case10: 1504

mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

Private Bag X6093,
Kimberley,
8300,
Tel: (053) 807 1700,
Fax: (053) 8325 631

29-31 Currey Street,
Kimberley
8301

Directorate Mineral Regulation: Northern Cape.
**Enquiries:** Mr.L.S Malatjie **E-Mail:** livhuwani.malatjie@dmr.gov.za
**Sub Directorate:** Mine Environmental Management **Ref:** NC30/5/1/2/3/2/1/ 271EM

**Date:** 06th January 2011

The Director
South African Heritage Resources Agency
PO Box 4637
CAPE TOWN
8000

Attention: Nonofho Ndobochani

**CONSULTATION IN TERMS OF SECTION 40 OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT 2002, (ACT 28 OF 2002) IN RESPECT OF MANGANESE ORE AND IRON ORE ON PORTION 1 OF FARM MARCATHY NO.559, SITUATED IN THE MANAGESTERIAL DISTRICT OF KURUMAN, NORTHERN CAPE REGION.**

**APPLICANT: DVD QUALITY ENGINEERING (PTY) LTD**

Attached herewith, please find a copy of the **Environmental Management Programme** received from the above-mentioned applicant, for your comments.

It would be appreciated if you could forward any comments or requirements your Department may have to this office and to the applicant before **04th March 2011** as required by the Act.

Consultation in this regard has also been initiated with other relevant State Departments. In an attempt to expedite the consultation process please contact **Mr Livhuwani Malatjie** of this office to make arrangements for a site inspection or for any other enquiries with regard to this application.

Your co-operation will be appreciated.

pp .....
**REGIONAL MANAGER: MINERAL REGULATION**
**NORTHERN CAPE REGION**

SA HERITAGE RESOURCES AGENCY
RECEIVED
21 FEB 2011

Duncan & Rothman
ATTORNEYS, NOTARIES AND CONVEYANCERS

DUNCAN & ROTHMAN BUILDING
39–43 CHAPEL STREET
KIMBERLEY – 8301
SOUTH-AFRICA

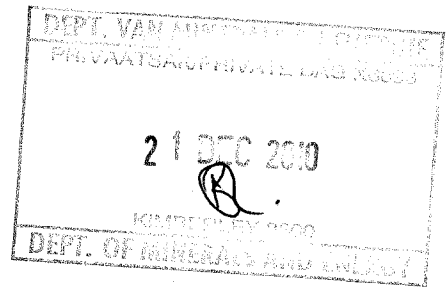
P.O. BOX 64, KIMBERLEY, 8300
DOCEX: 5, KIMBERLEY
E-MAIL: pam@duncan-rothman.co.za
TELEPHONE: (053) 8384700
DIRECT LINE: (053) 8384713
FAX: (053) 8312856
DIRECT FAX: 086 618 9747

Our Ref: MR POTGIETER/pf/ DBD1/0001 Your Ref:

21 December 2010

**BY HAND**

Regional Manager
Northern Cape Region
Department of Mineral Resources
29-31 Currey Street
KIMBERLEY
8301




Dear Sir

**RE: MINING RIGHT APPLICATION: DVD QUALITY ENGINEERING (PTY) LTD**

The reference number of the Department is NC30/5/1/2/3/2/1/271MR.

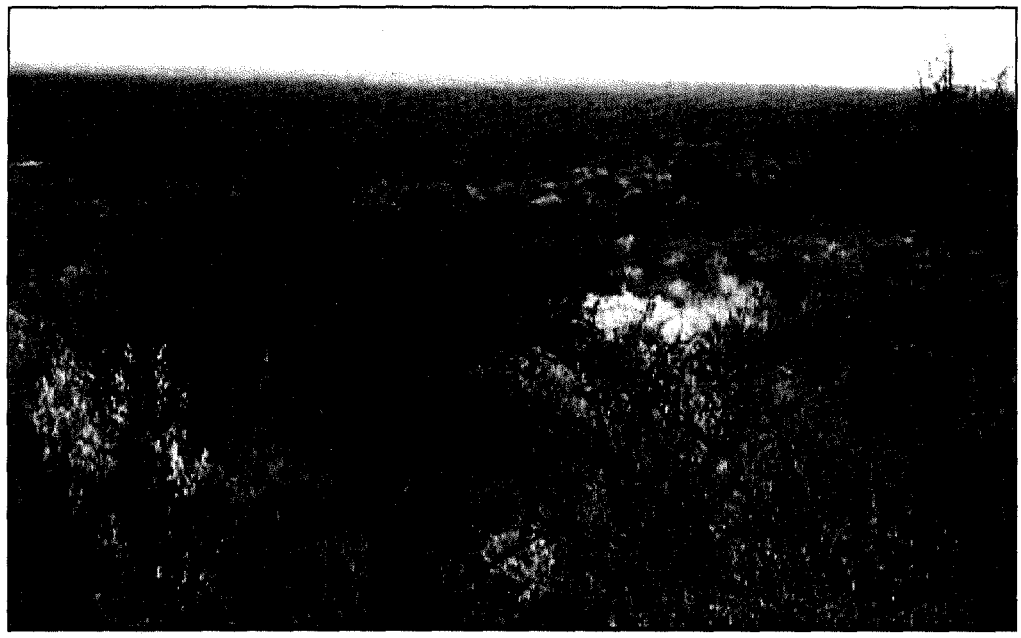
Attached hereto please find the Environmental Management Program in three fold in support of the application for the mining right.

Yours faithfully
**DUNCAN & ROTHMAN**

Per:

STELLENRYCK ENVIRONMENTAL SOLUTIONS

# *Draft Environmental Management Programme For Manganese & Iron Mining Concern On The Farm Macarthy 559, Kuruman District, Northern Cape*



**PREPARED FOR:**

**DVD Quality Engineering (Pty) Ltd**
**P/Bag 1532**
**Postnet Suite no. 109**
**KURUMAN**
**8460**

**DECEMBER 2010**

Tel. & Fax: 041-3672049 · Cell 0824140464 · 4 Josephine Avenue LORRAINE 6070
Member: J. A. van As: B.Sc (Botany & Zoology), B.Sc (Hons) (Eco-Physiology), M.Sc (Plant Physiology)

# 1. INTRODUCTION & BACKGROUND

DVD Engineering Services (Pty) Ltd (DVD) obtained a prospecting right from the Department of Mineral Resources (DMR) in 2006 and subsequently engaged in an invasive prospecting programme for manganese on Portion 1 of the Farm Macarthy 559 the farm (Boskop), Kuruman District. The prospecting programme included core drilling and trenching to the extent that the manganese ore body was adequately defined. The proven resource was deemed adequate to sustain a 30 year mining operation. Based on the volumes of the proven reserve, the applicant submitted an application for a mining right to the DMR in June 2010, which was provisionally accepted.

In terms of section 39 of the Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA), an Environmental Impact Assessment (EIA) must be undertaken and an Environmental Management Programme (EMP) must be compiled before the proposed activity can be commissioned. In terms of an agreement between the DMR and National Department of Environmental Affairs (Cape Town, December 2007), the DMR would remain the lead authority for mining applications in terms of the NEMA regulations and will govern all processes related to mining and primary processing of ore and will subsequently issue DVD with the required mining right and approve the EMP. The mentioned agreement would come into effect when both the MPRDA and NEMA have been amended and promulgated. NEMA amendments have already been promulgated, but not the MPRDA amendments.

In order to comply with MPRDA requirements, CEN Integrated Environmental Management Unit was appointed by DVD Quality to compile the scoping report as per Regulation 48(1)(a) of the MPRDA. This document was submitted in July 2010. No response to the scoping process was received and the applicant was instructed to progress to the next stage of the EMP. For this purpose, Stellenryck Environmental Solutions (*SES*) was appointed by DVD Quality Engineering (Pty) Ltd to undertake the environmental impact assessment and compile a management programme in terms of Sections 50 and 51 of the said Act, in support of the Mining Right Application.

The Boskop manganese mining project entails the mining of manganese residue by means of opencast strip mining to a depth varying between 5m and 15m deep on the flatter central and south-eastern portions of the farm and up to 30m deep on outcrop areas located on the north-western boundary of the farm. The proposed operation will consist of the following activities:

- Opencast strip mining with excavators;
- Transport of ore with dumper trucks to screening and crushing plants;
- Screening and crushing of ore;
- Washing of crushed ore;
- Limited waste and ore stockpiles;
- Residual storage facility;
- Transportation of the mined product.

One of the objectives of the MPRDA is to ensure that the applicant disposes of the financial, as well as technical capacity, to develop this ore body. DVD's application has been provisionally accepted and since no amendments have been requested to date, the applicant has complied with these requirements. A further objective is to ensure that the applicant disposes of the required finances to fund mitigation measures to prevent long term impacts and where that is not possible, to minimise such impacts to the biophysical and social environment. To meet this objective, DVD will provide the DMR with a financial guarantee equal to the anticipated disturbances that would be caused by the proposed mining venture.

****

## 2. TERMS OF REFERENCE

The following terms of reference were established upon reviewing the scoping report and conducting a site survey.

- Conduct the required environmental investigations in order to produce the environmental impact assessment for the proposed mining and crushing activities.

- Identify potential significant negative and positive environmental impacts associated with the proposed mining and crushing activities.

- Due to the limited depth of mining and extensive depth of water table, no hydrological specialist investigation was deemed necessary. Application will be made to DWAF for a water abstraction authorization.

- Due to the extensive proliferation of *Acacia mellifera* on this particular farm, but more specifically on the ore body and the subsequent impact on the faunal and floral composition, as well as the impact that extreme dry conditions had on the surface cover and faunal component, only a limited floral investigation was conducted. Faunal assessment was done based on literature review, discussions held with farm owners in the area and personal site survey.

- A Phase 1 Heritage Impact Assessment was conducted and revealed limited findings and no further investigations were deemed necessary.

- Additional studies required by the regulating authorities will be submitted on receipt of such request depending on the extent of such studies and will be funded by the applicant.

- Two screening & crushing operations will be established on the farm, one on the south-western deposit and one on the north-eastern deposit in order not to transport ore from one side to the other over the R325, to reduce safety risks.

- No underground mining will be performed.

- Mining will commence on the flatter portion (north-eastern side) of the farm since further reserve investigations still have to be done on the hills characterising the

north-western boundary of the farm. However, the EIA and EMP will provide a preliminary impact assessment related to the mining of these areas, as well as the required management procedures.

