Rehabilitation, profiling and contouring and Monitoring					
Description of impact	A major concern with regard to surface water is the erosion control and sediment / contamination mobilisation on the slopes that have been profiled and contoured.				
Mitigation required	Project-related mitigation measures and site management should be implemented in order to reduce the significance of the impact: ▪ Maximise the positive impacts by monitoring the re-vegetation process so that the runoff from the rehabilitated areas is free draining and can report to the catchment. ▪ The process of ground contouring must be implemented by competent personnel based on the slope requirements and to ensure free drainage of runoff and make sure there is no damming. Over compaction of the surface sites should be avoided to allow vegetation growth and infiltration to reduce runoff.				
Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significant rating*
Pre-Mitigation	3	3	3	5	45 (Medium-low)
Post-Mitigation	2	2	2	2	12 (Low)

7.3.10.3.2 __Surface Water Quantity__

Impacts on the surface water quantity during the decommissioning phase will be very low. The impact ratings are included in the Surface Water Assessment report.

7.3.11 Traffic Impact Assessment

The development of the mine and the proposed haul of the coal using heavy trucks will most likely result in an impact on the degradation of the existing gravel roads due to the increased loads.

According to the Traffic Study Report (Appendix M), it can be concluded that the proposed project would not have an adverse impact on the Road Network from a Traffic Engineering point of view. However, it is recommended that a detailed Traffic Impact Study be conducted so that the expected development trips and the existing traffic can be modelled to determine the exact nature of upgrades necessary to accommodate the development on the major intersections and road network.

Should the gravel road (D270/D239) and/or Road P117-1 be used in any way by interlink trucks the mine should engage the provincial department so that proper upgrading and maintenance of the route be done so that the proposed development's haul trips are sustained without damaging the pavement life. The P117-1 road has a tonnage restriction of 10 tonnes (Provincial road sign).

8 ALTERNATIVE LAND USES WHICH WILL BE IMPACTED UPON (REGULATION 50 (D))

8.1 Impacts on current land use

8.1.1 Agriculture (Arable and Cultivated Land and Grazing Land)

The proposed mining activities will result in the following impacts on the agricultural activities:

- Loss of arable land (likely permanent);
- Loss of grazing land (temporary);
- Disturbance of natural soil conditions;
- Dust emissions impacting on surrounding agricultural activities;
- Impacts on groundwater quality and quantity used for agricultural activities;
- Impacts on surface water quality and quantity used for agricultural activities; and
- Impacts on the natural topography of the area.

8.1.2 Tourism

Loss of biodiversity and the disturbance of the natural environment could result in less people visiting the area and negatively impacting on the current tourism ventures. The visual impact of the mine within the area could reduce the sense of place. Increased traffic volumes in terms of additional mine vehicles on the road networks in and around the project area could have a negative impact affecting tourism ventures. Mining activities increasing the current ambient noise levels could also pose a risk to tourism activities within the greater Chrissiesmeer area.

8.2 Assessment of duration of impacts

The mining activities will take place over a 15 year period.

8.3 Assessment of severity

Various specialist investigations have assessed and quantified the potential impacts of the mining activities on the receiving environment which includes the current state of the environment. The severity during the construction, operational and decommissioning phases on the current land use is discussed in Section 7.3. The significant impacts which resulted in a medium-high to high severity are the impacts on the following receiving environments:

- Soil, Land Use and Land Capability;
- Flora and Fauna;
- Aquatic Ecology;

- Wetland Areas.
- Groundwater; and
- Topography and Visual Environment.

9 SUSTAINABLE DEVELOPMENT

The National Environmental Management Act (Act No.107 of 1998) defines sustainable development as: “the integration of social, economic and environmental factors into planning, implementation and decision making so as to ensure that development serves present and future generations”.

Management and mitigation measures have been compiled (refer to Section 7 and Section 14) in order to monitor, minimise and/or prevent the identified potential impacts from occurring. To promote sustainable development in and around the Harwar Project area, the following environmental mitigation management is required:

- Infrastructure should be placed in areas of lowest sensitivity;
- Keep surface area disturbance to a minimum as far possible;
- Topsoil should be stockpiled separate from overburden material;
- Rehabilitation of disturbed surface areas should take place concurrently with mining activities;
- No construction or mining activities should take place within the catchment of Tevrede se Pan;
- Soil management plans should be implemented and followed accordingly;
- Water management plans should be implemented and executed accordingly; and
- Monitoring should be conducted as indicated in the management plan.

To promote sustainable development in the socio-economic environment, the following mitigation is required:

- Maximise and monitor local recruitment;
- Prevent nepotism/ corruption in local recruitment structures;
- Promote employment of women and youth;
- Train workforce;
- Development of a register of local SMMEs;
- Linkages with skills development/ SMME development institutions;
- SMME skills development as part of SLP commitments;
- Support economic diversification through development of alternative markets;
- Integration with mine and local government plans;
- Clearly communicated local recruitment policy;
- Use of community structures to identify local labour pool;
- Prioritising employment of unemployed members of local communities;

- Enforcing local employment targets for contractors;
- Liaise with local municipality to ensure that expected population influx is taken into account in infrastructure development planning;
- Diligently implement SLP and LED;
- Coordinate implementation of SLP/LED with municipal plans and community needs; and
- Liaison with local municipality to determine infrastructure needs once Harwar Colleiry reaches required profitability.

A sustainable development study is currently being compiled for the Harwar Project area. The study was not finalised before the compilation of the Draft EIA/EMP report, however it will be available for inclusion into the final EIA/EMP report.

10 MITIGATION MEASURES (REGULATION 50 (E))

Mitigation measures relevant to the anticipated environmental impacts are discussed below. The mitigation measures aim to reduce the overall significance of the anticipated impacts.

10.1 List of all significant impacts as identified in the EIA

A list of the significant impacts (Medium-high and High) expected to occur as a result of activities associated with the mining activities at the Harwar Colliery, is indicated in Table 10-1 below. Proposed mitigation measeures for all the impacts identified, not only the significant ones, are provided in Section 7.3 of this report.

Table 10-1: Significant environmental impacts identified requiring mitigation measures

Aspect	Impact Description	Significance
Aquatic Ecology		
Water quality on aquatic biota	■ Introduction of hydrocarbons from oil/lubricants and nutrients from explosives and sewage treatment facilities; ■ Introduction of dissolved salts and metals from stockpiles and exposure of contaminated soil; ■ Alteration of pH from contaminated soil and exposed coal seam.	These impacts will generally have a high significance in the Mpuluzi River, Boesmanspruit River and Buffelspruit River. However, after mitigation the impacts decrease in significance to the lower end of the medium-high spectrum.
Water quantity on aquatic biota (Boesmanspruit)	■ The aquatic biota of the Boesmanspruit was determined to be affected by low flow conditions. ■ The modification of the drainage area within the X11B quaternary catchment through the removal of vegetation and the creation of an opencast has implications on the quantity of water entering into the Boesmanspruit system.	The impact on the water quantity of the Boesmanspruit during the operational phase is rated to be of medium-high significance.

Aspect	Impact Description	Significance
Water quantity on aquatic biota (Buffelspruit)	■ The aquatic biota of the Buffelspruit was determined to be reliant on high flow conditions. Any alterations of water quantity would therefore negatively affect these flow-dependent species. ■ The modification of the drainage area within the X12A quaternary catchment through the removal of vegetation and the creation of an opencast has implications on the quantity of water entering into the Buffelspruit system.	The impact on the water quantity of the Buffelspruit during the construction and operational phase is rated to be of medium-high significance.
Flora and Fauna		
Loss of habitat types, biodiversity and ecosystem function.	■ Loss of primary grassveld. ■ Loss of riparian / wetland habitat types; ■ Loss of floral species of special concern; ■ Loss of faunal species of special concern; ■ Fragmentation and edge effects; and ■ Influx of alien invasive species.	The impact on the flora and fauna of the area is generally rated to be of high significance. Only small areas of medium biodiversity sensitivity are present within the project boundary.
Soils, Land Use and Land Capability		
Soils, Land Use and Land Capability - Reduced Agricultural Potential and Land Capability	■ Soil compaction and topsoil loss; ■ Soil erosion (sediment release to land and surface water); ■ Soil contamination; and ■ Low fertility.	These impacts are generally rated to be of high significance. Mitigation measures could however reduce the significance of these impacts.
Wetlands		
Direct loss of wetland areas, Indirect loss of wetland areas, loss of wetland integrity, and loss of wetland funcionality	■ Direct loss of hillslope seepage wetlands; ■ Loss of hillslope seepage wetland habitat; ■ Loss of non-wetland perched water table recharge areas;	The significance of the impacts on wetlands is generally rated to be of high significance. In some instances the significance of the impact is only rated to be medium-high.

Aspect	Impact Description	Significance
	■ Desiccation of springs; ■ Chemical contamination of surface water resources; ■ Sedimentation of surface water resources; ■ Alien invasive species encroachment; ■ Loss of biodiversity; ■ Loss of water quality enhancement capacity; ■ Loss of biodiversity support; ■ Degradation of unique wetland types; and ■ Loss of sensitive species.	Mitigation measures can however reduce the significance of these impacts.
Groundwater		
Groundwater quantity	■ Groundwater from both catchments will flow towards opencast area centres in response to the hydraulic gradient, known as a cone depression; ■ Dewatering and lowering of groundwater levels; and ■ Dewatering impacts on the pans.	The impacts on the groundwater quantity during the operational phase are rated to be of medium-high significance.
Groundwater quality	■ Possible decant water in the rehabilitated opencast areas will be exposed to oxygen, hence producing AMD; and ■ AMD could possibly impact on the Pans.	This impact is rated to be of medium-high significance during the operational, decommissioning and post-closure phase.
Air Quality		
Ambient Air Quality	■ Increase of fugitive dust emissions; and ■ Increase of PM_{10} and $PM_{2.5}$.	These impacts are rated to be of medium-high during the construction of infrastructure, blasting for the development of the opencast areas and mining activities.
Surface Water		

Aspect	Impact Description	Significance
Surface water quality and Tevrede se Pan	■ Increased solids and turbidity of the surface water resources of the Boesmanspruit River and Tevrede se Pan due to disturbances of the soils and drilling and blasting.	The significance of the impact during the construction phase close to Tevrede se Pan is of high significance. It is recommended that no construction or mining activities should take place within the catchment of Tevrede se Pan.

11 PUBLIC CONSULTATION (REGULATION 50 (F))

11.1 The identification of interested and affected parties

The landowners and other affected persons in respect of the land uses which have been identified on the property and on adjacent and non-adjacent farms that may be affected by the proposed project have been identified.

A list of names for landowners and land occupiers affected by the proposed project is provided in the Public Participation Report attached as Appendix O.

The relevant Local Government, Provincial Government Departments, Land Claims Commissioner and Traditional Authorities that were consulted are listed below.

Further detail can be found in the Public Participation Report included as Appendix O with the associated stakeholder database. The following Government entities were informed about the proposed Harwar Colliery:

- Department of Mineral Resources;
- Department of Environmental Affairs;
- Department of Water Affairs;
- Department of Agriculture;
- Mpumalanga Department of Public Works, Roads & Transport;
- Mpumalanga Department of Economic Development, Environment and Tourism; and
- Gert Sibande District Municipality.

The Land Claims Commission was consulted in order to identify if any land claims reside over the affected properties.

No traditional authorities have been identified during the Public Participation process and such roles and responsibilities reside with the Councillors.

The following Government entities were consulted:

- Department of Agriculture, Rural Development and Land Administration;
- Mpumalanga Department of Rural Development and Land Reform;
- Msukaligwa Local Municipality;
- Albert Luthuli Local Municipality; and
- Ward Councillors and Councillors for the above mentioned Local Municipalities.

The following Government agencies and institutions were consulted:

- South African Heritage Resources Agency
- Mpumalanga Tourism and Parks Agency

The following local communities were identified and consulted:

- Chrissiesmeer Community situated in Chrissiesmeer;
- Ward councillors of Kwazanele.

Further detail can be found in the Public Participation Report included as Appendix O with the associated stakeholder database.

11.2 The details of the engagement process

The local Government, Msukaligwa and Albert Luthuli Local Municipalities, have been consulted and information about the proposed project shared. Comments were obtained and captured in the Comment and Response Report (CRR), which forms part of the Public Participation Report. Comments received relating to economic and socio-economic development will be considered for possible inclusion into advisory guidelines proposed as part of the MRA and existing economic development plans developed by Msobo.

The DMR was also consulted on 12 April 2013 to discuss the project and some of the concerns raised by various stakeholders. The following concerns were discussed:

- Timeframes for submissions;
- Land access issues; and
- Knowledge gaps.

The Land Claims Commission was consulted in order to identify if any land claims reside over the affected properties. Feedback was received from TP Mkhabela via formal letter on 1 March 2013. No land claims were indicated on the farm portions in question by the Land Claims Commission.

Interested and Affected Parties (I&APs) from the stakeholder groups have been consulted and informed about the proposed project, anticipated impacts on the environment and people alike and the MRA process with associated Public Participation Process (PPP). Further detail can be found in the Public Participation Report included as Appendix O which sets out the PPP that was followed and includes a CRR that provide the detailed comments raised by I&APs.

The following specialists and/or knowledgeable institutions were consulted as part of the MRA process:

- The Federation for a Sustainable Environment (FSE), Dr Koos Pretorius. Consultation was undertaken in order to gain a better understanding of the history and details of similar projects located within the area.
- North West University, Johann Tempelhoff: Consulted Johann to get an understanding of the area from a broader perspective as his research is integrated in terms of human and environmental interaction.

- Mpumalanga Tourism and Parks Agency, Brian Morris and Frans Krige. The MTPA was consulted due to the sensitivity surrounding the Chrissiesmeer area. Digby Wells wanted to get a better understanding of the project area and what the status is of the Application for Protection for the Chrissiesmeer Biodiversity Area.

11.3 Details regarding the manner in which the issues were addressed

Materials containing information pertaining to the environment which will be affected by the proposed Harwar Colliery has been developed and presented to I&APs. In these presentations, discussions were conducted about the environment specifically to ensure that landowners and other I&APs alike were able to verify accuracy of the affected environment and/or also contribute by highlighting additional affected areas to be considered for specialist studies.

Detailed maps that overlaid the proposed mining areas (open cast) with the MRA area, affected water resources and sensitive biodiversity areas were shared with stakeholders. Comments received from stakeholders are included in the CRR as part of the Public Participation report.

As part of the PPP, anticipated impacts of the proposed Harwar Colliery were shared with stakeholders which formed a basis for further discussion to identify additional potential social and environmental impacts of the project. Comments received pertaining to potential impacts from stakeholders are included in the CRR, which has been categorised to provide a quick reference to social and cultural impacts, as part of the Public Participation Report. A summary of comments provided by stakeholders can be found in Table 5, under Section 4, of the Public Participation Report.

The CRR was actively interrogated by the specialists who conducted studies and incorporated requirements and suggestions by stakeholders into studies being undertaken where practically possible. Regular updates pertaining to key stakeholder concerns were provided to the specialists throughout the MRA process. In some cases stakeholders also became involved with the specialist who conducted the studies to ensure that clear understanding was created on what was being undertaken. This also allowed stakeholders to share concerns directly with specialists.

12 KNOWLEDGE GAPS AND LIMITATIONS (REGULATION 50 (G))

A knowledge gap identified is the fact that no mine infrastructure layout plan indicating the location of ancillary mine infrastructure such as workshops, offices, etc. was available at the time of compiling the EIA/EMPR report. This report and all final specialist studies will assist in identifying possible viable locations for surface infrastructure.

The following knowledge gaps were identified during the various specialist investigations.

12.1 Aquatic Ecosystem Study

Due to the complex nature of the endoheric freshwater pans such as Tevrede se Pan the study of the ecological status has been proposed to be sourced to a freshwater endoheric pan ecological specialist. The results of the assessment are not yet available but will be included as part of the final aquatic ecological assessment.

The macroinvertebrate assessment in the Mpuluzi River and Buffelspruit has limited reference sites to which comparisons can be made. The categorisation of the sites related to this river system must therefore be interpreted with caution.

The submission of the current specialist study has only allowed for a single low flow study. Therefore, the results of the current study may be viewed with a low confidence as temporal trends will not be determined for the current report.

There is a distinct lack of recent (± 10 years) peer reviewed/published information pertaining to the aquatic biota in the surrounding affected river systems.

The aquatic ecosystems associated with the proposed Harwar mine vary from natural to moderately modified states. Limited confidence may be placed in these results as only a single survey has been undertaken thus far.

Based on the findings of the current aquatic assessment the following recommendations can be made:

- A high flow survey will be conducted in order to aid in the identification of temporal trends;
- Additional sites will be chosen in order to cover all available habitat types and thereby ensure the presence of various fish and macroinvertebrate species; and
- Follow the mitigation and conditions set out in the impact assessment section.

12.2 Heritage Study

The following restrictions occur in the Hawar project area:

- Site access to Harwar 58 IT RE and Vryheid 59 IT was denied. This presents a major gap in the HIA report as the fieldwork component of the HIA could not be conducted on these farms.

- Detailed surface infrastructure design plans were not available at the time of the HIA and as a result more detailed HIAs may be required should the finalised infrastructure footprints exceed minimum thresholds described in Section 38 of the SAHRA.

The following limitations occur in the Harwar project area:

- Existing agricultural fields and farm roads occur in the area. These features may have damaged or destroyed any archaeological sites that may have been present.
- Contemporary uses of historical structures as well as contemporary modifications of historical structures are a common occurrence in the Harwar project area.

The following knowledge gap was identified in the Harwar project area:

- Visible heritage resources are unlikely to occur in wetlands and as a result, these areas were avoided.

Potential fossil sites may exist on Harwar 58 IT and Vryheid 59 IT but this can only be verified through a Palaeontological Assessment inclusive of a site visit. It is therefore recommended that a Phase 1 Palaeontological Assessment be conducted for the Harwar Project Area including the farms Harwar 58 IT and Vryheid 59 IT.

Fossils may also exist beneath the surface but their existence beneath the surface can only be verified through monitoring excavations. In this sense, the impact of construction activities such as excavations is positive for palaeontology, provided that efforts are made to monitor and rescue the fossils.

12.3 Flora and Fauna (Biodiversity) Study

The present Flora and Fauna Study is a desktop study of the area with the recommendation that no decision with regards to mining is made without the completion of at least two periods of sampling within the area; two in the growing season (November 2013 and February 2014, as required by the MTPA minimum requirements).

Although additional studies have been recommended in order to place the area in context, it is clear from existing information that the area is of exceptional biodiversity value. It is certain that additional field studies will simply add additional supporting evidence of this.

12.4 Soil, Land Use and Land Capability Study

The following gaps are present in the Soil Assessment:

- The Harwar project area was surveyed during a site visit. The proposed opencast mining areas were surveyed in detail using a 150 m grid where access was allowed. However, access was prohibited on the farm Vryheid and therefore no soil survey data was obtained from this farm. Land use data was extrapolated by using satellite data and visual observations from outside the farm boundary; and
- Presently there is no indication of where the mining infrastructure areas will be located.

12.5 Noise Study

No information on the exact route or specific haul roads to be constructed was available at the time of this assessment; therefore the noise dispersion modelling excludes the construction and operation of the haul roads on site. No information of the location of infrastructure and stockpiles was available during the impact assessment phase of the project and was also excluded from the modelling and subsequent rating of impacts.

With regards to the effect of noise on surrounding fauna, the author's research on the effect of anthropogenic noise on amphibians and avian populations revealed that no conclusive studies were found that expressed the threshold noise level at which population change occurs. Thus due to this uncertainty, a conservative assessment was performed.

12.6 Social Study

At the time of undertaking the field studies for the Social Assessment, access was denied to several directly affected properties. While Msobo Coal is still consulting with these property owners, the Social Assessment report does not include information related to these farm properties.

The Social Assessment team informally consulted some of the affected farm workers during the site visit. However, no farm workers were formally consulted due the lack of access and/or objections from employers with regard to the request to consult their farm workers.

12.7 Wetlands Study

The following knowledge gaps were identified as part of the assessment of wetland areas associated with the proposed Harwar project area:

- Access to some of the directly affected farms was not granted by the property owners. Therefore the wetland areas associated with such farms were not assessed as part of the proposed project; and
- Fieldwork for the wetland assessment was conducted during May 2013 and information collected from the survey was used for the findings of this specialist report. Any changes within the project area that may affect the integrity and

functionality of the delineated wetland post the site investigations have not been identified and therefore the results of such impacts on the wetlands have not been taken into consideration as part of this assessment.

12.8 Groundwater Study

Based on the findings of the preliminary conceptual geohydrological model and impact assessment, the following information and knowledge gaps exist;

- Site specific geology and aquifer thickness, presence of preferential flow paths - to be obtained from percussion and core drilling programmes;
- Aquifer hydraulic parameters to be obtained from aquifer testing programme;
- ABA geochemical assessment;
- Incomplete hydrogeological conceptual model; and
- Incomplete quantification of the identified impacts – analytical modelling.

The outstanding information will be included once all the outstanding investigations have been completed and will address the following aspects:

- Finalisation of the hydrogeological conceptual model;
- Analytical modelling to quantify environmental impacts and radius of impacts;
- Quantification of mining impacts on the groundwater regime and current users;
- Site specific mitigation and management measures; and
- A site specific water monitoring programme.

12.9 Topography and Visual Study

A Visual Impact Assessment is open to subjectivity. This subjectivity is due to the different opinions visual receptors have of a proposed development. A receptor may be partial to the fact that development is occurring in an area, which becomes a source of economic upliftment for a community, whereas another receptor may view a proposed development as a negative factor which could hamper tourism or recreation activities.

Many factors can enhance or reduce the visual impact of the proposed development. Vegetation near a receptor's viewpoint can greatly reduce that receptor's view of the proposed development. Other factors such as weather / climatic conditions and seasonal change can also affect a receptor's view of the proposed development. It is, therefore, difficult to determine the visual impact of the proposed development from the viewpoint of each individual visual receptor.

Lastly, the viewshed analysis only considered the topographical elevation of the project area and surrounds, and not the heights of vegetation or man-made structures which may potentially conceal the proposed development. Furthermore, heights of infrastructure were not available at the time of study, and were therefore estimated based on advice provided by experienced colleagues.

12.10 Air Quality Study

The following assumptions and limitations were identified for the Air Quality Study:

- Adequate ambient air quality monitoring data is not available to evaluate the baseline air quality situation at proposed Harwar project area;
- Use was made of modelled, site-specific meteorological data for the baseline assessment, and
- No emissions inventory or dispersion model was compiled.

12.11 Basic Traffic Study

The assessment of the current traffic conditions was only based on a basic traffic assessment. The expected development trips and the existing traffic was not moddled. The exact nature of upgrades required in order to accommodate the project on the major intersections and road network has not yet been identified.

No Traffic Modelling was conducted, hence no detailed intersection layouts are provided. Alternative haul routes from the project area to the Spitzkop plant should also still be determined.