- The bulk of mine employees will reside offsite and will commute to work every day. Skeleton staff will occupy the farm residence.

*******

# 3 ABRIDGED CURRICULUM VITAE OF RESPONSIBLE ENVIRONMENTAL PRACTITIONER OF STELLENRYCK ENVIRONMENTAL SOLUTIONS

J. A. Van As

| | |
|---|---|
| Farming experience (1974-1984) | ± 10 years experience of cash crop production and cultivation of export and wine grapes in the Worcester area and stock farming in the Touws River Area. |
| B.Sc. 1984 (Stell) | Botany & Zoology |
| B.Sc. (hons) 1985 *C.L.* (Stell) | Plant Physiology: Eco-physiology |
| M.Sc. 1991 *C.L.* (Stell) | Plant Physiology: Mineral Nutrition |
| Ph.D (research completed, Thesis not Completed (1995) | Botany Department Univ, of Stellenbosch (Mineral Nutrition) |
| Technical Officer 1985 – 1995 | Botany Department Univ, of Stellenbosch |
| Acting Senior Lecturer 1993-1995 | Plant Physiology & Mineral Nutrition, Botany Department, Univ, of Stellenbosch |
| Bsc. (Hons) tutor & project leader (1992-1994) | Botany Department, Univ, of Stellenbosch |
| Principle Environmental Officer (1995-1997) | Department of Minerals & Energy |
| Assistant Director: Environment (1998-2004) | Department of Minerals & Energy |
| Deputy Director: Environment (2004-2008) | Department of Minerals & Energy |
| Environmental & Mining Consultant (Current) | Stellenryck Environmental Solutions |

******

# 4 MOTIVATION FOR ESTABLISHING BOSKOP MINE

South Africa disposes of approximately 80% of the world's identified manganese resources and the most significant deposits occur near Hotazel in the Northern Cape Province. Manganese ores of the Kalahari Manganese Field are contained within sediments of the Hotazel Formation of the Griqualand West Sequence and reserves were estimated at approximately 13 billion tons in 2009. Manganese content is generally high (± 60%) and is thus of considerable better quality than the Australian and Chinese ore deposits that dispose of a very low manganese content in the order of 23%. South Africa is therefore a significant player in the global manganese market and demand from South Africa is high and is still increasing, one of the reasons why the Boskop deposit was identified and investigated.

Due to the extent of manganese reserves in the Hotazel area, little attention was devoted to the Kathu-Postmasburg ore deposits until recently, especially being of lower grade. However, global demand has now made it possible that reserves with a content as low as 33% can be mined economically. Of more importance is the positive factor that weathered manganese (detrital) can be mined without excessive costs and without imposing significant long term environmental impacts, which causes mining of these deposits less expensive.

A number of manganese mining concerns was established in recent years between Kuruman and Postmasburg and DVD Quality Engineering (Pty) Ltd also identified the potential of this specific ore reserve, hence the reason for applying for a mining right. Considering the global economic cool down and its impact on South Africa, it was important for DVD to firstly ensure the economic sustainability of the concern by generating a second source of income and secondly, to ensure the well-being of its workforce. The proposed mining venture will achieve both objectives. In addition, establishing the concern will create additional job opportunities and considering the low income per capita in the Kathu-Postmasburg area and the high levels of unemployment, it will make a contribution to economic growth within the John Taolo Gaetsewe District Municipality. This would be in line with the objectives of the IDP of said Municipality and Northern Cape strategic plans.

*******

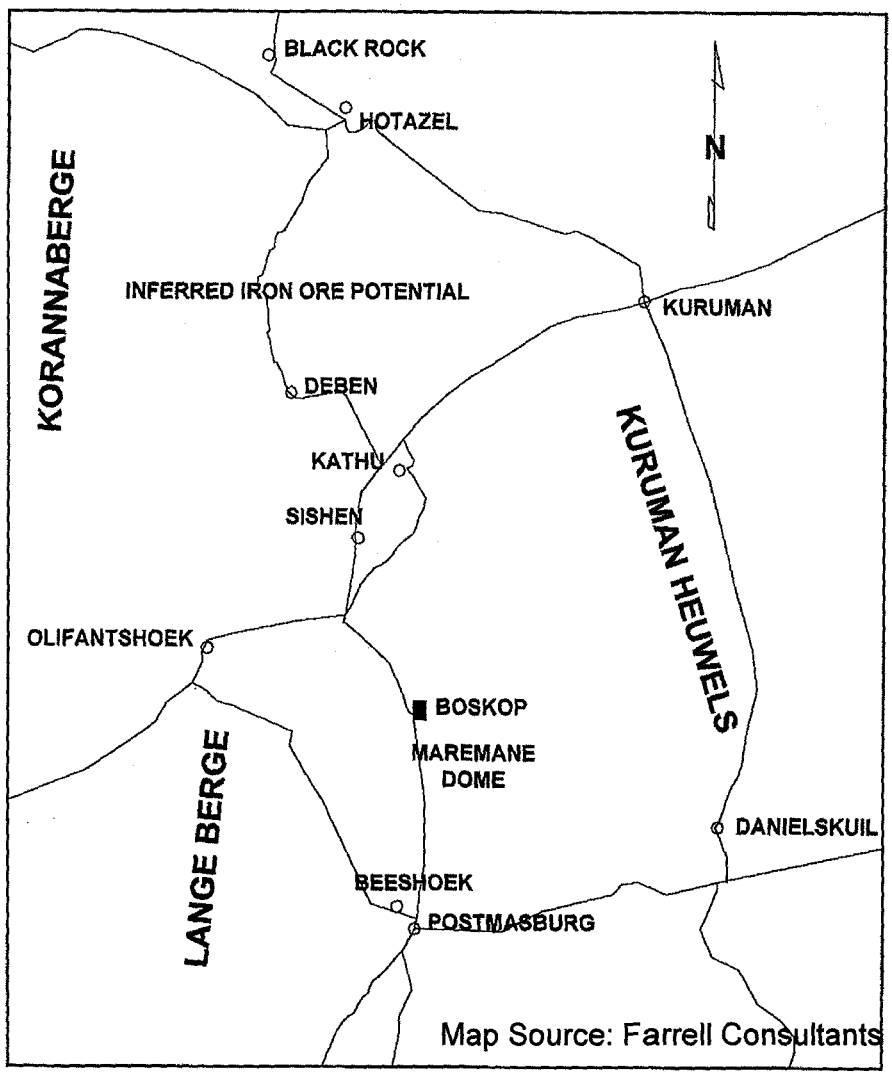
# 3 PROPERTY DETAILS

## Farm Registration

Portion 1 (Boskop) of the farm Macarthy 559, District Kuruman.

## Locality

The farm Boskop is situated approximately 19km from Kathu and 34km from Postmasburg. The farm straddles the R325 from which access will be gained. The present mining right application covers the entire farm, but most of the north-eastern part would not be mined, since it does not dispose of viable manganese reserves and the area is mostly underlain by dolomite.



## Surface infrastructure & servitudes

Mining Right Application Area

Eskom and Telkom lines run parallel with the R325 and are extended along the farm access road to the farm residence from where it swings north-eastwards towards the landowners' abutting farm residence.

The Vaal-Gamagara bulk water supply pipeline runs on the inside of the property fence on the western side of the R325 at a depth of approximately 2m.

An internal road network is available for mining purposes and it would not be necessary to establish additional roads for the first two phases of mining. This is of particular interest, should blasting be done in this area.

The Sishen-Saldahna rail line borders the farm in the north-east, but would not be affected since there are no viable manganese deposits in this area.

The farm residence and outbuildings are located in the centre of the farm on the border of the dolomite and manganese contact.

This property was historically extensively prospected and 50m gridlines (E-W) are clearly visible from the air.

Surrounding areas

A Chinese owned mine is located 2km south of Boskop, whilst another mine is located 8km north of the farm. The Kumba Sishen mine is located 15km to the north-northwest. The landowner's abutting farm residence is located 380m north of the boundary fence and may be affected by blasting and noise pollution during phase 3 of the mining venture (2030-2040). There are no other infrastructures within reasonable distance from the southern and eastern boundaries. A farm residence is located 1,1km south-west of the boundary and would not be affected by mining and specifically by blasting and noise pollution.

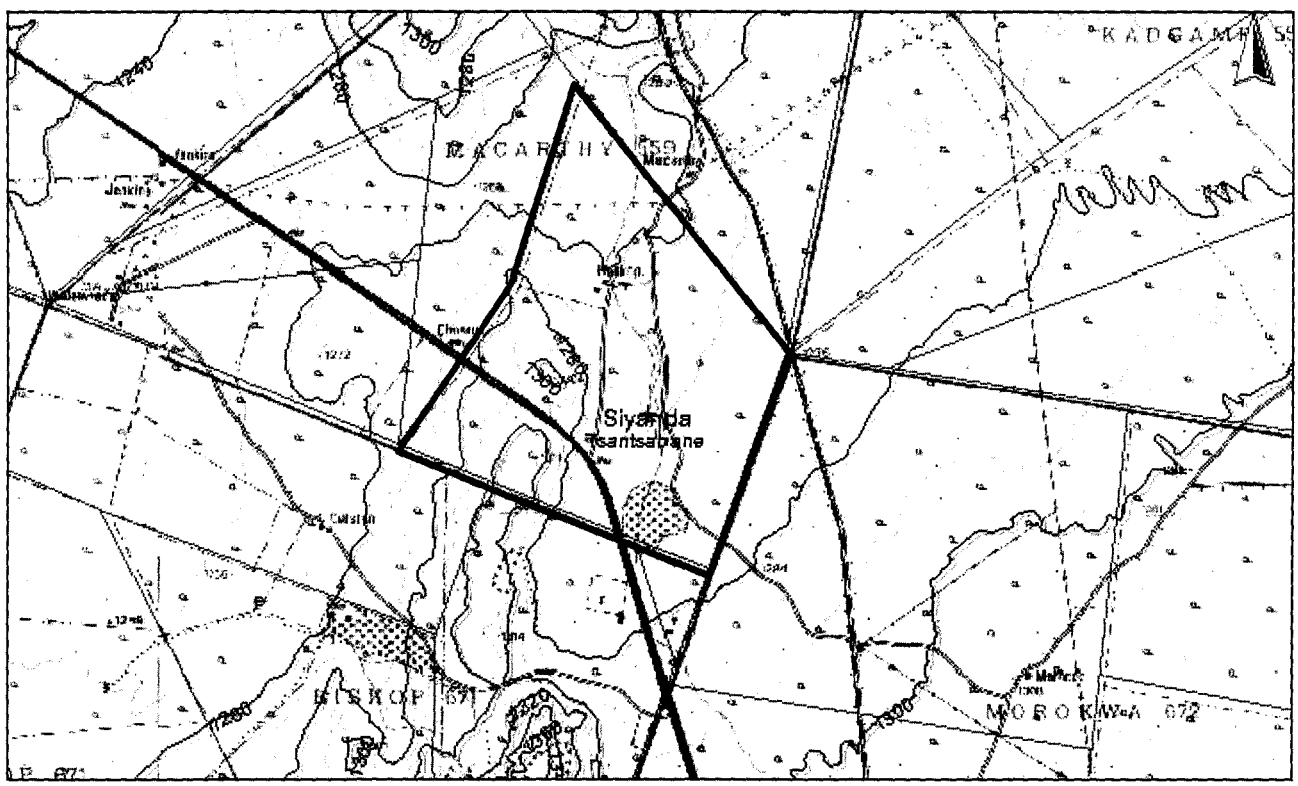
 

## Zoning

Current zoning is agricultural and was used for livestock grazing until recently. Although the largest portion of the farm is still natural in terms of disturbances and percentage vegetation cover, the proliferation of *Acacia mellifera* on the mining area has caused an almost total disturbance of ecological processes on most of it.