12.12 Conceptual Rehabilitation Plan

The following assumptions and limitations are applicable to the conceptual Rehabilitation Plan:

- The draft conceptual rehabilitation plan is based on the current information available. Access to some of the farms has been restricted, thus resulting in some of the specialist studies being conducted with knowledge gaps. The conceptual rehabilitation plan is based on information from the farms where access has been granted;
- At the time of the compilation of the plan the detailed mine plan and life of mine plan was not available. The conceptual rehabilitation plan focuses on general principles for rehabilitation and the costs for rehabilitation are for the first year of mine only for opencast area 1 and not for any other infrastructure that may be located on site; and
- The conceptual rehabilitation plan will be updated during the course of the proposed project when additional information is made available.

13 MONITORING AND MANAGEMENT OF ENVIRONMENTAL IMPACTS (REGULATION 50 (H))

The overall accountability for the implementation of this plan lies with Msobo Coal. Various parties will remain responsible for certain activities, however Msobo Coal will remain accountable for ensuring the mitigation measures, monitoring and corrective action contained in the EMP are implemented. The monitoring programmes are discussed below.

13.1 Aquatic Ecosystem Monitoring Programme

13.1.1 Location

The monitoring programme should include sites/locations where biological monitoring has occurred previously. The sites included in the aquatic study will be sufficient to include in future monitoring applications during the high flow season. Refer to Table 16-1 for the monitoring locations with their respective GPS coordinates.

13.1.2 Parameters

The following parameters should be monitored by qualified specialists:

- *In situ* water quality constituents;
- Sediment metal analysis;
- Toxicity testing;
- Habitat integrity;
- Aquatic macroinvertebrates;
- Fish assemblages; and
- Riparian vegetation.

13.1.3 Objectives

The objectives of the programme would be to monitor the state of the aquatic ecosystem through the measurement of physical and biological properties. As of this study the baseline data is established and can be used to compare with in future studies as a means to determine if ecological degradation has occurred.

13.1.4 Key Performance Indicators

Key performance indicators would include the improvement of macroinvertebrate communities associated with the project area.

13.1.5 Responsibility

Environmental Control Officer.

13.1.6 Frequency

Biomonitoring activities should occur bi-annually and where required monthly.

13.1.7 Resources

Aquatic specialist.

13.1.8 Reporting Structure

A biomonitoring report should be provided annually on completion of the two surveys or where required monthly.

13.1.9 Threshold or Limits

If modifications to the system occur, a reduced biological diversity will be observed. Proliferation of pollution tolerant species may also be an indication of a deterioration of ecological integrity. If there is further reduction in species diversity further studies should be undertaken which should include water quality analysis as well as the accumulation of pollutants in the sediments.

13.1.10 Corrective Action

Bi-annual biomonitoring should be undertaken to ascertain any effects caused by the mine. Should there be any deterioration discovered corrective action should be followed. However, if mitigation measures are followed this may be avoided or reduced.

13.2 Soil Monitoring Programme

The soil stripping process should be assessed on a regular basis in order to ensure that the various soil types are stripped to the correct depths and that the different soil horizons are kept separate. Professionals carrying out this assessment should also consider the replacement of materials in the correct locations and the depths to which it is replaced.

Progressive monitoring should take place on at least a quarterly basis and should involve the following:

- Inspection of stripping depths;
- Inspection of stockpiles to check degradation and/or pollution;
- Inspection of spoil surfaces before replacing soil to ensure that pre-mined topography is emulated;
- Random inspection of soil thickness on rehabilitated sections;
- Fertility analysis and amelioration procedures prior to re-vegetation; and
- Evaluating and readjusting the rehabilitation plan.

A final post-mining rehabilitation performance assessment should be done and information should be adequate for closure applications that involve:

- Assessment of rehabilitated soil thickness and soil characteristics by means of auger observations using a detailed grid;
- A post-mining land capability map based on soil thickness and characteristics;
- A proposed post-mining land use map;
- Erosion occurrences;
- Soil acidity and salt pollution analyses (pH, electrical conductivity and sulphate) at 0-250 mm soil depth every 10 ha;
- Fertility analysis (exchangeable cations K, Ca, Mg and Na and phosphorus) every 16 ha (400x400 m); and
- Representative bulk density analysis.

Continuous erosion monitoring of rehabilitated areas should be undertaken and zones with excessive erosion should be identified. Erosion can either be quantified or the occurrence there-of simply recorded for the particular location

13.3 Noise Monitoring Programme

It is recommended that the monitoring plan be implemented to determine potential sources of noise, increases and decreases in noise levels, and determine level of mitigation required. Components to be included in the proposed monitoring plan are discussed in Table 16-1.

13.3.1 Method

Sampling should be done in accordance with the SANS 10103:2008. Noise measurements should be taken for a period not less than 10 min at each location.

13.3.2 Monitoring Location

Monitoring locations will be finalised once the finalised mine plan has been confirmed.

13.3.3 Frequency

Monitoring should be conducted on a quarterly basis throughout the construction phase.

Once it is established that the mitigation measures have decreased the specific noise levels from the mining activities, the noise monitoring should be carried out on a bi-annual basis thereafter throughout the life of mine.

13.3.4 Objective

Noise levels from the proposed mining activities should not measure above the SANS 10103:2008 rating limit for rural areas.

13.3.5 Reporting

A report must be compiled quarterly/ bi-annually, depending on the intervals of the monitoring programme and then submitted to mine management to ascertain compliance with the required standards.

13.4 Heritage Resources Monitoring Programme

It is proposed that the "Chance Finds Procedure, Fossil Finds Procedure and Fossil Monitoring" technique be applied for management of heritage resources. Refer to Appendix F of the HIA for a description of this technique. This should be conducted on the project area.

13.5 Surface Water Monitoring Programme

A monitoring programme is essential as a management tool to detect negative impacts as they arise and to ensure that the necessary mitigation measures are implemented.

A monitoring program is used as an early detection tool for surface water quality and is used to determine when mitigation must be implemented. Monitoring should be implemented throughout the LoM. The impacts on water quality will be determined by benchmarking the monitoring data against the SANS 241: 2011 drinking water standards as well as the baseline water quality.

The variables listed in Table 16-1 should be monitored on an annual basis and a full suite of water quality monitoring variables must be analysed through an ICP_MS in order to determine any rare variables that may be identified.

Where possible the stream flows and channels geometry will be monitored in extreme flood events to determine any impact of the mining on river channels and water quantity in general, in the catchment.

13.6 Groundwater Monitoring Programme

A groundwater monitoring programme can only be established once the outstanding investigations have been completed.

13.7 Air Quality Monitoring Programme

13.7.1 Monitoring Location

Dust monitoring sites have been selected and the sites will be commissioned during June 2013. Refer to Plan 5 indicating the monitoring locations.

13.7.2 Objective

This will be used to appraise the pre-mining air quality for the area.

13.7.3 Method

The standard procedure accepted internationally is adopted by the SANS 1137:2012 "Standard Test Method for Collection and Measurement of Dustfall" (Settleable Particulates Matter). This method uses a passive wet dust collector, which comprises of a vertical pole of approximately 2 m above the ground, a 5 litre bucket with a surface area of 227 cm^2 (Lewis, 1983; Lodge 1988). Each bucket contains 4 litre of distilled water to which was added Copper Sulphate ($CuSO_4$ (25 mg-1 solution)). The presence of $CuSO_4$ in solution prevents algae growth (Krah et al., 2004).

13.7.4 Frequency

Dust monitoring will occur on a monthly basis throughout the LoM.

13.7.5 Reporting

A Dust monitoring report should be provided on a monthly basis.

SECTION 2: ENVIRONMENTAL MANAGEMENT PROGRAMME

14 ENVIRONMENTAL MANAGEMENT PROGRAMME

14.1 Environmental objectives (Regulation 51 (a))

In terms of the Environmental objectives (Regulation 51 (a)), the applicant is required to modify, remedy, control or stop any action, activity or process that could impact negatively on the socio-economic and natural environmental conditions of the region.

14.1.1 Specific goals for mine closure

In compliance with the relevant legislative requirements (Regulation 51 (a), Table 14-1 was compiled to indicate which aspects would need to be managed and which identified impacts will require monitoring programmes. The objective for each required impact and management action has been included to set clear goals for each management and monitoring action. The roles and responsibilities have been assigned to each of the goals and objectives for each impact to ensure the Environmental Management Programme and performance criteria are effectively implemented during each phase of the proposed project.

14.1.2 Specific goals for the management of identified environmental impacts

Refer to Table 14-1 for the specific goals for the management of identified environmental impacts.

14.1.3 Description of environmental objectives and specific goals for the socio-economic conditions as identified in the social and labour plan

It is anticipated that the Harwar Colliery Project area SLP and LED Programme will provide further benefits the local economy by stimulating the growth of small businesses and contributing towards skills development. The objectives of the SLP are to:

- Promote employment and advance the social and economic welfare of all South Africans;
- Contribute to the transformation of the mining industry; and
- Ensure that holders of mining rights contribute towards the socio-economic development of the areas in which they operate.

Progress in meeting the commitments set out in the programmes outlined in the SLP with regards to Human Resource Development (HRD), LED and the Management of Downscaling and Retrenchment.

14.1.3.1 Community Development / CSR Initiatives

Through a consultation process with local authorities and communities, the mine is in the process of developing LED programme to maximise the socio-economic and developmental impact of the proposed project on the surrounding communities, as well as contribute to the greater vision and mission of the MLM as identified in its IDP and SDF Framework.

This programme, combined with the Human Resources Development Programme outlined in the SLP, will have significant positive impacts on surrounding communities, including:

- The establishment and upgrading of services and infrastructure;
- Creating improved economic opportunities through entrepreneurship development; and
- The development of skills supporting employment and economic development.

It is recognised that, unless LED projects are designed to be sustainable beyond the life of the mine, they can also have negative long-term impacts by increasing economic dependency on the mine.

14.1.3.2 Multiplier Effects on Local Economy

The Comparative Economic Study will assess the multiplier effect on the local economy in terms of total value of business sales leveraged by the caopencast areaal investment, as well as through indirect and induced employment creation. It is anticipated that the project's multiplier effect will be significant, while most of these economic benefits will accrue to the construction and manufacturing sectors.

During full production capacity of the project, in addition to people directly employed by the mine, overall production and consumption induced effects will support additional jobs. It is anticipated that this will outweigh the number of agricultural jobs that will be lost through the sterilisation of agricultural land by the project.

It is anticipated that the Harwar SLP and Local Economic Development (LED) Programme will provide further benefits the local economy by stimulating the growth of small businesses and contributing towards skills development.

The measures recommended above to maximise local employment through the project will also serve to maximise the positive impacts of the project on the local economy. In addition, the following measures are recommended to maximise this positive impact:

- Develop a register of local SMMEs, as well as the types of goods and services they provide. This register may be linked to the skills register recommended above.
- Establish linkages with other institutions involved in skills development and SMME development, such as community development programmes of the local municipality and non-governmental organisations (NGOs) active in the broader project area.
- Where SMMEs do not exist locally, investigate the possibility of launching a training/ skills development initiative under the auspices of the skills development programme outlined in the SLP.

14.1.4 Description of environmental objectives and specific goals for historical and cultural aspects

In terms of the specific goals for the heritage and cultural conservation, Msobo Coal's ultimate aim is to promote overall conservation and protection of natural and cultural resources in the proposed Harwar Project Area and its surroundings.

14.2 Management programme (Regulation 51 (b))

14.2.1 Description of the appropriate technical and management options for environmental impacts

Table 14-1 provides a description of the appropriate mitigation and management options for the environmental impacts anticipated during each mining phase (i.e. construction phase, operational phase and decommissioning and closure phase). Mitigation measures have been proposed to minimise the environmental impacts and these are presented in section 7.3 of this report.