The land was also historically subjected to *ad hoc* and haphazard mining of outcrop areas, which were left unrehabilitated. These disturbances are generally small and cannot be categorized as extensive mining.

The South African Chamber of Mines' Guidelines classifies pre-mining land capability of the area as approximately 0% arable and 100% wilderness, as stipulated by CEN, which is thus a distortion of the actual ecological classification of the site. The term 'wilderness', means that a section of land is still natural and has not been transformed by any external impact, nor has it been insignificantly impacted. This is clearly not the case at a large portion of the farm concerned.



# 6 PROJECT DESCRIPTION FOR BOSKOP MINE

## Applicant

DVD Quality Engineering (Pty) Ltd Reg. No: 2003/028732/07
P/Bag 1532
Postnet Suite no. 109
KURUMAN
8460

Tel No: 053-7120603/9 Fax No. 086 508 4393 Cell: 082 825 6452

## Responsible person

Mr. Dion van Dyk
P/Bag 1532
Postnet Suite no. 109
KURUMAN
8460

Tel No: 053-7120603/9 Fax No. 086 508 4393 Cell: 082 825 6452

## Surface owner

Mr. L. Venter

## Mine Development Plan

The proposed Boskop mining project will entail four phases:

### Phase 1

Mining area

The first phase of mining will represent the mining of detrital on the flat area located between the main access road to the farm residence and the watercourse to the east, with projected tonnage of approximately 238 000 cubic meters (715 000 tons). The extent of this mining area totals approximately 35ha. Based on an extraction rate of 5 000 tons per month, the mining period would be approximately 9-12 years, depending on actual production rate and actual *in situ* tonnage. The area would be mined in 9 development blocks (phases) in extent of approximately 3,5ha to ensure a concurrent rehabilitation process and to facilitate measureable performance.

Since access to the farm residence has to be retained, the road will remain in place unless the landowner agrees to mining the area and relocating the road.

Mining method

Mining will start from the south and progress northwards. Since the red sand deposit is integrated with the manganese nodules, total extraction will be applicable and the sand-detrital 'conglomerate' will be removed by excavator, deposited on dumper trucks and dispatched to the crushing and screening plant.

In some areas, manganese outcrops are clearly visible and mostly represent high quality ore. These areas will be drilled with a diamond coredrill and blasted. Overburden and spacing will typically be 2,5m x 2,5m with drill holes of 76mm. Probably P101 slurry will be used as explosives and will be primed with pentolite boosters. Since more than one shot hole will be fired at a time, shock tube assemblies of the Nonel and handidet systems will be used to ensure controlled blasting conditions and limit flyrock and PPV readings. Average stemming of 0,75-1m will be applicable. Depth of mining would be approximately

3-8m. Shot rock will be loaded on dumper trucks with an excavator and transported to the diesel powered mobile crusher and screening plant.

This latter mining approach will result in minimal "pocket mining" that will impact on land use parameters and needs to be addressed in the rehabilitation programme

**Phase 2**

Mining area

The second phase of mining will represent the mining of manganese detrital on the flat area located between the main access road to the farm residence and the foot of the hill located to the north-west, with projected tonnage of approximately 333 000 cubic meters (1 000 000 tons). The extent of this mining area totals approximately 12,5ha. Based on an extraction rate of 7 000 tons per month, the mining period would be approximately 12 years depending on actual production rate and actual *in situ* tonnage. The area would be mined in 6 development blocks in extent of approximately 2,5ha to ensure a concurrent rehabilitation process and to facilitate measureable performance.

Mining method

Mining would start from the south and progress northwards. Portions of the area also dispose of manganese detrital and will be mined in similar manner as described in phase 1.

In this particular phase manganese outcrop areas are much more prominent and will result in a significant amount of drilling and blasting. Considering that individual outcrop areas are smaller, production blasts will be smaller (5 000 $m^3$) and be performed once every month or second month. This phase of mining will result in more extensive "pocket mining" that will impact on land use parameters and needs to be addressed in the rehabilitation programme. The close locality to the farm residence will require controlled blasting procedures.
Detrital 'conglomerate' and shot rock will be removed by excavator, deposited on dumper trucks and dispatched to the crushing and screening plant. Depth of mining would be approximately 8m.

**Outcrop in phase 1**

**Outcrop in phase 2**

## Phase 3

### Mining area

The third phase of mining will represent the mining of the crest of the hill located to the north-west and will represent narrow slots in the crest. Apparently the interface between the flats and crest does not dispose of any viable manganese deposits. The projected tonnage is approximately 158 000 cubic meters (474 000 tons). The extent of this mining area totals approximately 6ha. Based on an extraction rate of 8 000 tons per month, the mining period would be approximately 5 years depending on actual production rate and actual *in situ* tonnage. The area would be mined in 3 development blocks in extent of approximately 2, 3, 7 & 1ha.

### Mining method

This phase does not dispose of any significant overburden and no detrital is found in this particular area. Mining would start from the north and progress southwards. In this particular phase all mining will be done by means of drilling and blasting method. Each production blast will generate approximately 10 000 cubic meters of shot rock. Production faces will be split in two benches and then be advanced alternatively. The bench will be approximately 15m wide to facilitate safe access for quarry machinery/vehicles and to facilitate final perimeter profiling. In order to access the benches, a cambered access ramp will be constructed through precision blasting. Production blasts will be performed by a competent blaster, whom disposes of an opencast blasting qualification.

Development of a ten meter high production face as an alternative is possible, but will increase safety risks and will cause profiling to be more cumbersome. This is not the prepared option.

Production volumes will average approximately 10 000 $m^3$ and blasting will take place once a quarter. This type of development will result in reasonable size slot quarries to be developed, ranging from 70m x 100m to 70m x 200m to 70m x 400m. Quarry floors should be reasonably flat.

The southern portion of block 1 will be within 30m from the R325, which poses a definite safety risk and it is proposed that electronic blasting be done in this area until the clearing distance is at least 100m. The following general operational principles would apply:

- A burden/spacing assessment, as well as risk assessment, will be done to ensure that safety standards are upheld.
- Smaller blasts, rather than large blasts will be conducted. This will fit in with the low-key concern that is anticipated.
- Blasting design will be evaluated to facilitate precise rock positioning and reduce diameter of blast.
- The R325 should be closed during blasting for at least 5 minutes before and after blasting in conjunction with the local traffic department.
- No road user will be allowed within 300m from the blasting area, to prevent any loss of lives or damage to vehicles.
- During blasting, the roads will be secured by flagman and stop-go signs as per instructions of the DRT should be in place.
- Direction of all blasts shall be north-west, away from the R325.
- Adequate stemming must be used to reduce fly rock.
- The minimum charges shall be used to achieve the required fracturing.

**Phase 4**

Mining area

The fourth phase of mining will firstly represent mining of the crest of the hill located to the south-west of the R325 and will represent the largest development on the property, unless infill drilling results reveal less ore reserves. The projected tonnage is approximately 333 000 cubic meters (1 000 000 tons). The extent of this mining area totals approximately 13ha. Based on an extraction rate of 8 000 tons per month, the mining period would be approximately 10 years, depending on actual production rate and actual *in situ* tonnage.

Secondly, the detrital located in the southern corner of the property will be mined and could produce a tonnage of 450 000 tons (135 000 cubic meters) and would last for approximately 4 years. The extent of this mining area totals approximately 9ha.

Mining method

Mining the crest of the hill will entail a blasting and drilling method similar to phase 3, but will be supplemented by the mining of detrital in the south-south-eastern corner of the property as described under phases 1 and 2. The same safety considerations will be applicable to this area, but to limit the potential risk further, it is proposed that blasting direction should be westward. The mine may therefore not be developed from the north-east (road side) or alternatively, it should be developed from the south, which could be more practical. Depth of mining would also range between 8m and 10m. This phase will result in an extensive quarry with dimensions of 250m x 500m.

Development of the eastern section of this particular phase could be problematic, due to the locality of the Vaal-Gamagara pipeline located parallel to the boundary fence. It is essential that seismic activity is monitored in the beginning at the various points where the pipeline could be affected. PPV readings should be below 8mm/s.

## Crushing & Screening

### Positioning of plant

Positioning of the mobile crushing plant will have to take haul distances into consideration, since it will most probably result in one of the most costly activities of around R1.2/$m^3$/km. The fact that waste 'contaminated' ore will be transported and that screened waste would have to be returned to the excavations, will cause the transport of bulk material to be even more costly. On the other hand, the continuous relocation of the plant as per the scoping report might also not be feasible.

Phase 1 plant position

It is therefore proposed that the plant will be located at three locations during phase 1 mining, with the first position in block 5, the second position on the southern end of block 8 and the third position opposite block 9. The plant will therefore be relocated when blocks 4 and 7 have been completed. Should the applicant opt to change the positions identified, it would not pose any additional environmental impact, since all positions fall within the mining footprint.

From a cost perspective and to have a trial run with the development and rehabilitation of the quarries on the crest of the hill, it is proposed that the most southern block of phase 3 is developed in conjunction with the development of block 4 of phase1. It would provide the applicant with valuable insight into *modes operandi* applicable to quarry development and rehabilitation of these quarries in the absence of topsoil.

Phase 2 plant position

The third position of phase 1 will also be able to serve blocks 1-5. Considering that the grade and yield in this area would be substantially better with less waste to be moved, slightly longer hauling distances would still be economically viable. Final position of the plant will have to take blasting in blocks 2, 3 & 4 into consideration.

Phase 3 plant position

Positioning of the plant on the crest of the hill is not advised, since the area is exposed to prevailing winds which will induce a significant dust and visual impact. The distance from water for dust suppression is also a drawback. It is therefore proposed that the plant is relocated to the western end of block 5 of phase 2 for the development of blocks 1 and 2 and northern portion of block 3. The plant can then either be relocated to block 1 of phase 2, or positioned inside the pit for further development of the remainder of block 3. This might be the less costly option, since material can be transported along the existing road alignment to the second entrance to the property, once the status of this historic entrance has been determined, or when the access has been approved by the Department of Public Works (Roads Division).

Phase 4 plant position

Development of phase 4 is still uncertain, due to a lack of adequate infill prospecting data. Due to its extent and the steepness of the slope leading to the detrital area to the south-west, the crushing plant will have to be positioned on the western boundary of the mining area. Once adequate room has been established in the pit, the plant can be moved inside the pit, which will result in significant topographical screening and dust reduction. It is also anticipated that a second plant will be positioned in the detrital area away from the road and that the two sites will be developed simultaneously. Considering that this phase might only be developed in 20 years' time, the management programme should be reviewed at that particular time insofar as development strategy and related impacts are concerned.

At the time of development of this phase, water allocation from the pipeline should have been obtained for dust suppression and probably rehabilitation.

**Screening and crushing**

The mobile crushing plant will typically consist of a primary crusher, secondary crusher and tertiary cone crushers with triple-deck screens. Due to the difference between the two ore bodies, two crushing processes will be applicable to the Boskop Mine. Detrital recovered from the plain areas do not require extensive crushing and will most probably be fed directly into the secondary crusher, to reduce crushing costs and from there will be

further reduced in size by the cone crushers. It would, however, be costly to put waste through the secondary crusher as well, which will increase wear on the crusher head and mantle liners. The best option would be to first screen extracted detrital before it enters the bin of the secondary crusher, which will result in waste bypassing the secondary crusher. Once screened, bulk material will then be directed to a long conveyer belt from where iron ore will be handpicked from the conveyer to improve manganese grade, whilst the residue is stockpiled at the end and returned to excavations. This method of sorting is excellent for job creation and will support the objectives of the Social & Labour Plan.

Shot rock will be of much larger size and will be put through the primary crushing plant. Considering the lack of overburden and soil in the outcrop areas, residue screened out would be minimal and will impose a negative impact on rehabilitation potential of the hard rock quarry areas.

From the secondary crusher, crushed rock is fed into one or more tertiary cone crushers that operate in an open circuit with triple deck screen at the end, to develop the required 6mm serge piles. If more efficiency is required, material could be screened once it has passed through the secondary crusher to ensure that fines generated, bypass the cone crushers.

General

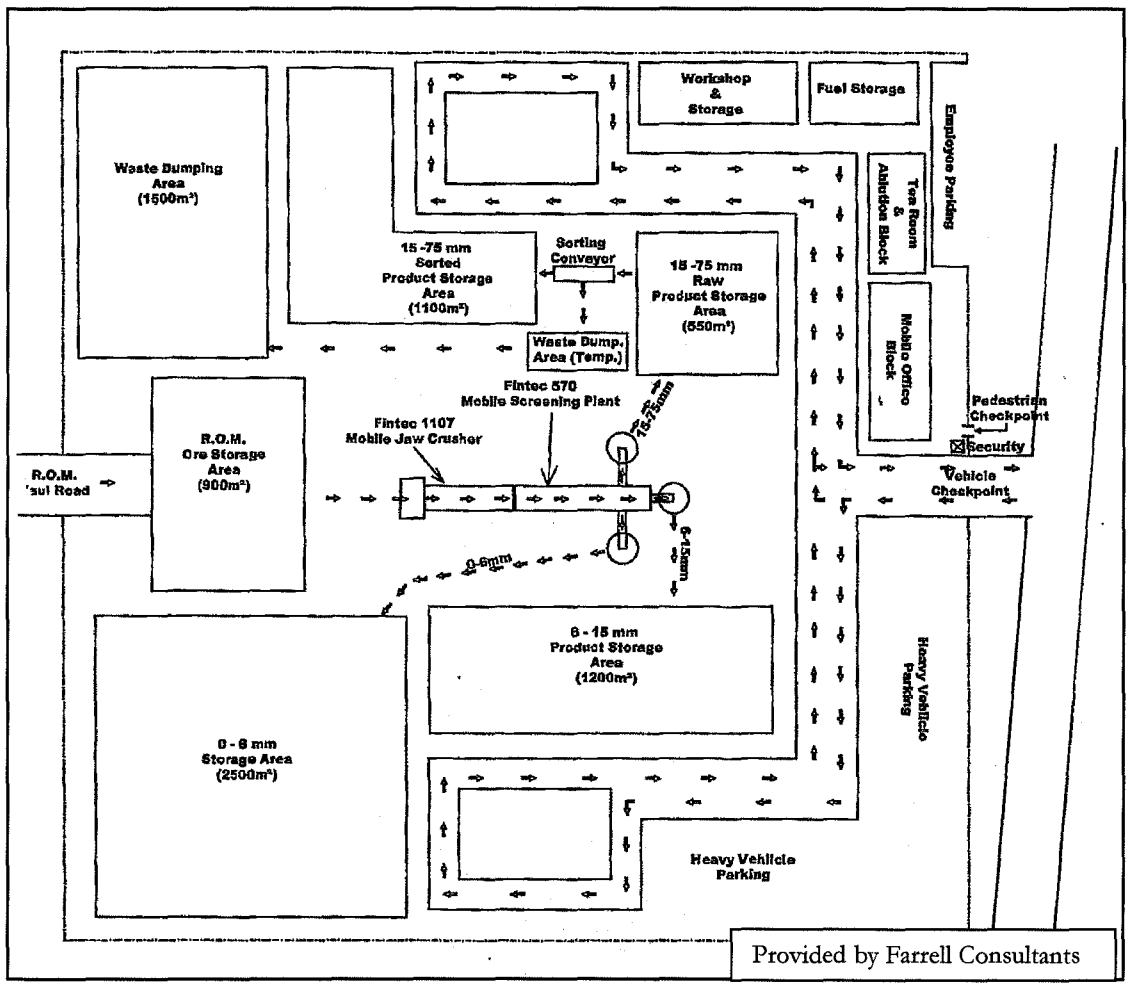
The nature of manganese rock and the relative shallow depth will result in mining to remain above any primary or perched aquifer.

All shot rock would be utilized except for oversize, which will either be returned to the excavation for profiling of the sides, or alternatively, these rocks would be reduced in size by fitting a hydraulic hammer to the excavator or performing secondary blasting, although these processes is generally expensive.

The proposed operation would be continuous and working hours from 7am to 5pm, five days a week, with cessation of hauling activities on 1pm on Saturdays, if contractual agreements require work on a Saturday. Under normal working conditions, the Boskop Mine will not operate over weekends or recognised holidays.

## Typical plant layout

The layout area would be approximately 2,ha in extent.




## Construction phase

### Access & Roads

The farm disposes of a reasonably well extended road infrastructure and usage of these roads will provide access to all mining areas. No additional roads will be established, except for within mined out areas, which will not pose any environmental impact. Access roads seem reasonably stable, due to the nature of the underlying rock and will generally not require any major upgrading, but could become corrugated with time. In such cases, road construction material will be obtained from a registered source and placement of a 30cm thick wearing course will be contemplated through grading and compaction.

Access to the R325 is reasonably problematic, since line of sight is reduced to both sides. In order to safely use this access, calming lanes have to be constructed on both sides, which will be done in conjunction with the District Roads Engineer (DRE). This will entail that the incline to the R325 is significantly reduced and the area needs to be filled in. Material for this purpose should be obtained from residue dumps at local mines, or appropriate aggregate will be imported for this purpose. With the development of phases 3 & 4, it is proposed that the existing roads on both ridges be used for this purpose, but the legal status of the accesses to the R325 needs to be clarified and if it is not approved, an application in this regard needs to be directed to the DRE. This will naturally entail the establishment of Bell- mouths at all accesses to the R325.

Water reticulation

Two boreholes drilled during the prospecting phase will be registered and utilised for potable water (if quality is good), dust suppression at the plant and washing of crushed ore.

A water reticulation system will be established at the crushing site, consisting of an elevated water tank, taps and sprinkler system. Water will be gravity fed to the crusher, to facilitate dust suppression and washing of crushed material. Tanks will be filled from the boreholes mentioned above.

Once the mine is up and running and capacity of the Vaal-Gamagara pipeline is improved, an application will be lodged for access to water from the Vaal-Gamagara pipeline in an effort to reduce pressure on groundwater in the area.

Construction of the water reticulation system will not result in any waste production, or any other significant environmental impact.

Sewage system

Due to the thin overburden on the hills, no toilet facilities will be established in these areas and the construction of conservancy tanks, or use of chemical toilets, will be considered. In case the former option is decided upon, an elevated water tank will be established for flush toilets. Within the plant area, similar systems will be used for workers, whilst

management will make use of facilities at the farm residence. One toilet facility will be provided for every ten employees. Conservancy tanks will be emptied on a regular basis and contents disposed at nearest sewage plant in Kathu or Sishen.

Relocation of the plant will result in emptying the conservancy tank and demolishing it. Building waste will be returned to one of the pit excavations, compacted and covered with soil. The environmental impact would be insignificant.

Waste facilities

Considering that at least 50 people will be onsite permanently, a waste disposal area will be demarcated. One or more skips will be positioned in this area. Ordinary dust bins will be positioned at every site with high human activity and these dustbins will be emptied in the skip on a regular basis. The waste facility will be fenced to prevent wind dispersal of some of the waste components. The skip will also be covered with a small mesh net to facilitate the same function. The skip will be regularly emptied at an approved waste facility in Kathu or Sishen.

Used hydrocarbon fluids will be stored within selected receptacles and stored within a bunded area demarcated for this purpose and for disposal to recycling facilities.