Table 14-1: Environmental Management Programme Table

Project Phase Activities	Receiving Environment	Objectives	Management and Mitigation Measures	Frequency	Recommended Action Plans	Duration	Responsible Person
Construction Phase							
Site clearing, construction of surface infrastructure, drilling and blasting for box cut development and storage of hazardous products.	Aquatic Ecology	To minimise the impacts of the water quality and quantity on the aquatic biota	▪ Due to the sensitive nature of the W55A catchment, all stockpiles should be located in the X11B quaternary catchment to avoid contamination in the W55A quaternary catchment; ▪ Although the systems are considered channelled valley bottom wetlands, based on the sensitivity of the system a sufficient buffer from nearest wetland zone should be established to ensure the riparian integrity of the associated river courses remains intact; ▪ Cut-off trenches around stockpiles; ▪ Hazardous materials stored in a bunded area; ▪ Effective storm water management; ▪ Only remove limited vegetation; ▪ Only dirty water should be managed in the storm water management plan; ▪ No clean water should be stored; and ▪ Runoff should be managed to prevent channel straightening.	Pre-mining	A biomonitoring report should be provided annually on completion of the bi-annual bio-monitoring activities.	LoM	Environmental Manager; and Project Engineer.
	Flora and Fauna	To minimise loss of habitat types, biodiversity, ecosystem function and species of special concern.	▪ Mining infrastructure should be moved into an area of lower sensitivity, rather than being built near any grassland or riparian/wetland/pan habitat types, ▪ Minimise the opencast area footprint areas;	Pre-mining	Identification and management of Alien Vegetation	LoM	Environmental Manager; and Project Engineer.

Project Phase Activities	Receiving Environment	Objectives	Management and Mitigation Measures	Frequency	Recommended Action Plans	Duration	Responsible Person
			▪ Keep earth clearing to a minimum; ▪ Rehabilitation of small areas disturbed during construction and not needed for operation should take place; ▪ Alien plants must be identified and removed throughout the construction phase.				
	Soils	To minimise the impacts of soil compaction, topsoil loss and soil erosion.	▪ Site clearance to take place during the dry season (May to October); ▪ Minimise activity within the designated areas of disturbance; ▪ Minimise period of soil surface exposure, ▪ During stockpiling, use the 'end-tipping' method to keep the stockpiled soils loose; ▪ Ensure stockpiles are located on free draining locations to limit waterlogging; ▪ Limit stockpile height (safe height can be regarded as the height at which material can be placed without repeated traffic over already placed material); ▪ Construction vehicles and equipment should be serviced regularly, in a designated paved area; ▪ Construction vehicles should remain on designated gravel roads; ▪ Drip trays must be used when machinery and/or vehicles are serviced; and ▪ Spill containment and clean up kits should be available onsite.	Pre-mining	Soil Management Plan	LoM	Environmental Control Officer (ECO), Mining Contractor and Mine Overseer.
	Noise Receptors	To minimise the impact on the surrounding ambient	▪ Restrict construction activities to daylight hours; ▪ Ensure noise suppression	Pre-mining	Noise Monitoring Plan	LoM	Environmental Manager and Mining Contractor

Project Phase Activities	Receiving Environment	Objectives	Management and Mitigation Measures	Frequency	Recommended Action Plans	Duration	Responsible Person
		noise levels.	mechanisms are installed and effective; ▪ Switch off equipment when not in use; and ▪ Fixed noise producing sources should be housed in enclosures.				
	Wetlands	To minimise the direct and indirect loss of wetland areas, loss of wetland integrity, and loss of wetland functionality.	▪ No construction activities should take place within the 100m buffer zone.	Pre-mining	Wetland rehabilitation and off-set strategy.	LoM	Environmental Manager, Mine Manager and Mining Contractor
	Groundwater	To minimise impacts on groundwater quality and quantity of springs, which could impact on pans.	▪ Drip trays must be used when machinery and/or vehicles are serviced; and ▪ Spill containment and clean up kits should be available onsite	Pre-Mining	Groundwater Monitoring Plan	LoM	ECO
	Topography	To minimise the impacts on the natural topography.	▪ Stockpiles should be contoured appropriately and vegetated where possible; ▪ If possible, stockpiles should not be placed on slopes above drainage lines and pans; ▪ Access and haul roads should be contoured appropriately so that erosion due to surface water runoff is limited; ▪ Only remove overburden when and where necessary; and ▪ Ensure stockpiles are contoured and not too steep.	Pre-mining	N/A	LoM	Environmental Manager, Mine Manager, Mine Overseer and Mining Contractor
	Visual	To minimise the project's visual impact on the surrounding environment.	▪ Dust suppression techniques should be implemented. ▪ Stockpiles should be vegetated and positioned to reduce visual disturbance where possible; ▪ The area of surface infrastructure should be limited where possible; ▪ Surface infrastructure should	Pre-mining	N/A	LoM	ECO, Mine Overseer and Mining Contractor

Project Phase Activities	Receiving Environment	Objectives	Management and Mitigation Measures	Frequency	Recommended Action Plans	Duration	Responsible Person
			be painted with natural hues so as to blend into the surrounding landscape where possible; ▪ Down lighting should be implemented to minimise light pollution at night; and ▪ Construction of vegetation berms should be implemented close to infrastructure so that vegetation can be established.				
	Ambient Air Quality	To minimise fugitive dust, PM_{10} and $PM_{2.5}$ on the ambient air quality.	▪ Removal of topsoil should be limited to non-windy months; ▪ Topsoil stockpiles should be re-vegetated; ▪ Loading heights of material onto trucks should be minimised; ▪ Travel speed of vehicles should be kept to a minimum; and ▪ Dust suppression should take place on roads.	Pre-mining	Air Quality Monitoring Plan	LoM	Rehabilitation Supervisor, Mining Contractor and Mine Overseer.
	Surface Water	To minimise the impacts on the surface water quality and quantity.	▪ Storm water collection channels conveying the runoff to sediment control dams; and ▪ Isolate the pan areas using a constructed concrete slab; and ▪ Dirty area isolated from the catchment must be minimised to reduce the volume of runoff prevented from reporting to the catchment.	Pre-mining	Surface Water Monitoring Plan	LoM	Environmental Manager, Mine Overseer and Mining Contractor.
Operational Phase							
Removal of soil and overburden during new opencast operations, the temporary stockpiling of	Aquatic Ecology	To minimise the impacts of the water quality and quantity on the aquatic biota	Same as during construction phase.	Mining activities	▪ A contribution in the form of a study into the threatened species *Varicorhinus*	LoM	Environmental Manager and Aquatic specialist

Project Phase Activities	Receiving Environment	Objectives	Management and Mitigation Measures	Frequency	Recommended Action Plans	Duration	Responsible Person
these, and the filling of the voids of mined out areas as opencast operations proceed, vehicle movement, and blasting of rock.					*nelspruitensis* with the potential establishment of a reserve for the species; ▪ SASS5 conducted on a quarterly basis; and ▪ Toxicity analysis should occur on a quarterly basis.		
	Flora and Fauna	To minimise loss of habitat types, biodiversity, ecosystem function and species of special concern.	Same as during construction phase.	Mining activities	Identification and management of Alien Vegetation.	LoM	Environmental Manager, Mine Manager and Mining Contractor
	Soils	To minimise the impacts of soil compaction, topsoil loss and soil erosion.	▪ Re-vegetate cleared areas and stockpiles to avoid water erosion losses; ▪ Preserve looseness of stockpiled soil by executing fertilisation and seeding operations by hand; ▪ Drip trays must be used when machinery and/or vehicles are serviced; ▪ Fuel and heavy hydrocarbon products storage on site should be secured by bunded facilities; ▪ Operational vehicles and equipment should be serviced regularly; and ▪ Spill containment and clean up kits should be available onsite.	Mining Activities	Soil Monitoring Plan	LoM	Environmental Manager, Mine Manager, Mine Overseer, Rehabilitation Supervisor and Mining Contractor
	Noise	To minimise the impact on the surrounding ambient noise levels.	▪ Ensure noise suppression mechanisms are installed and effective; ▪ Switch off equipment when not in use; ▪ Fixed noise producing sources should be housed in enclosures; and ▪ Blasting operations should be limited to daylight hours when ambient noise levels	Mining activities	Noise Monitoring Plan	LoM	Mine Overseer and Mining Contractor

Project Phase Activities	Receiving Environment	Objectives	Management and Mitigation Measures	Frequency	Recommended Action Plans	Duration	Responsible Person
			are highest.				
	Wetlands	To minimise the direct and indirect loss of wetland areas, loss of wetland integrity, and loss of wetland functionality.	▪ Mining of hillslope wetland areas as well as the recharge areas that function as recharge areas for the hillslope seeps must be avoided at all costs; and ▪ No mining activities should take place within the 100m buffer zone.	Mining activities	Wetland rehabilitation and off-set strategy.	LoM	Environmental Manager, Mine Manager and Mining Contractor
	Groundwater	To minimise impacts on groundwater quality and quantity of springs that could ultimately impact on pans.	▪ Drip trays must be used when machinery and/or vehicles are serviced; ▪ Spill containment and clean up kits should be available onsite.	Mining activities	Groundwater Monitoring Plan	LoM	Environmental Manager and Mine Overseer
	Topography	To minimise the impacts on the natural topography.	▪ Backfill as much of opencast area area as possible in order to remove the overburden stockpile. This will assist in restoring the topography to a pre-mining state.	Mining activities	N/A	LoM	Mine Overseer, Environmental Manager and Mining Contractor
	Visual	To minimise the project's visual impact on the surrounding environment.	▪ Numerous haul roads should not be created alongside each other; ▪ Vehicles must be roadworthy and obey the recommended speed limits at all times; ▪ Haul roads should be dust supressed frequently; ▪ Coal stockpiles should be positioned to reduce visual disturbance where possible; and ▪ Ensure vegetation screens are maintained.	Mining activities	N/A	LoM	Environmental Manager, Mine Overseer and Mining Contractor
	Ambient Air Quality	To minimise fugitive dust, PM_{10} and $PM_{2.5}$ on the ambient air quality.	▪ Water sprays on the road and dust suppressants on the well-defined truck routes; ▪ Waste management plan should be in place; and ▪ Addressing, inspection and	Mining activities	Air Quality Monitoring Plan	LoM	Environmental manager and Mine Overseer

Project Phase Activities	Receiving Environment	Objectives	Management and Mitigation Measures	Frequency	Recommended Action Plans	Duration	Responsible Person
			updating procedures on storage efficiency, waste-specific management and disposal requirements; ▪ Speed bumps to reduce over speeding.				
	Surface Water	To minimise the impacts on the surface water quality and quantity.	▪ PCDs should be lined too prevent leachate of nitrates and other pyritic material to the soil as they may be acid generating; ▪ Dust suppression should be implemented; ▪ The area where overburden is stockpiled must be compacted to reduce leachate of acid generating material into the soil.	Mining activities	Surface Water Monitoring Plan	LoM	Environmental Manager and Mine Manger
Decommissioning and Post-Closure Phase							
Rehabilitation of disturbed surface areas and disturbed environments, removal of infrastructure and profiling and contouring of rehabilitated areas.	Soils	To minimise the impact on the soil resources during the decommissioning phase and to enhance the fertility and land capability of the land to as close as possible to the pre-mining state.	▪ Land capability and compaction should be assessed on all rehabilitated opencast areas; ▪ Representative soil samples should be collected and analysed for pH and soil fertility annually; ▪ Any problems and or deficiencies should be corrected through ripping, organic matter inputs, liming and or fertilisation by evaluating the soil analytical results; ▪ Re-vegetation should take place using appropriate rehabilitation seed mixes; ▪ Seeding should take place prior to the rainy season to ensure that the vegetation seeds hold and grow; ▪ Post mining land use is dependent on land capability and must be planned for	Post-Mining	Post-closure rehabilitation performance assessment	Annually	Environmental Manager, Rehabilitation Manager and Soil Specialist