Offices and workshops

No permanent offices will be constructed at this stage. A temporary, mobile office in the form of a steel container will be positioned in the plant area. A second container will be used as ablution facility and tearoom as per plan. A small maintenance area for machinery/vehicles would be established and will constitute of a container and concrete slab for vehicle servicing/repairing and will be fitted with a central sump for capturing any spilled hydrocarbons. However, the applicant will perform major maintenance work off-site at facilities at the nearest towns. Workshops should preferably be established in one of the farm outbuildings, to reduce the potential impact on the natural environment.

Fuel storage

A steel diesel tank with a capacity of 50 000L and possibly a petrol tank with capacity of 2 000L would be established. These tanks will be positioned within a bunded area disposing of a concrete floor and release valve to drain the bund after extreme precipitation. The walls of the bund will be at least 25cm thick, plastered and with a capacity of 56 000L. The tank will be provided with an apron and sump to capture any fuel spills during refuelling processes.

Housing

No housing would be provided as the workforce would not reside on the mine, but will commute to work every day. The farm residence and outbuildings will be used as accommodation of skeleton staff that will permanently reside on the property.

Power sources

The mobile crusher will dispose of an onboard generator. An additional generator will be positioned near the plant to provide power to additional screens and sorting belt, if it is used instead of a screen. The generator will be positioned in a bunded area with a concrete floor to limit diesel and oil spillages.

Weighbridge

A weighbridge will be installed at the checkpoint of the mine and will require minor building work, which will generate a very small volume of building waste.

Salvage yard

A mining operation of this magnitude will result in the generation of scrap metal, dysfunctional equipment/parts and storage of second hand spare parts removed from broken down equipment. This area will be fenced and items will be orderly stored within the area.

## 7 REHABILITATION, CLOSURE & DECOMMISSIONING

Plant area

- All containers, vehicles and equipment related to the crushing and screening process will be removed.
- Empty and remove fuel tanks, or request a service provider to remove them.
- All foundations and bund walls will be ripped up and demolished respectively and disposed of in the quarry voids.
- Once removed, the excavation created by installing the weighbridge will be filled in, compacted and covered with topsoil.
- All scrap metal/dysfunctional parts and waste will be removed to an approved facility.
- All hydrocarbon waste and contaminated soil will be safely transferred to appropriate receptacles and removed to a hazardous waste site or recycling facility.
- Any unsold material stockpiles, if any, will be sold off or be returned to the quarry voids.
- Remove chemical toilets and/or empty conservancy tanks. Demolished conservancy tanks and fill area in, compact and introduce topsoil.
- Remove fences and waste facilities.
- Reintroduce topsoil, fertilize, rip the affected area, seed, scarify and irrigate.
- Once vegetation has been successfully established, the irrigation system will be removed.

Quarry areas

As per the scoping report produced by CEN, provisions have been made for mine closure as rehabilitation of the open pits will be done in conjunction with the mining sequence. The mining sequence complements the rehabilitation of the old abandoned quarries. The discard (about 60% of the raw materials) is dumped back into completed excavations. The worked out excavations will be approximately 5-8m deep. As the discard consists of crushed rocks and mineral sands, the volume of the backfill will be much higher than extracted ore. The ore density is 3 tons/$m^3$, while the expected density of the discard will be 2 tons/$m^3$. This will equate to a 33% increase in volume. As 40% of the quarried material is removed as saleable material, the final in-filled excavations should be about 7%

below the original profile. *SES* is of the opinion that it might be slightly more and will work on a 10-15% reduction in soil levels at worst case scenario. This scenario would only be applicable to phase 1, since phase 2 disposes of significant less sand deposits and generally a rocky bed. A soil level reduction of between 30-40% is contemplated. In phases 3 & 4, soil level reduction of 10m is contemplated since the area disposes of very little overburden.

Final rehabilitated profiles should therefore be much closer to *in situ* ground level in phase 1, than at phases 3 & 4. This is aligned with other mining profiles observed in the area.

The following general principles would be applicable:

- Any access material or overburden will be used to profile the production faces.
- All crushed or shot rock on the quarry floor shall be removed and used in the profiling of the sides of excavations.
- Perimeter of hard rock excavations will be trimmed and profiled to an acceptable 1:2-1:3 slope through precision blasting, to achieve safety requirements and to blend the quarry with surrounding landscape. Should two 5m high faces be developed, the upper bench will be profiled to a 1:3 slope and the lower bench to a 1:2 slope. All additional benches will be sloped 1:1.
- Spread at least 45cm of overburden over compacted material on quarry faces to allow for crevasse infill and prevent topsoil to completely disappear amongst shot rock.
- Spread topsoil to a depth of at least 20cm over overburden and scarify lightly to key it in with the sub-layer. The development of production faces will require additional topsoil and it should be sourced from the detrital area, or imported from residue dumps at surrounding mines.
- Seed affected areas during the rainy season and follow up with irrigation.
- All equipment, waste or scrap metal will be removed from site.
- Facilitate after-care process.

# 8 HEALTH AND SAFETY MATTERS

The applicant will comply with the conditions of the Mine Health & Safety Act, Act 29 of 1996 (as amended), Minerals Act and Regulations, Act 50 of 1991 and Mines and Works Act, Act 27 of 1956 and as a minimum will ensure the following:

General/Permissions

- The Principle Inspector of Mines will be informed on the date on which mining commences.
- Mining will take place on surveyed land and 9m boundary pillars (depending on depth of excavations, particularly on the crest of the hills) must be retained. – MA Reg 7.12.
- Work will be performed within 100m from an Eskom line that needs to be protected, hence authorization in this regard is required from the Principle Inspector of Mines – MHSA Reg 17.
- At this stage Sunday labour will not be applicable, hence no permission is required – MW Sect 9.
- Appointment of Competent Person to be responsible at more than one mine – Not applicable.
- Appointment of Sub-ordinate Manager to be responsible at more than one mine– Not applicable.
- More than one shot hole will be blasted at a time and the necessary authorization will be obtained from the Principle Inspector of Mines.
- Mining will be done within 500m from structures and the necessary risk assessments will be done in this regard.

Appointment of following responsible persons will be done

- A competent mine manager will be appointed (Section 3).
- If the holder entrusts functions to another person, e.g. CEO (Section 4), such person must be duly appointed.
- Employer will staff the mine with due regard to health and safety. (Section 7).
- Engineer/ Competent Person - MA Reg. 2.13.1/ 2.13.2.
- Sub-ordinate Manager - MA Reg. 2.6.1.
- Risk & Safety Officer - MA Reg. 2.17.1.

- A competent mine surveyor will be appointed for submission of plans and annual updates thereof to the DMR - MHSA Reg. 17.(2).
- Health & Safety Committee (if needed) - MHSA Sect 34.
- Operators of Mobile Machines - MA Reg. 18.1.1.

List of Codes of Practices (COP) to be submitted:

- CoP to combat rock fall and slope instability related accidents in surface mines;
- CoP on Trackless Mobile Machines;
- CoP on minimum standards of fitness to perform work at a mine;
- CoP on personal exposure to airborne pollutants;
- CoP on thermal stress – not applicable to this mine;
- CoP on occupational health programme for noise;
- CoP on occupational health programme (occupational hygiene and medical surveillance) on thermal stress;
- CoP on mine residue deposits;
- Lock-out Procedures.

Duties of appointed persons

- If the mine, or sections thereof, is not worked in respect of which a closure certificate in terms of the Minerals Act or MPRDA has not been issued, DVD Quality Engineering (Pty) Ltd will take reasonable steps to continuously prevent injuries, ill-health and loss of life or damage of any kind from occurring at, or because of the mine in terms of Section 2.
- DVD Quality Engineering (Pty) Ltd will provide and maintain a working environment that is safe and without risk to the health of employees. The owner will identify the relevant hazards and assess the related risks to which persons who are not employees may be exposed and ensure that persons who are not employees, but who may be directly affected by the activities at the mine, are not exposed to any hazards to their health and safety as per Section 5.
- DVD Quality Engineering (Pty) Ltd will prepare a Health and Safety Policy document as per Section 8.
- DVD Quality Engineering (Pty) Ltd will prepare and implement a code of practice on any matter affecting the health or safety of employees and other persons who may

be directly affected by activities at the mine, if the Chief Inspector of Mines requires it as per Section 9.

- DVD Quality Engineering (Pty) Ltd will provide employees with any information, instruction, training or supervision that is necessary to enable them to perform their work safely and without risk to health and as far as reasonably practical, the owner will ensure that every employee is properly trained as per Section 10.
- DVD Quality Engineering (Pty) Ltd will identify the hazards to health or safety to which employees may be exposed while they are at work, assess the risks to health or safety to which employees may be exposed while they are at work, record the significant hazards identified and risks assessed and make those records available for inspection by employees. The owner will conduct an investigation into every accident which must be reported in terms of this Act, serious illness and health-threatening occurrence as per Section 11.

Dust

- Since there are no residences within 300m from the Boskop Mine, dust impact would not be applicable.
- Loads will be covered with tarpaulin.
- Screens, conveyors and crusher will be fitted with water atomizers at transfer points to curb dust generation.
- A sprinkler will be installed at the crusher and stockpile areas to reduce airborne pollutant levels.
- $PM_{2,5}$ dust counts will be done and will be repeated annually and the outcome conveyed to the DMR. Considering that it is a manganese mine, the $PM_{2,5}$ value will generally be below 0,5 within the mining environment.
- Drilling rigs will be fitted with dust bags.
- Blasting will not be done during periods of high winds, to reduce dust counts at any receiving environ of importance.
- Applicant will comply with the provisions of the Mine Health and Safety Act 29 of 1996 and NEMA with regards to dust generation.

Noise

- Crushing equipment will be regularly serviced/lubricated.
- Noise generation by vehicles will be controlled through regular servicing and fitting of standard exhaust systems.

- Noise levels at source will be maintained below 85dB.
- Noise levels at any abutting residence will be maintained below 50dB.
- No operations will be conducted before 07h00 or after 18h00.
- Blasting will be done at midday when clear skies prevail, to reduce noise levels and the impact of air overpressure.
- Baseline noise counts will be done and will be repeated annually, if required by the DMR and the outcome conveyed to the DMR.