Project Phase Activities	Receiving Environment	Objectives	Management and Mitigation Measures	Frequency	Recommended Action Plans	Duration	Responsible Person
			throughout the rehabilitation process; and ▪ The yields (performance) of re-vegetated areas must be assessed and problem areas must be identified and reclaimed immediately.				
	Groundwater	To minimise the impacts of possible AMD formation impacting on surface environments due to possible decant.		LoM	Groundwater Monitoring Plan	N/A	Environmental Manger and Groundwater Specialist
	Topography and Visual Landscape	To minimise the impact on the natural topography of the area and the associated visual landscape and to enhance the neutral impact.	▪ Ensure all unnecessary infrastructure is removed. This will assist in returning the topography to a pre-mining state; ▪ Ensure that the area rehabilitated is contoured to a topography similar to the pre-mining topography; ▪ Re-vegetate disturbed areas with appropriate indigenous vegetation.	Decommissioning activities	N/A	N/A	ECO and Mining Contractor
	Surface Water	To minimise the impact on surface water resources during the decommissioning phase and to enhance the neutral effect of the post closure phase.	▪ Contractors should submit disposal certificates to the mine for record keeping; ▪ All vehicles to be fitted with oil leak trays and oil and silt traps are to be kept in place as residual impacts could occur; ▪ Monitoring the re-vegetation process and contouring of the land so that the runoff from the rehabilitated areas is free draining and can report to the catchment; ▪ The rehabilitation activities must be implemented prior to the onset of the rainy season to ensure that the vegetation seeds hold and grow; ▪ Cumulative impacts have to		Surface Water Monitoring Plan	LoM and Post-Closure	Environmental Manager and Surface Water Specialist

Project Phase Activities	Receiving Environment	Objectives	Management and Mitigation Measures	Frequency	Recommended Action Plans	Duration	Responsible Person
			be monitored through an increased frequency of water quality monitoring.				

14.2.2 Description of the appropriate technical and management options for socio-economic impacts

The description of the appropriate management options for the socio-economic impacts anticipated during the construction phase, operational and closure/decommissioning phase is described below.

Table 14-2: Summary of the appropriate management options for the socio-economic impacts anticipated during the construction phase

Receiving Environment	Potential Impact description	Project Phase	Mitigation and management requirements
Local economy	Job creation	Construction Phase and Operational Phase	■ Maximise and monitor local recruitment; ■ Prevent nepotism/ corruption in local recruitment structures; ■ Promote employment of women and youth; and ■ Train workforce.
	Multiplier effects on local economy	Construction Phase and Operational Phase	■ Development of a register of local SMMEs; ■ Linkages with skills development/ SMME development institutions; and ■ SMME skills development as part of SLP commitments.
	Economic empowerment of previously disenfranchised communities	Construction Phase and Operational Phase	■ Develop capacity of local HDSA; ■ Prevent nepotism/ corruption in local recruitment structures; ■ Promote employment of women and youth; and ■ Use of local labour for maintenance during operation
	Loss of farm/ other labour to the mine	Construction Phase and Operational Phase	■ Minimise recruitment on farms; and ■ Adhere to labour legislation
	Dependency on mine for sustaining local economy	Operational Phase and Decommissioning Phase	■ Effect retrenchments according to procedure stipulated in SLP; and ■ Support economic diversification through development of alternative markets.

Receiving Environment	Potential Impact description	Project Phase	Mitigation and management requirements
Impacts on the physical environment	Improved availability of/ access to services for local population	Construction Phase and Operational Phase	■ Integration with mine and local government plans.
	Safety and security impacts	Construction Phase and Operational Phase	■ Traffic control to prevent speeding; ■ Implementing continuous maintenance programme; ■ Fencing of mine site; ■ Prevention of fires; and ■ Community education.
	Disruption of daily movement patterns	Construction Phase and Operational Phase	■ Recommend that traffic impact assessment is undertaken; and ■ Inform communities of planned construction activities that would affect vehicle/ pedestrian traffic.
Population influx	Increased markets for local entrepreneurs	Construction Phase	■ As for enhancing multiplier effects on the local economy
	Negative impacts related to construction camp	Construction Phase	■ Suitable location for camp, with adequate facilities; ■ Camp must be fenced and access controlled; ■ Fire safety and fire fighting strategy included in the EMP; ■ Rules of construction worker conduct stipulated in EMP; and ■ - Demolition of camp after it is vacated.
	Increased social pathologies	Construction Phase and Operational Phase	■ Maximise & monitor local recruitment; ■ Prevent nepotism/ corruption in local recruitment structures; ■ Promote employment of women and youth; and ■ Use of local labour for maintenance during operation.
	Conflict/ competition	Construction Phase	■ Clearly communicated local recruitment policy; and

Receiving Environment	Potential Impact description	Project Phase	Mitigation and management requirements
	between newcomers and incumbent population		■ Use of community structures to identify local labour pool.
	Increased pressure on local services/ resources	Construction Phase and Operational Phase	Discourage influx of job-seekers by: ■ Prioritising employment of unemployed members of local communities; ■ Enforcing local employment targets for contractors; and ■ Liaise with local municipality to ensure that expected population influx is taken into account in infrastructure development planning.
	Growth of informal settlements	Construction Phase and Operational Phase	■ Establishment of Community Safety Committee; ■ Monitoring growth of informal settlements and speculative building; and ■ Prompt reporting of illegal squatting.
Displacement impacts	Impact on current occupants of the project area	Construction Phase and Operational Phase	■ Adequate compensation to displaced farmers; ■ Meet with land owners and farm managers to discuss the eviction of farmers and the legislative requirements as outlined in ESTA; ■ Liaise with the MLM as they have already begun allocating land and assisting with agricultural livelihoods development for evicted farmworkers; ■ Consider including relocated farm workers who are no longer employed in local skills development and training undertaken as part of SLP commitments; and ■ Interact with the Department

Receiving Environment	Potential Impact description	Project Phase	Mitigation and management requirements
			of Education and other relevant stakeholders on the replacement of affected schools.
	Impact on surrounding farms	Construction Phase and Operational Phase	■ Refer to recommendations from specialist reports.
Community development	Establishment/ upgrading of services	Construction Phase	■ Diligently implement SLP and LED; ■ Coordinate implementation of SLP/LED with municipal plans and community needs; and ■ Liaison with local municipality to determine infrastructure needs once Harwar reaches required profitability.

14.2.3 Description of the appropriate technical and management options for historical and cultural

The description of the appropriate management options for the anticipated impacts on heritage resources during the construction phase, operational and closure/decommissioning phase is described below.

Table 14-3: Summary of the appropriate management options for the historical and cultural impacts anticipated

Receiving Environment	Potential Impact Description	Mitigation and Monitoring
Informal Burial Grounds – within project boundary	Two informal burial grounds S.36 047 and S.36 048 are located in the opencast mine footprint and will be impacted on by the proposed development. No Project-related mitigation measures such as changes to design or mine plan was considered for the burial grounds as they are located within the opencast mine footprint and will be destroyed.	It is recommended that these burial grounds be relocated. A Grave Relocation Plan (GRP) must be drafted and implemented in accordance with Section 36 of the NHRA and NHRA Regulations.
Informal Burial Ground – 400m from opencast area	Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	The graves should be restored where these are dilapidated, protected and conserved in perpetuity. A perimeter fence should be built around the burial ground and placed two meters away from the perimeter of the graves. The perimeter fences should include an entry gate to allow visits from relatives and family friends. The mine should be responsible for the maintenance of these fences. The ECO should be present on site when these fences are being erected around the burial ground.
Built Environment Resources (*Werfs*)	The construction of the opencast will destroy the sites. In addition, any removal of vegetation and ground clearing may expose more extensive deposit potentially existing subsurface.	It is recommended that the *werfs* undergo a Phase 2 Built Environment Assessment by a qualified historical architect to accurately determine the significance value of the resources and provide appropriate mitigation measures. If the site is not 60 years or older then it may not need to be assessed by the impact rating system.

14.3 Environmental Action Plan

As contemplated in Regulation 50 (a), specific action plans need to be implemented to achieve the objectives and specific goals of each specialist study.

14.3.1 Time schedules

As contemplated in Regulation 50 (a) and Regulation 51 (b), specific timeframes for the mitigation and management of environmental impacts need to be provided. As detailed in Table 14-4, there are various mitigation and management measures that need to be implemented during the various project phases.

The LoM is 15 years. Therefore, during the LoM, to mitigate and manage negative impacts, the following timeframes for the implementation of the relevant management actions are summarised below.

Table 14-4: Timeframes for implementation of relevant management actions

Mitigation/ Management Measures	Frequency	Project Phases
Topography and Visual Landscape		
Correct stockpiling of overburden material, contour of stockpiles, etc.	Construction and Operational activities	LoM and Decommissioning Phase
Aquatic Ecology		
The following parameters should be monitored by qualified specialists: ■ *In situ* water quality constituents; ■ Sediment metal analysis; ■ Toxicity testing; ■ Habitat integrity; ■ Aquatic macroinvertebrates; ■ Fish assemblages; and ■ Riparian vegetation.	Biomonitoring activities should occur bi-annually and where required monthly.	LoM
Surface Water		
The impacts on surface water quality will be determined by benchmarking the monitoring data against the SANS 241: 2011 drinking water standards as well as the baseline water quality. The variables listed in Table 16-1 should be monitored. Where possible the stream flows and channels geometry will be monitored in extreme flood events to determine any impact of the mining on river channels and water quantity in general, in the catchment.	Surface Water Monitoring should be conducted on a monthly basis.	LoM
Groundwater		
Monitoring of groundwater quality and quantity.	Construction,	LoM and

Mitigation/ Management Measures	Frequency	Project Phases
	Operational and Decommissioning activities	Decommissioning Phase
Heritage and Archaeological Resources		
The "Chance find procedures, fossil find procedures and fossil monitoring" technique should be applied.	Construction and Operational activities	LoM
Wetlands		
The 100 m and 500 m buffer zones should be applied around the delineated wetland areas.	Construction and Operational activities	LoM
Flora and fauna		
Identification and removal of alien invasive species.	Construction and Operational activities	LoM
Noise		
To prevent the noise emanating from machinery and equipment from impacting on the sensitive receptors.	Construction, Operational and Decommissioning activities	LoM and Decommissioning Phase
Soils		
Correct handling of soils to prevent, erosion, contamination and compaction.	Construction, Operational and Decommissioning activities	LoM and Decommissioning Phase

15 ENVIRONMENTAL EMERGENCY PLAN

The environmental management programme and associated management options are intended to minimise environmental risk as far as possible. Should, however, circumstances lead to unacceptable risks, emergency systems and procedures have been designed and will be implemented in the case of an emergency to prevent or minimise the consequential environmental damage. The environmental emergency contingency plan addresses any reasonably anticipated failure (most probable risk) for the entire mining area and focuses on incidents that could cause environmental emergencies.

The most crucial aspect of the emergency system is the identification and communication of the emergency to the appropriate persons. Consequently, the names of the appropriate contact person together with their contact numbers would be prominently displayed around the facility. The contact details will be updated on a regular basis. First-party employees (such as security, safety superintendents, mine overseers, environmental officers) will be trained to respond to the responsible personnel in the event of an emergency.

The Risk Assessment covers the following risks:

- Fall of Ground;
- Explosions;
- Fires;
- Inundation of workings (water and mud);
- Transport (surface busses);
- Ventilation fan; and
- Labour Unrest.

15.1 Code of Practice (CoP)

The Emergency Preparedness process will be conducted in accordance with the model as indicated in Figure 15–1.

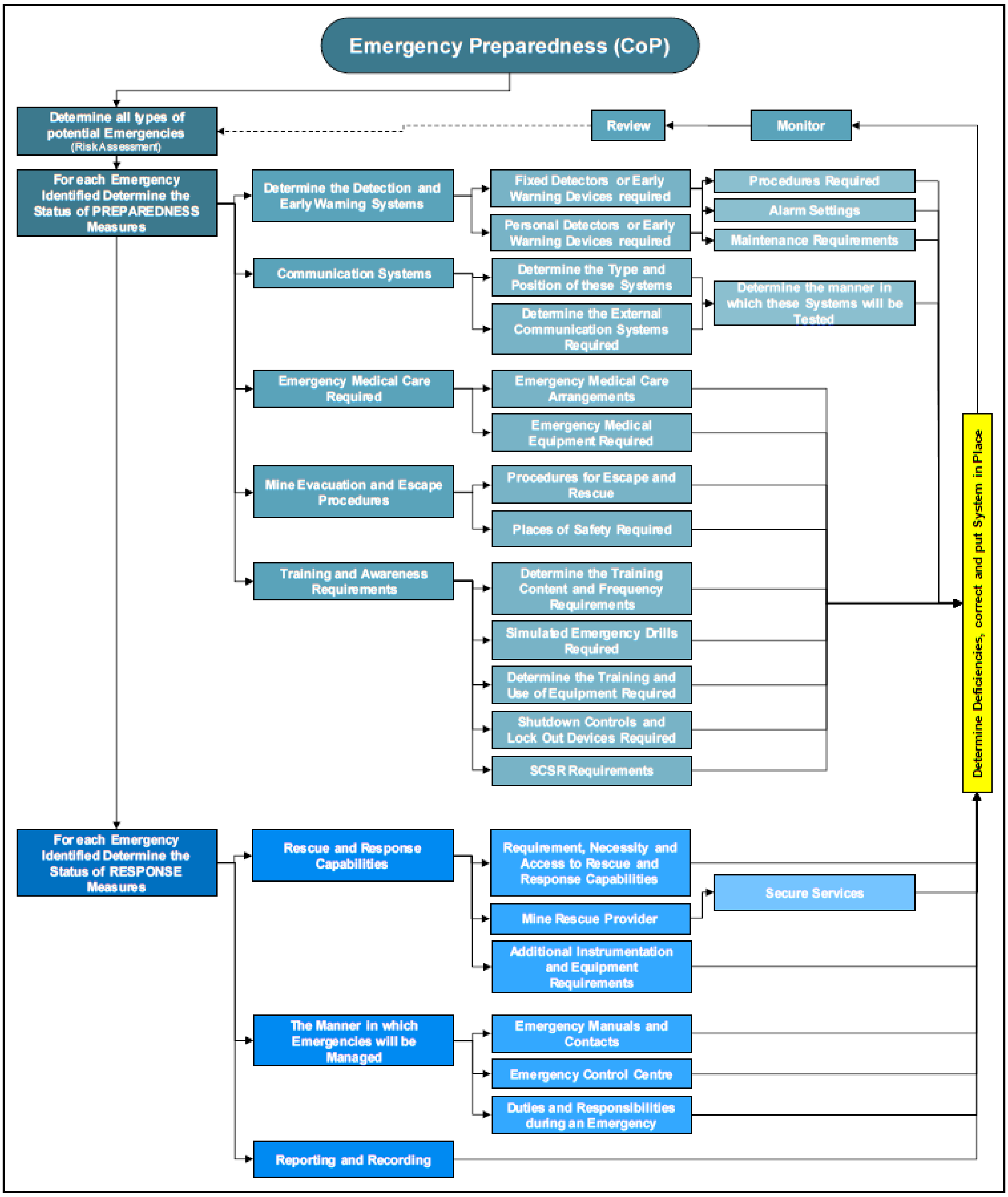

Figure 15–1: Code of Practice procedure

15.2 Emergency Preparedness Measures

15.2.1 Communication System

In order to ensure that appropriate communication systems are available to deal with an emergency, the following measures are put in place.

15.2.1.1 Type and Position of Communication Systems

- Surface Operations
  - Two way radios are installed in all mine vehicles; and
  - Telephones as well as cell phones are situated at designated areas and with supervisors as well as in the underground control room
- Opencast
  - Two way radios situated in all supervisor vehicles; and
  - Telephones as well as cell phones are situated at designated areas and with supervisors.

15.2.1.2 External Communication Systems

- Surface Operations
  - Telephones as well as cell phones are situated at designated areas and with supervisors.
- Opencast
  - Telephones as well as cell phones are situated at designated areas and with supervisors.

15.2.1.3 Communication Systems Testing

Testing will be done on a daily basis.

15.2.2 Training and Awareness

In order to ensure that all potentially affected persons are educated, trained and made aware on how to deal with emergencies, the following is in place:

- All mine employees are trained yearly at the Training Centre, in the appropriate actions to be taken in the event of an Emergency and in the use of Emergency equipment;
- Escape and Emergency Drills are done on a quarterly basis;
- Clipboard Emergency system kept at designated places, i.e. Control Rooms and main office;
- Clip board Emergency System and Appointments;
- On-going training done in the use of SCSR and Osenco sets; and
- Copies held at all HOD’s and are available to employees on request.

16 EMP PERFORMANCE ASSESSMENT

Planned monitoring and environmental management performance assessment

16.1 List of the environmental aspects that will be monitored

Details of the manner in which monitoring on the Harwar Colliery will be conducted have been outlined in each specialist report. Below, provides a description of the monitoring to take place.

Table 16-1: Description of Monitoring Measures

Monitoring	Locations	Standards and/or legislative requirements	Description of the analysis to be conducted and the records to be kept
Aquatics – Biomonitoring conducted by an Aquatic Specialist	The monitoring programme should include sites/locations where biological monitoring has occurred previously. The sites included in this study will be sufficient to include in future monitoring applications during the high flow season. **Monitoring Locations:** **Site ID and GPS Coordinates** HAR1: 30°17'47.31"E - 26°14'59.43"S HAR2: 30°35'32.62"E - 26°16'50.00"S HAR3: 30°35'32.62"E - 26°16'50.00"S HAR4: 30°9'4.01"E - 26°9'56.30"S HAR5: 30°9'0.68"E - 26°9'32.98"S HAR6: 30°7'30.53"E - 26°9'2.50"S HAR7: 30°16'41.26"E - 26°6'54.91"S	■ National Environmental Management Act (Act 107 of 1998), NEMA; ■ Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA); ■ The Environment Conservation Act, 1989 (Act 73 of 1989).	**Parameters:** The following parameters should be monitored by qualified specialists: ■ *In situ* and *Ex situ* water quality constituents; ■ Sediment metal analysis; ■ Toxicity testing; ■ Habitat integrity; ■ Aquatic macroinvertebrates; ■ Fish assemblages; and ■ Riparian vegetation. **Frequency:** Biomonitoring activities should occur bi-annually or where required monthly/quarterly. **Reporting:** A biomonitoring report should be provided annually on completion of the two surveys.
Soil	Project Area	■ National Environmental Management Act (Act 107 of 1998), NEMA; ■ Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA); ■ The Environment Conservation Act, 1989 (Act 73 of 1989).	**Progressive Monitoring:** ■ Erosion assessments should be carried out to visually assess new erosion channels. **Frequency:** After rain events. **Progressive Monitoring of Soil stripping, stockpiling, shaping spoil surfaces and replacing of topsoil:** ■ Inspection of stripping depths; ■ Inspection of stockpiles to check degradation and/or pollution; ■ Inspection of spoil surfaces before replacing soil to ensure that pre-mined topography is emulated; ■ Random inspection of soil thickness on rehabilitated sections; ■ Fertility analysis and amelioration procedures prior to re-vegetation; and ■ Evaluating and readjusting the rehabilitation plan. **Frequency:** Quarterly Basis **Reporting** Final post-mining rehabilitation performace assessment after mine closure.

Monitoring	Locations	Standards and/or legislative requirements	Description of the analysis to be conducted and the records to be kept
Heritage Resources	Project Area	■ National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA) ■ The South African Heritage Resources Authority (SAHRA) ■ Association of Southern African Professional Archaeologists (ASAPA) Constitution and Code of Ethics. ■ International Best Practise and Guidelines ■ ICOMOS Guidance on Heritage Impact Assessments for Cultural World Heritage Properties (2010)	The "Chance Finds Procedure, Fossil Finds Procedure and Fossil Monitoring" technique should be applied (refer to Appendix F of the HIA).
Noise	Monitoring locations will be finalised once the final mine plan has been confirmed.	■ Noise levels from the proposed mining activities should not measure above the SANS 10103:2008 rating limit for rural areas.	**Frequency:** Noise measurement should be taken for a period not less than 10 minutes at each location. **Reporting:** A report must be compiled quarterly / bi-annually, depending on the intervals of the monitoring programme then submitted to management to ascertain compliance with the required standards

Monitoring	Locations	Standards and/or legislative requirements	Description of the analysis to be conducted and the records to be kept
Surface Water – Surface water quality and stream flow	The surface water sampling GPS points are listed below. Plan 10 depicts the locations of the surface water sampling points. **Monitoring Locations:** **Site ID and GPS Coordinates** **Site: Ycoord Xcoord** HSW01: -26.2008 - 30.1975 HSW02: -26.2255 - 30.1724 HSW03: -26.1672 - 30.1559 HSW04: -26.1403 - 30.2333 HSW05: -26.1645 - 30.2332 HSW06: -26.1412 - 30.2103 HSW07: -26.1569 - 30.2049 HSW08: -26.1527 - 30.1955 HSW09: -26.1555 - 30.2424 HSW10: -26.1637 - 30.2488 HSW11: -26.1713 - 30.218 HSW12: -26.174 - 30.2304 HSW13: -26.1861 - 30.156 HSW14: -26.2462 - 30.1973 HSW15: -26.1661 - 30.1512 HSW16: -26.2471 - 30.1636 HSW17: -26.2254 - 30.1831 HMF: -26.2152 - 30.1748 HSWS01: -26.1996 - 30.1893 HSWS02: -26.2073 - 30.1769	■ Republic of South Africa. (1998). Regulation GN 704 published in terms of the National Water Act of 1998. (Act no 36 of 1998). Pretoria. ■ Department of Water Affairs South African Water Quality Guidelines for Domestic Use Target Values (DWA SAWQTV) ■ South Africa National Standard (SANS 241-1:2011) drinking water standard in order to evaluate the groundwater quality.	Monitoring should be implemented throughout the LoM. The impacts on water quality will be determined by benchmarking the monitoring data against the SANS 241: 2011 drinking water standards as well as the baseline water quality. The variables listed below should be monitored: ■ Total Dissolved Solids (TDS); ■ Sulphate as SO_4; ■ Sodium as Na; ■ Magnesium as Mg; ■ Nitrate NO_3 as N; ■ Fluoride as F; ■ Calcium as Ca; ■ Free and Saline Ammonia as N; ■ Potassium as K; ■ Chlorides as Cl; ■ Iron as Fe; ■ Manganese as Mn; ■ Electrical Conductivity (EC); ■ Total Alkalinity as $CaCO_3$ ■ pH-Value at 25° C; and ■ Aluminium as Al. These variables should be monitored on an annual basis. A full suite of water quality monitoring variables must be analysed through an ICP_MS in order to determine any rare variables that may be identified. Where possible the stream flows and channels geometry will be monitored in extreme flood events to determine any impact of the mining on river channels and water quantity in general, in the catchment.
Groundwater – Quality and quantity and possible AMD formation	The groundwater sampling points will be known once percussion drilling is complete and monitoring boreholeas are established.		Site Specific groundwater monitoring programme to identify possible impacts on groundwater quality and quantity as well as the possible formation of AMD.
Air Quality	Refer to Plan 5 indicating the monitoring locations.	National Dust Regulations.	Monthly Dust Monitoring report for the LoM.