Roads

- Since public roads will be used for carting material, it would have an impact on traffic flow and will impose a safety risk. Risks associated with the transport of material will be identified and mitigated.
- Vehicle speed on gravel roads will be maintained to 40km/h, to lower safety risks.
- Internal haul roads will be dampened where necessary, to curb fugitive dust levels.
- Heavy vehicle signage will be posted on both sides of the accesses with affected roads.
- Vehicles and mining equipment will be properly maintained and will not be overloaded.
- All vehicles will come to a complete stop before accessing any road. Operators will be trained to carefully observe whether any traffic is nearing the access and operators will make use of indicator lights when turning into any road.
- Vehicles will turn their lights on whilst hauling takes place.
- If required, a flagman will be used at accesses to the R325, to improve safety standards at access points.
- Good visibility at the intersection with all roads will be ensured by removing all vegetation, other obstacles, or natural topographical screens (if possible) within the road verge.
- With the anticipated production rate, the amount of trips would be low (15 trips per day) and thus the potential risk of accidents occurring will also be low. This scenario will change significantly if large contracts are secured and the necessary risk assessment will be done and remedial measures implemented. In such case, it is important that trucks do not follow directly behind each other, but that trips are spaced. Provisions of the National Transport Act must be observed.

Stability and safety of production faces

- The geology of the site will be regularly assessed to identify any fault lines and weathered layers that could affect stability of the face and result in abnormal blasting patterns.
- Production faces will be maintained at a height of 5-8m and if necessary, the production face will be split to increase in-pit safety and rehabilitation potential.
- Benches/faces will be kept clean and free of loose/hanging rock.
- Workers will be granted the right to refuse working in unsafe areas.
- Pit development will comply with standard procedures prescribed by the Mine Health & Safety Act and regular consultations with personnel of the Mine Health & Safety Directorate will be held in this regard.

Access to mine and plant areas

- Access to the mining area will be controlled by maintaining the farm perimeter fence, to reduce the safety impact of the concern.
- A security guard will be appointed to control access to the site.
- A check point will be established at the plant.
- No loitering within the mine or plant area will be allowed.
- No access to the excavations will be allowed, except for people operating in these areas.
- An access register will be held.
- Required hazard/safety signage will be posted at excavations, plant and at the entrance to the property.

Safety/Accidents

- Any accidents will immediately be reported to the Principle Inspector of Mines telephonically and in writing in the applicable format.
- Mine development and applicable safety regulations will be discussed with the abutting landowners. If applicable, a community liaison forum will be established and will meet on a quarterly basis for the first year and then six-monthly thereafter to disseminate information and outline mining and rehabilitation procedures.
- Vehicle movement in excavations will be restricted to the excavator and one haul truck and safe turning circles will be established.
- Workers will be provided with the necessary mining and safety training.
- Equipment will be well maintained, to reduce the risks of accidents from occurring.

- Blasting will be done by an appropriately qualified person and if necessary, electronic detonation will be used if there is a risk of damaging structures.
- The correct powder factor will be used during blasting.
- The correct amount of stemming will be used to prevent flyrock production.
- The blaster will ensure that all people are removed to a safe distance from the blasting area, before setting off the blast.
- After blasting, the blaster will inspect the blasting area to ensure that there were no misfires and that all live detonators are removed from site, before any people/machines enter the mine area. Holes where misfires occurred will be dealt with by the blaster according to standard protocol.
- Abutting landowners will be informed of the time of blasting and a siren will be activated three minutes before blasting, to inform any resident of each blast.
- All civilian people within a 500m radius will be vacated before every large production blast.
- If a generator is to be used, it will be operated by a trained person and all cabling will dispose of the required isolation cover and/or be buried underground. The generator shall be fenced.
- Quarry development will include the establishment of a bench splitting the high walls, to facilitate effective and safe rock production.
- Benches will be wide enough to facilitate easy and safe movement of mining equipment.
- Monitor ground vibration at pipeline and residence to the north of phase 3 for the first four representative blasts and maintain PPV counts to below 12mm/s at the house and 8mm/s at the pipeline. Thereafter it needs to be monitored less frequently, or as prescribed by the Principal Inspector of Mines.
- Reverse warning hooters shall be fitted to all mining vehicles.
- All structures within a 500m radius will be assessed for structural flaws and a photographic record will be compiled before the first blast.
- Protection of workings will be implemented as per MHSA Chapter 14.

<u>Health & Safety equipment to be provided</u>

- DVD Quality Engineering (Pty) Ltd will ensure adequate supply of all the necessary health and safety equipment and health and safety facilities, e.g. (safety boots, hard hats, ear plugs, eye protection, dust masks, gloves, safety belts, etc.) (Section 6) at the office and in the cabins of the mining equipment/vehicles.

- Workers will be medically tested on an annual basis, as prescribed by the Health & Safety Act.
- Workers will be professionally trained to deal with medical emergencies.
- Fire extinguishers for fuel tanks, vehicles, compressors and generators will be provided.
- First Aid Equipment as per MA Reg. 24.1 will be provided.

Hygiene

- Clean drinking water will be provided in a small tanker/JOJO tank at individual excavations and plant area.
- Chemical toilets will be provided and serviced as prescribed, or conservancy tanks will be established and regularly emptied.
- A safe and clean area will be provided where workers can rest and have lunch/tea breaks.
- Waste will be stored in suitable receptacles and disposed of regularly.
- The surrounding environment will not be used for ablutions.
- A policy on the above matters will be developed and the necessary penalties imposed where and when appropriate.
- Since manganese will be mined, no deleterious minerals will be released to the environment that could facilitate acid mine drainage, which could affect water quality and subsequently the health of local inhabitants.
- DVD Quality Engineering (Pty) Ltd will conduct occupational hygiene measurements as per Section 12.
- The applicant will establish a system of medical surveillance as per Section 13 and appoint Health and Safety Representatives as per Section 25.

Decommissioning/closure

- Benches and side walls will be fracture blasted through precision blasting, to facilitate a slope of approximately 23 degrees.
- All loose and dangerous rock will be removed or compacted. Established slopes will be compacted.
- Shot rock will be covered with at least 0,5m of soft overburden to filter into crevices and prevent post closure subsidence.
- Overburden on the slopes will be compacted.
- Slopes will be covered with topsoil and vegetated to facilitate a stable soil surface.

- Excavations will not be free draining, but due to the low rainfall, no water accumulation will occur that could pose a safety risk.
- Individual hard rock quarry areas will remain fenced until closure was granted. Depending on the depth (excess of 10m), the landowner will take over the responsibility to maintain the fence, for which he will be compensated. The necessary consultation with the landowner on this matter will take place. The necessary signage will be posted around such mining areas to sensitize local residents on the latent dangers of the rehabilitated quarry areas.
- All equipment, structures and cabling will be removed from the plant area.
- All hazardous substances will be removed from the mine and plant area.
- All stockpiles will be removed and the area will be vegetated and protected against erosion.
- Roads will be ripped, vegetated and protected against erosion.
- Four years of aftercare will be provided and the necessary performance reports will be submitted to the DMR.
- Closure application will be lodged with the DMR.
- Final meeting with community liaison committee will take place.

Reports that will be submitted

- Monthly return of work - MA Reg.14.1.1
- Annual medical report - MHSA Sect 16
- Accident reports - MHSA Chapter 23

# 9. COMPETENCY TO CONDUCT MINING

## Financial competency

DVD Quality Engineering (Pty) Ltd is a well established concern and will, in conjunction with DVD Engineering Services, provide the finances to develop the proposed mining site. The concern is financially sound and has been in existence for more than a decade and financial statements reveal substantial net profits. Financial statements also reveal substantial accumulated net profits, which will enable the concern to fund the development and rehabilitate the mine and the development should therefore not pose a financial risk to the DMR or landowner.

Currently the average price of manganese per ton is R800 and the gross operating costs approximately R225 per ton and total costs approximately R399 per ton. Nett profit accumulates to R196 after tax deduction, which would result in a monthly profit of R980 000, which is more than adequate to provide additional cover to rehabilitate 0,2ha that will be affected by mining per month.

Considering the above, DVD Quality Engineering (Pty) Ltd was able to satisfy the DMR in terms of section 23(1)(b) regarding its current financial status and financial sustainability of the proposed mining operation.

## Technical competency

Technical competency will be provided in-house by DVD Quality Engineering (Pty) Ltd. The concern is involved with earthworks at various mines in the district and in Kuruman and will be fully competent to develop and profile the individual detrital mining areas. With regards to blasting, the applicant has no experience, but will appoint a qualified blaster whom would be able to develop the mining areas with rehabilitation objectives in mind, with specific emphasis on slope profiling. Since the applicant has no hard rock mining experience, a competent mine manager will also be appointed.

Furthermore, the applicant will appoint a competent geologist to ensure that ore deposits of significance are developed and that wasteful mining is prevented, which would prevent unnecessary establishment of waste dumps and increase in rehabilitation monies.
The applicant also disposes of a fully qualified workforce that will ensure that development and rehabilitation procedures are executed correctly, which eventually will reduce the significance of impacts and improve the quality of rehabilitation work.

The applicant disposes of most of the equipment, except for the crushing equipment and will therefore be able to perform the required rehabilitation tasks without significant capital outlay.

## Environmental competency

It is important that an applicant for a mining authorization, or its representative, disposes of adequate environmental knowledge to ensure that an environmentally sustainable concern is established, that complies with current legislation and poses limited post closure impacts.

Environmental related aspects will be dealt with by the managing director of DVD Quality Engineering (Pty) Ltd and the appointed mine manager. The EIA will provide the applicant with adequate information to understand the impacts related to the quarry concern and the prescribed mitigation measures outlined in this document will enable the applicant to mostly address environmental impacts. Since they might not have all the necessary knowledge to facilitate rehabilitation of the quarry footprints, a competent environmentalist will be appointed on an *ad hoc* basis to provide specialist input, especially with establishing ground covers.

Due to the applicant's involvement in earthworks and related activities at mining areas, the managing director is fully conversant with servicing/maintenance of vehicles in the appropriate manner to preclude hydrocarbon impacts and to facilitate safe storage of hydrocarbons and implement dust control measures. Considering the activities involved with the mining venture, the proposed concern will require good management and housekeeping which are daily activities at the applicant's work stations. A site manager will be appointed and will be able to identify and mitigate any environmental impacts that might surface during the operational phase and in the process, prevent any extended environmental and social impacts.

Since the site is located in a very low rainfall area with highly porous soils, storm water diversion/control measures are generally not required at the mine, provided that the hill slopes below phases 3 and 4 are not disturbed, hence no specialist assistance is required. Re-vegetation of disturbed areas, especially at the hard rock mining sites, will pose some challenges due to the lack of topsoil and the applicant will appoint a pasture specialist and if necessary, a botanist to assist.

Visual impacts will be addressed through the rehabilitation of the site. The distance to noise receptors is mostly extensive and it will be easily controlled through proper management.