16.2 Performance Assessment Process

Reviews of the project's performance and Environmental Audits are necessary during all mining phases to ensure that procedures are appropriate and to ensure the desired environmental outcomes are being achieved. It is recommended that regular internal and external Environmental Audits be conducted to assess the performance of the EMP. An internal or independent competent person needs to be employed. The competent person will be responsible for evaluating if the EMP is effective and relevant, and provide recommendations for improvement. Internal audits needs to be undertaken by the ECO be on an annual basis (at least once a year).

Specific requirements for environmental management relative to specific areas of construction and subsequent operation will be detailed in the respective contracts of sub-contractors (which will be defined during the pre-construction and construction phase). Continual evaluation measures must be implemented to ensure that performances with regard to social, health and well-being of the environment are improved and environmental management is effectively implemented throughout the lifespan of the development. The table below gives a summary of the Performance Assessment Process.

Table 16-2: Performance Assessment Process

Internal EMP audits / performance assessments	Internal: Annually (at least once a year)	LoM, all phases
External EMP audits / performance assessments	External: Annually (every 2 years)	

17 FINANCIAL PROVISION

South Africa's legislation unambiguously places the responsibility of mitigating environmental damage as a result of mining operations on mining companies. The liability exists throughout the life of the mine, and beyond in terms of residual impacts. It includes commitments for remediation and/or rehabilitation.

The key legislation governing the requirements for legislation for rehabilitation is contained in the following acts:

- The Constitution of the Republic of South Africa (Act 108 of 1996) ("The Constitution");
- The National Environmental Management Act (Act 107 of 1998, NEMA);
- The Mineral and Petroleum Resources Development Act (Act 28 of 2002, MPRDA); and
- The National Water Act (Act of 1998, NWA).

17.1 Decommissioning and closure map

The overall rehabilitation objectives for the proposed project are as follows:

- Maintain and minimise impacts to the functioning wetlands and waterbodies within the study area;
- Implement progressive rehabilitation measures;
- Re-establishment of the pre-mining land use;
- Prevent soil, surface water and groundwater contamination;
- Comply with relevant local and national regulatory requirements; and
- Maintain and monitor the rehabilitated areas.

Currently no Decommissioning and Closure map can be provided although a rehabilitation plan to rehabilitate the negative environmental impacts associated with the mining activities is provided. The conceptual Rehabilitation Plan is attached to this report as Appendix N.

Section 8 of the conceptual Rehabilitation Plan provides a description of the management and rehabilitation of the area to be affected by the proposed mining activities. The conceptual Rehabilitation Plan focuses on the following:

- Land Preperation;
- Soil Management Plan and Amelioration;
- Infrastructure and Opencast Management;
- Vegetation and Fertiliser Management Plan;
- Weed Control and Alian Invasive Control Plan;

- Monitoring and Maintenance of receiving environment;
- Acid Mine Drainage (AMD); and
- Wetland Rehabilitation.

17.2 Standard guideline document (Regulation 54(1) 2)

The financial provision has been based on the Guideline Document for the Evaluation of the Quantum of Closure-Related Financial Provision Provided by a Mine compiled by the then Department of Minerals and Energy (DME), now the Department of Mineral Resources (DMR).

17.2.1 Assumptions

The following assumptions were formulated in order to calculate the financial provision:

- The provision has been calculated for first year of rehabilitation in the event of the construction and operation of the mine. The costs for rehabilitation should be updated annually as the rates change annually;
- Opencast area 1 has been assumed to be the opencast area that will be mined during the first year of mining;
- The costs included in this report only address the costs to rehabilitate Opencast area 1 and its associated overburden dumps. No infrastructure information was available at the time this report was compiled, hence no costs were included to demolish and rehabilitate infrastructure;
- The calculation of the rehabilitation costs has been based on the DMR and its associated Quantum of Closure-Related Financial Provision;
- The rehabilitation cost is a high-level cost since there was limited information;
- A cost has been allocated to rehabilitated and vegetate the whole Opencast area 1 area after mining (i.e. 38ha) and the overburden dumps (coal, hards and topsoil);
- Costs associated with topsoil have been estimated at replacement and spread 300 mm thick (for areas that have a high agriculture potential the replacement of topsoil in these areas need to be deeper than 300 mm thick);
- The assessment did not include any costs associated with water treatment due to decants post-closure;
- The cost provided for the rehabilitation excludes costs associated with the clean-up of soil that has become contaminated; and
- The cost estimate is a provisional estimated based on the opencast areas and waste rock dumps information that has been provided. Once the detailed infrastructure layout design has been complete the rehabilitation costs can be updated accordingly.

17.2.2 Financial Provision

The financial provision required for the first year of operation using the DMR costing spreadsheet is **R 15 082 825.00** (Table 17-1). The monitoring and maintenance post rehabilitation should be undertaken for three years.

Table 17-1: Financial Provisions for the Harwar Operation

CALCULATION OF THE QUANTAM		
	Msobo - Closure Costs Assessment	Mpumalanga
	Digby Wells Environmental	03-Jun-13
		E=A*B*C*D
	Description:	**Amount**
	Class C (Low Risk)	**(Rands)**
Component		
1	Dismantling of processing plant & related structures (incl. overland conveyors & Power lines)	R 0
2 (A)	Demolition of steel buildings & Structures	R 0
2 (B)	Demolition of reinforced concrete buildings & structures	R 0
3	Rehabilitation of access roads	R 0
4(A)	Demolition & rehabilitation of electrified railway lines	R 0
4(B)	Demolition & rehabilitation of non electrified railway lines	R 0
5	Demolition of housing &/or administration facilities	R 0
6	Opencast rehabilitation including final voids & ramps	R 6 754 316
7	Sealing of shafts, adits & inclines	R 0
8(A)	Rehabilitation of overburden & spoils	R 1 302 726
8(B)	Rehabilitation of processing waste deposits & evaporation ponds (basic, salt producing waste)	R 0
8(C)	Rehabilitation of processing waste deposits & evaporation ponds (acidic, metal-rich waste)	R 0
9	Rehabilitation of subsidised areas	R 0
10	General surface rehabilitation	R 0
11	River diversions	R 0
12	Fencing	R 0
13	Water management	R 1 748 676
14	2 to 3 years of maintenance & aftercare	R 612 037

CALCULATION OF THE QUANTAM		
	Msobo - Closure Costs Assessment	Mpumalanga
	Digby Wells Environmental	03-Jun-13
		E=A*B*C*D
	Description:	**Amount**
	Class C (Low Risk)	**(Rands)**
Component		
	Specialist study	R 0
	Specialist study	R 0
	Sub Total 1	
	(Sum of items 1 to 15 Above)	**R 10 417 754**
	Weighting Factor 2 (step 4.4)	**R 10 938 642.16**
	Preliminary and General	**R 1 250 130.53**
	Contingency	**R 1 041 775.44**
		R 13 230 548
	VAT (14%)	**R 1 852 276.74**
	GRAND TOTAL	**R 15 082 824.88**

The financial provision of **R 15 082 824.88** as calculated above using the DMR costing spreadsheet will be provided in the form of a bank guarantee should the Mining Right be granted. Msobo Coal is however recommended to consider the amount calculated using the Digby Wells method.

The closure cost calculated using the Digby Wells method, which incorporates actual contractor costs for rehabilitation, is described in section 17.3 below.

17.3 Capacity to manage and rehabilitate (Section 39 (4))

Section 39 (4) (a) (iii) of the Act, read together with section 37 (2) of the Act, requires that the applicant will have the capacity, or have provided for the capacity, to rehabilitate and manage negative impacts on the environment.

The following recommendations are applicable to the management and rehabilitation of the negative impacts on the environment:

- Digby Wells recommends that once the final infrastructure designs can be provided or when the first year of mining has taken place that a detailed financial provision calculation is completed. In addition it is recommended that the financial provision be annually updated as per the requirements of the MPRDA;

- Digby Wells has developed its own standard methodology for calculating financial provisions. The method used by Digby Wells uses actual contractor rates sources from various contractors in the industry. This makes Digby Wells costing methodology provide a factual reflection of a mine's environmental liability. Digby Wells recommends Msobo Coal to consider its methodology for considering financial provisions, unlike the generic DMR method. Based on Digby Wells methodology, Msobo Coal has to provide **R 25 561 410.48.** This costing was based on the following assumptions:
  - Rehabilitation costs were based on the assumption that concurrent rehabilitation will occur and only 30% of the material (topsoil, softs and hards) removed from the opencast area will need to be load and hauled from the proposed dumps to backfill 30% of the opencast area, whilst the rest (70%) of the overburden and opencast area areas will be concurrently rehabilitated during mining;
  - The softs and hards will be used for backfilling the opencast area and only the footprints will be left. These (footprint areas occupied by the coal, softs and hards) will be ripped and vegetated;
  - A dozing rate (dozing of 50 m or less) was used in order to calculate the costing for closure and rehabilitation;
  - A cost has been allocated for vegetation monitoring and maintenance; and
  - A 12% and 10% of the total liability has been allowed for project management and contingencies.
- Ensure that all water users have been identified and that the applicable authorisations are obtained in terms of the NWA (obtain WUL before construction or operation of the mine is undertaken), NEMA and NEMWA;
- Opencast area and final void
  - Long term management of the rehabilitated opencast area will be required via contractual agreements with land owners in the area;
  - Rehabilitation specifications and goals will need to be set for wetland rehabilitation as well as arable land rehabilitation;
  - Rehabilitation should also be undertaken to best practise;
- Regular audits should be undertaken to monitor the progress of areas that have been rehabilitated;
- Regular audits should be undertaken by a soil scientist during the soil stripping process. This will guarantee that soil are stripped and stockpiled correctly;
- A wetland geomorphologist will conduct an audit post construction of erosion control structures to determine if the any further work needs to be undertaken;
- Material balance is undertaken and updated on a monthly basis;

- Undertake geochemical testing (currently being undertaken) to determine the potential for the formation for AMD;
- Bulking factors need to be confirmed in practice for the materials on site and this information needs to be included in the materials balance;
- Surface water monitoring of the pans and associated wetlands surrounding the project area is to be undertaken to determine the impacts associated with operations of the proposed mine; and
- Development and implementation of a Wetlands Offsetting strategy – It is recommended that Msobo Coal commits to the finalisation of this strategy and once approved by the DWA, this plan be implemented.

18 ENVIRONMENTAL AWARENESS PLAN (SECTION 39 (3) (C))

18.1 Description of awareness plan

The purpose of an Environmental Awareness Plan is to outline the methodology that will be used to inform the mine's employees of any environmental risks which may result from their work and the manner in which the risks must be dealt with in order to avoid contamination or the degradation of the environment. The awareness plan is primarily a tool to introduce and describe the requirements of the range of environmental and social plans to the Msobo Coal construction and operational personnel.