In conclusion, the environmental impacts associated with the proposed mining concern are restricted to low silt transport, low-moderate soil instability, limited erosion on slopes, low-moderate visual impact, low vegetation cover loss, minor loss of soil fertility and low social impact in terms of blasting, noise and dust generation. Remedial measures to manage these impacts fall within the scope of the applicant's capabilities.

Since the concern will have a reasonable product turnover and guaranteed financial stability, the rehabilitation fund can be managed properly and the applicant will be able to effect the amendment of the guarantee as required by the provisions of the MPRDA, which in turn will reduce the environmental risk.

Through the implementation of the conditions of the EMP, the applicant will ensure that the important environmental considerations applicable to this particular mining site are executed. The applicant will also submit an annual performance assessment report reflecting on its ability to manage the environment.

******

[redacted]

The applicant holds no old order or new order mining rights or permits.

[redacted]

The Northern Cape is one of the poorer provinces which also reflects in available job opportunities. IDP objectives identify job creation as one of the major tasks in the Siyanda Local Municipality and considering that DVD Quality Engineering will create at least 30 new job opportunities, development of the mine is in line with IDP objectives. There is one provision for this positive impact to realise and that is the successful rehabilitation of mined out areas, which is also an important matter identified in the IDP and is connected to efforts of the Siyanda Municipality to stimulate local tourism.

Every job opportunity is therefore valuable and with the objective to rehabilitate mined out areas to decent standard, the proposed mining venture should receive the necessary support.

*****

# 12. "NO-GO" OPTION

This option will result in the following:

1. The proposed development will provide at least 30 new employment opportunities and therefore financial support for at least 120 individuals (excluding downstream employment) over a period of thirty years would be lost. Similarly skills development and an entire career would be lost to 30 people. Based on the multiplier effect, approximately 300 individuals would not benefit from the project.
2. The RSA will not receive a substantial amount of income generated through tax deduction and export revenue, which is a significant loss considering the drive to expand the tax base and increase social expenditure, in order to increase the quality of life for the lower income group.
3. The Department of Mineral Resource's objective of the sustainable development of the RDA's mineral resources as embodied in section 1 of the MPRDA would not realise. This will further result in a significant loss of funds contributed to the Social & Labour Plan for uplifting of local communities and assistance to IDP projects.
4. Development of the mine will lead to a welcome cash injection to the local Siyanda economy - this opportunity would be lost.
5. Economic and ecological value of the land will remain low, due to its present status of overgrazing and proliferation of *Acacia mellifera*. Currently the land concerned has very little value during the winter and periods of drought as a grazing unit, due to the extensive impact of *Acacia mellifera*.
6. The owner would receive substantial higher income from the mining project than what farming could offer and would still be in a position to utelize farm areas that do not dispose of manganese deposits.
7. Mining would eradicate most of the *Acacia mellifera* and would reinstate a grass and shrub cover over time, which would be a significant long-term benefit to the landowner.
8. The applicant will be prevented from expanding its business and in the process also prevent its workforce a secure job environment and decline its BEE partner the opportunity to share in these future benefits.
9. Tranquillity of the area will be significantly better.
10. Noise and dust levels will be significantly lower during working hours.

11. The amount of vehicles on the R325 per day, will remain the same, but due to the poor road conditions and already significant heavy vehicle count, the reduction in potential impact would significantly reduce safety risks. This scenario might change, should production rates exceed 10 000 tons per month.
12. The deterioration of road surface will not be expedited.
13. Visual impact will be significantly lower, but considering the degraded visuals of the larger area, the concern will fit into the current setting. Concurrent rehabilitation will ensure that visual impact will remain low.
14. The abutting landowners will be able to continue with current farming practices, irrespective of whether the development takes place or not.

When considering the 'No-Go' option, the substantial higher income that the landowner could generate if he personally mines the area concerned, cannot be considered, since the landowner had the sole right to apply for mining authorization as from 1 May 2004 to 1 May 2005 as per MPRDA provisions, a benefit that was not made use of.

Considering the low-moderate environmental impacts that the Boskop mine will impose and the fact that a large portion of the site can be reasonably well rehabilitated, the economic benefits render the "No-Go" option the less favourable option.

*****

Climatic conditions such as temperature, rainfall and wind velocity for example, influence vegetation growth, erosion levels of disturbed areas, dust generation and air pollution levels, as well as social impact in terms of quality of life. Climatic conditions can therefore influence the significance of impacts caused by developments such as mines. It is important to understand the role thereof when determining the impacts of a specific development and the remedial measures that need to be implemented.

The Siyanda District and the Northern Cape *per se* is known for its extreme climate conditions. The landscape is characterized by the Kalahari desert, wavy hills, sand plains and sand dunes. It is a semi-desert area, with low summer rainfall levels. The average summer temperatures differ between 18°C and 36°C, with extremes of up to 43°C. Winter temperatures are moderate and differ between 3°C and 20°C. The Siyanda District falls within a rain shadow and rain generally occurs in early spring and then again between February and April. Using rainfall of the Kuruman area with significant higher rainfall would be risky when the impact of climate on rehabilitation procedures is considered. The use of statistics for the Kathu to Postmasburg area would therefore be more accurate.

Average rainfall of the area differs between 150 and 200mm per annum. The area concerned therefore has a typical continental climate, with extreme high temperatures and rainfall in the form of thunderstorms, mainly restricted to the summer months. The highest summer day temperatures of more than 40°C are measured from November to February. Winters are extreme with temperatures often below 0°C and experienced from June to August.

Climatic data and information on the area concerned is insufficient and various sets of data related to the area between Kathu and Postmasburg are presented to provide a general overview of the climate of the study area.

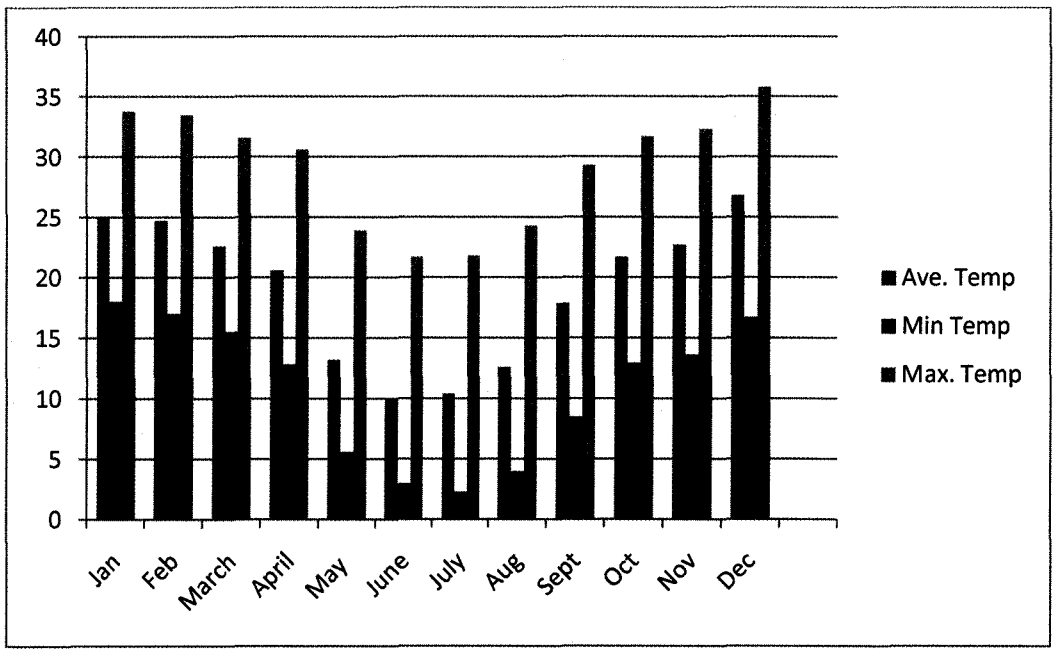
## Temperature

Postmasburg

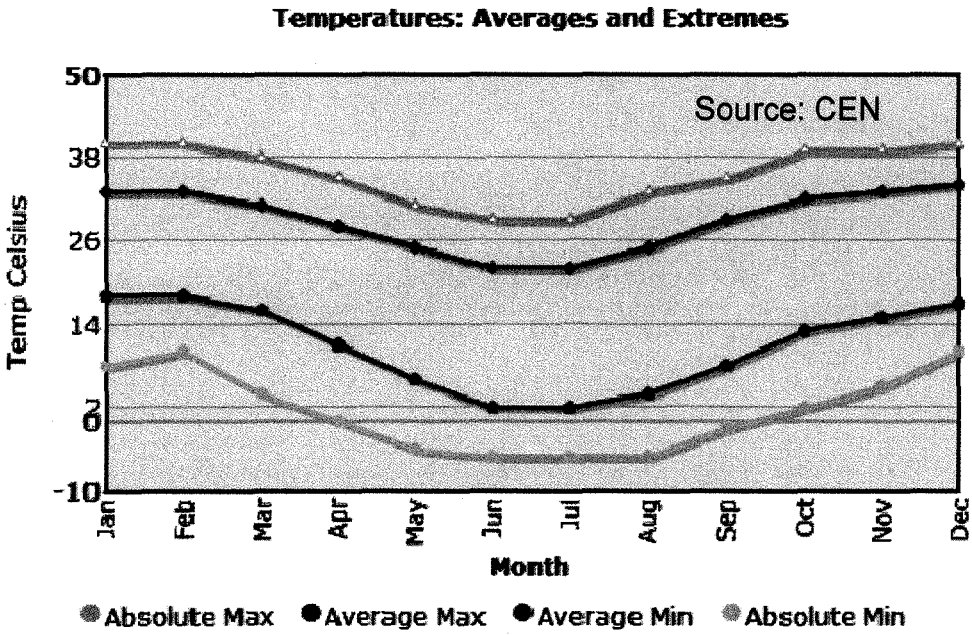
The monthly distribution of average daily maximum temperatures indicate that the average midday temperatures for Postmasburg range from 17°C in June to 32°C in January. The region is the coldest during July, when the mercury drops to 0°C on average during the night.

Kathu

From the graph below, it seems if the Kathu area is slightly warmer in summer and slightly colder in winter than Postmasburg and most probably represents the most accurate statistics for the Boskop Mine area. The Kathu statistics are more or less the same as those for Kuruman. It is therefore clear that low temperatures during winter will significantly affect vegetation processes, whilst high summer periods will significantly increase bare soil temperatures which, in the absence of rain and soil moisture, will significantly affect establishment of vegetation during the summer months. It is thus essential that seeded soils be protected with a mulch and possibly be irrigated in the beginning to head start the vegetation process.