18.2 Objectives

In accordance with the requirements of Section 39(3)(c) of the MPRDA, 2002 (Act 28 of 2002), the objectives of the Environmental Awareness Plan are to:

- Promote internal awareness of environmental and social issues with all mine personnel and third party contractors;
- Train personnel on the requirements of the environmental and social management plans in order to actively improve environmental performance of the mine; and
- Instil in all employees, an understanding of the potential consequences of not following the requirements of the social, health and environmental management plans.

In general, the purpose of implementing an Environmental Awareness Plan is to optimise the awareness of those partaking in the mining and related activities which have the potential to impact negatively on the environment (e.g. spillages form dirty water dams), and in doing so, promote the global goal of sustainable development.

18.2.1 Environmental Training Programme

Msobo Coal will provide its employees and contractors with the necessary tools and training to ensure the effective implementation and maintenance of the Sustainable Development Management System. Training at all levels of the company forms the core of any management system. Employees should understand the components of the management system and the implementation thereof as well as their responsibility regarding the management of sustainable development. Sustainable Development awareness training will form part of the induction at the Training Centre and includes the following (Jones and Wagener, 2009):

- Msobo plc SD policy;
- Relevant legislation and other requirements;
- Xstrata Sustainable Development framework management system;
- Responsibilities;

- Any corporate management plans and procedures; and
- Other topics as required.

18.2.2 Environmental Awareness Campaign

18.2.2.1 Communication Strategy

Environmental awareness will be included as part of the mine's internal communication strategy. The promotion of environmental awareness amongst all levels of staff will be achieved by the following means;

- Including contributions on the environmental management activities of the operation in the internal newsletter;
- Producing "Environmental Talk Topics" which will be posted on notice boards throughout the organisation on a monthly basis. These will address topics such as pollution prevention, resource conservation, waste management and spill clean-up and will be made appropriate to the working and home environments of employees;
- Posting the environmental Policy of the organisation on notice boards throughout the organisation and discussing implications of the policy during appropriate meetings;
- Including environmental management as a standing agenda item in all safety and production meetings. Topics for discussion during such meetings should include current Environmental Talk Topics, recent environmental incidents and environmental action plans of interest. Discussions of applicable legislation and changes to the legislations, where this affects the operation's activities may also be discussed at such meetings; and
- A community forum that meets on a bi-monthly basis has also formed to continuously inform the stakeholders of the new developments and also to deal with issues and when they arise.

18.2.2.2 Management Sector

The communication of environmental risks to the management and administrative sectors will occur through a one day workshop. This workshop will seek to explain the following necessary actions:

- Firstly each aspect and their significance will be described. Risks associated with each aspect will be discussed to ensure that an understanding of how each action of the project may impact on the environment;
- The mitigation of the environmental risk will be elaborated on. It is important that each person understands these management strategies as it ensures that the impact on the environment is kept to a minimum. Data collection regarding each aspect will also be explained to ensure that each aspect is monitored according to those protocols specified by the mine and the DMR. Along with data collection the reporting of the findings will be discussed; and

- This workshop will take place before the construction phase begins thus ensuring a full understanding of the project and its associated environmental risks before any mining begins. The course will be repeated at the beginning of the operational phase and the material will be integrated in the induction of new personnel.

18.2.2.3 Mine Worker's Sector

The mine worker's sector will attend a full day induction to ensure that each person is aware of the environmental risks associated with the project. This induction will form part of the health and safety induction, if timing allows.

This induction course will explain and describe the relevant phases of the project as well as those environmental risks that may occur during these phases. The environmental risks of each aspect as well as the mitigation will be elaborated on.

As a method of gaining an understanding of the relevant risks, a play or industrial theatre will be performed to explain lay issues and the employees will be encouraged to rehearse and act out a play of their own. These workshops will be conducted in English as well as one of the local languages and translators will be provided where necessary. The course will take place prior to mining commencing, thus ensuring an understanding of the mine workings and risks.

18.2.2.4 Evaluation of the Environmental Awareness Plan

The evaluation of the Environmental Awareness Plan (EAP) will be conducted by either the management or qualified sub-contractors chosen by the mine. This evaluation will entail the auditing of the operation in both the construction and operational phases once the activity has commenced.

The EAP described above, will make all those involved with the project aware of the risks that may occur as well as the necessary mitigation required to minimise these risks. This awareness plan displays that Msobo Coal is serious about the environment's well-being, empowerment of the local people and returning the land to the appropriate use in the future.

Environmental issues will be highlighted at regular meetings scheduled at the mine.

19 CONCLUSION

This EIA/EMPR report was compiled in support of a MRA for the proposed Harwar Colliery (DMR ref. number *MP 30/5/1/1/2/10061 MR*). The aim of the EIA process is to provide adequate information to the decision makers in order to make informed decisions about the way forward regarding the proposed opencast mining activities. The LoM for the mining of the B and C coal seams is estimated at 15 years.

In general the area characterised by agricultural activities including cropping and livestock farming. The arable areas are typically found on the high lying areas with grazing practices mainly taking place on the remaining areas where lower potential soils are found such as the low lying areas and wetland areas. Tourism activities are also predominant within the larger Chrissiesmeer area, with the St. Louis Private Nature Reserve located to the north west of the project area. Sensitive areas include Tevrede se pan, other pans, grasslands and rocky ridges.

Confirmation of the Sasol Gas pipeline, possibly traversing the most northern part of the proposed project area towards the R33 will also be confirmed and included in the final EIA/EMPR report for submission.

Several knowledge gaps were identified and recommendations have been made to rectify this. Upon submission of the Final EIA/EMPR, it is anticipated that the outstanding knowledge gaps will be the high flow survey for the aquatic ecology study, the wet season fauna and flora site identification survey as well as the hydrogeological model and the geochemical test work to determine the AMD potential of the parent material. The gaps identified needs to be completed before the full impacts can be understood.

Site access restrictions to certain farm portions within the study area contributed to the knowledge gaps, as this restricted field investigations to only certain portions of the project area. The mine plan indicating the exact location of the opencast areas has not been finalised and hence no infrastructure plan is available as it is through this EIA/EMPR report and associated specialist studies from which the locations of the opencast areas can be determined.

The impact assessment identified significant negative environmental impacts and social risks on the receiving environment. The most significant environmental and social impacts are:

- Degradation of water quality on aquatic biota within the Mpuluzi River as the water quality within this catchment is still of good quality and the expected presence of a near threatened species;
- Loss of flora and fauna habitat types, biodiversity and ecosystem function in terms of the remaining grasslands on the proposed project area and the area being classified as an Important Bird Area (IBA);
- Reduced agricultural potential and land capability on current land use practices due to disturbance of soil;

- Sedimentation of surface water resources and reducing surface water quality, specifically at Tevrede se Pan;
- Surface water quality impacts after mine closure due to possible decant of Acid Mine Drainage (AMD);
- Direct and indirect loss of hillslope seepage wetland habitats, loss of wetland integrity, and loss of wetland functionality;
- Ambient air quality impacts during the construction and operational phase as a result of increased dust emissions; and
- Groundwater quantity impacts due to dewatering;
- Groundwater quality impacts due to possible AMD formation during the mine closure phase;
- Safety Impacts;
- Increase social pathologies;
- Increased pressure on local services/resources during construction and operational phase;
- Displacement during construction and operational phase;
- Impacts on tourism activities in the area;
- Loss of agricultural and tourism job opportunities; and
- Transport routes to be used by the mine.

The positive impacts expected on the socio-economic environment relate to possible job creation for locals and local skills development. Existing workforce from Msobo Coal's other operations in the area, Spitzkop and Tselentis Collieries, will be employed at the proposed Harwar Colliery. However, employment opportunities for locals will also be created.

Based on the impacts on the environment, both natural and socio-economic, mitigation measures and monitoring programs have been compiled in order to assist Msobo Coal in minimising and avoiding negative impacts and maximising the benefits of the proposed development.

Final rehabilitation of the area during the decommissioning and post-closure phase is critical in restoring the natural environment as close as possible to pre-mining conditions. To achieve this, concurrent rehabilitation efforts during the operational phase should be conducted according to the rehabilitation plan and appropriate soil handling management measures should be implemented. The current rehabilitation plan is however only a conceptual plan based on the current information available.

The preliminary recommendation based on current knowledge is that no mining should take place within the catchment of the Tevrede se Pan, as this pan system is not entirely understood and is a unique feature in the local and regional landscape.

The remaining mining opencast areas within the project area cover a combination of wetland, grassland and agricultural fields. The baseline condition of these areas will only be fully understood upon completion of the two wet season surveys, a per the MTPA minimum requirements, which will be done in November 2013 and February 2014. It is recommended by the fauna and flora specialist that a decision on the remainder of the mining plan only be taken once these studies have been completed. The hydrogeological model, geochemical assessment and a high flow survey also needs to be completed before the full impacts can be understood and to ensure proper mitigation and management measures for these impacts.

It must be stressed that access to the following properties were not granted and is required for the additional specialist studies:

- Portion 3 of the farm Fairview 62 IT (Mr. Johan Aubrey De Jager);
- Portion 3 of the farm Florence 78 IT (Baltimore Familie Trust - Mr. Chris Nel);
- Remaining Extent of the farm Harwar 58 IT (Johan Botha Trust – Mr. Hannes Botha)
- Portion 1 of the farm Harwar 58 IT (Fanie Nel Testamentary Trust – Mr. Chris Nel);
- Remaining Extent of the farm Leliefontein 79 IT (Mr. Jacobus Stephanus Nel);
- Portion 6 of the farm Leliefontein 79 IT (Mr. Hannes Botha);
- Portion 4 of the farm Lusthof 60 IT (Johan Botha Trust – Mr. Hannes Botha);
- Portion 6 of the farm Lusthof 60 IT (Hannes Botha Trust – Mr. Hannes Botha);
- Portion 8 of the farm Tevreden 56 IT (Johan Botha Trust – Mr. Hannes Botha);
- Remaining Extent of the farm Vryheid 59 IT (Mr. Hannes Botha);
- Remaining Extent of Haarlem 39 IT (Worldwide Coal Carolina (Pty) Ltd.); and
- Portion 5 of Iona 77 IT (Mr. Koos Davel).

All efforts will be made with the relevant land owners to gain access to these properties in order to complete the additional studies.

Bridging the current knowledge gaps and having access to all properties concerned for proper field investigations would enable the decision making authority to make a more informed decision on the proposed project.

20 UNDERTAKING

The Environmental Management Programme will, should it comply with the provisions of section 39 (4) (a) of the Act and the right be granted, be approved and become an obligation in terms of the right issued. As part of the proposed Environmental Management Programme, the applicant is required to provide an undertaking that it will be executed as approved and that the provisions of the Act and regulations thereto will be complied with.

UNDERTAKING BY APPLICANT TO COMPLY WITH THE PROVISIONS OF THE ACT AND THE REGULATIONS THERETO AND THE COMMITMENTS WITHIN THE EMP

I, ……., the undersigned and duly authorised thereto by……………………………………………… have studied and understand the contents of this document in its entirety and hereby duly undertake to adhere to the conditions as set out therein.

Signed at………………………on this………………day of………………………………

……………………………………   ………………………………

Signature of applicant   Designation

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Appendix A: Plans

Appendix B: Air Quality Assessment Report

Appendix C: Topography and Visual Assessment Report

Appendix D: Soil Assessment Report

Appendix E: Flora and Fauna Assessment Report

Appendix F: Aquatic Ecology Assessment Report

Appendix G: Surface Water Assessment Report

Appendix H: Noise Assessment Report

Appendix I: Heritage Assessment Report

Appendix J: Social Assessment Report

Appendix K: Wetland Assessment Report

Appendix L: Interim Hydrogeological Assessment Report

Appendix M: Traffic Assessment Report

Appendix N: Conceptual Rehabilitation Plan

Appendix O: Public Participation Report