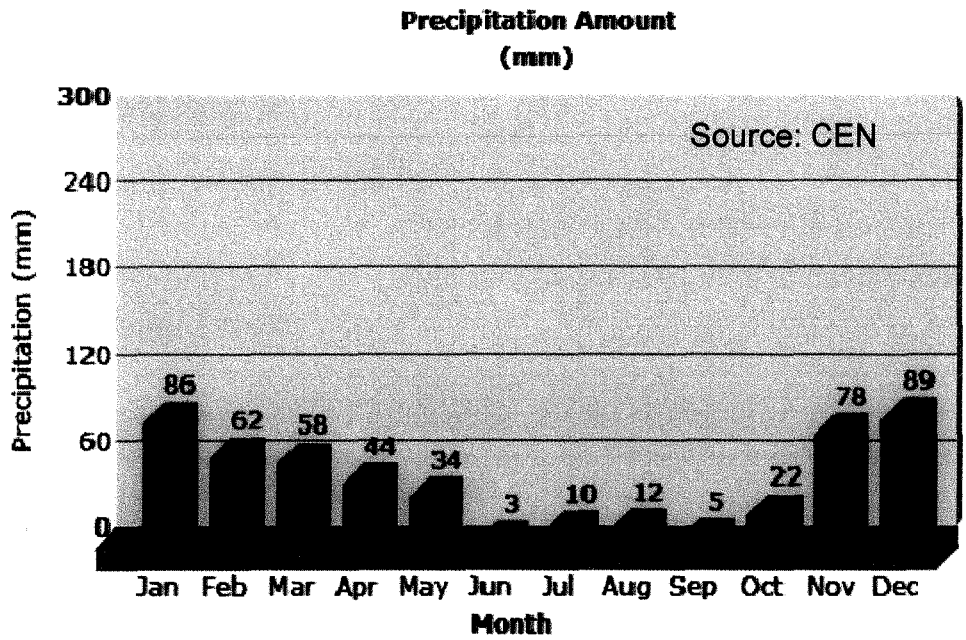


## Kuruman




## Rainfall

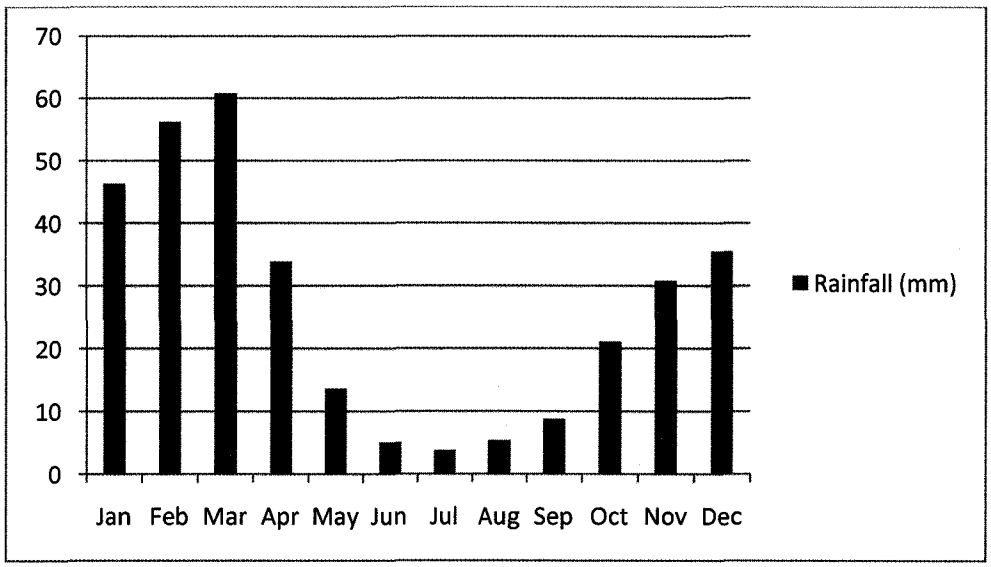
Average rainfall in Kuruman more than 100km away, totals around 500mm per annum, which is significantly more than the rainfall that the immediate study area receives.



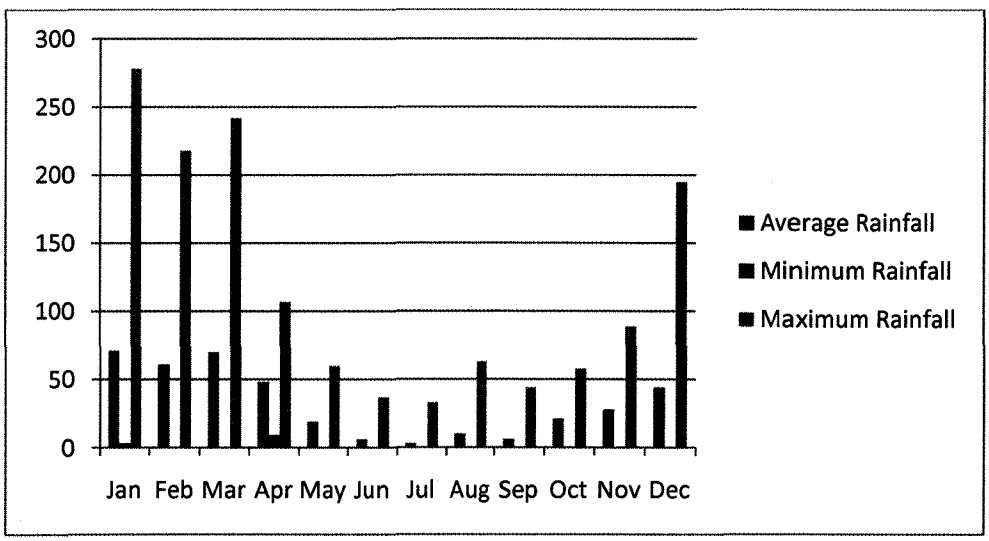
Postmasburg

Average rainfall of Postmasburg, 32km to the south, totals approximately 340mm per annum and could be more representative of the rainfall in the study area. It clearly indicates that seed beds should be prepared in October with seeding taking place from November to December to facilitate proper germination in the wetter summer months. The low rainfall will require that initial irrigation be contemplated.



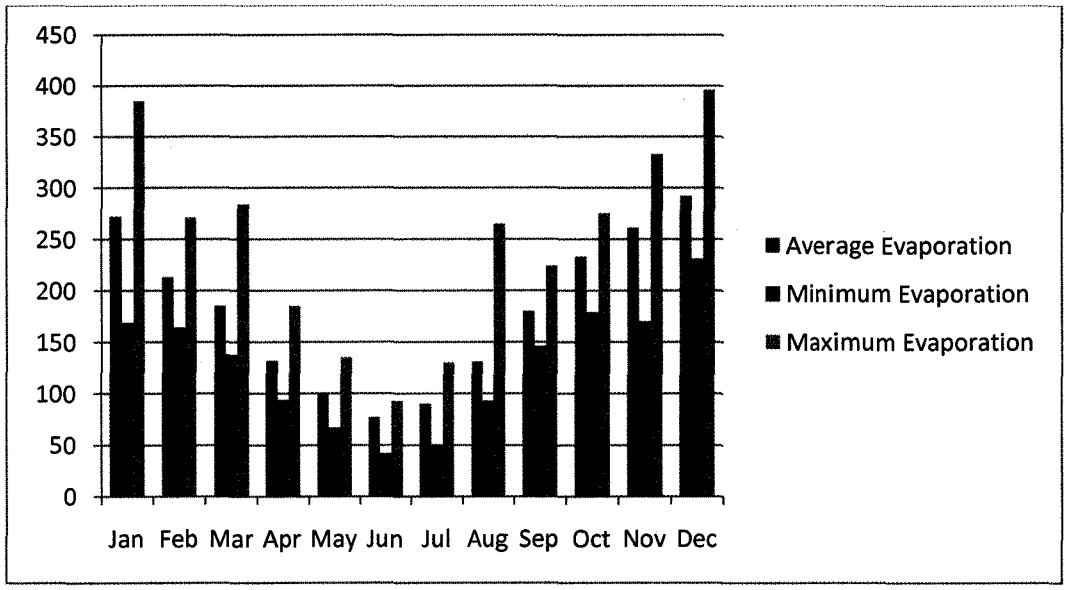

Olifantshoek Dam

Average rainfall at the Olifantshoek weather station located to the west of the study area, totals 385mm per annum and it seems that it can be safely assumed that the study area could potentially receive around 350mm per annum.



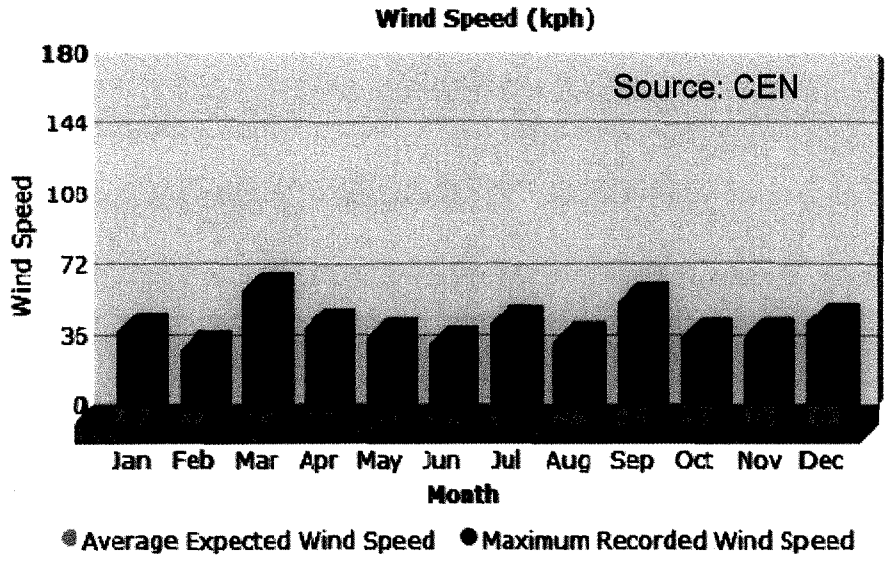

 

Evaporation is extremely high at 562% of annual precipitation, which will seriously affect soil moisture regimes and thus establishment of vegetation covers and needs to be taken into consideration during the rehabilitation phase.

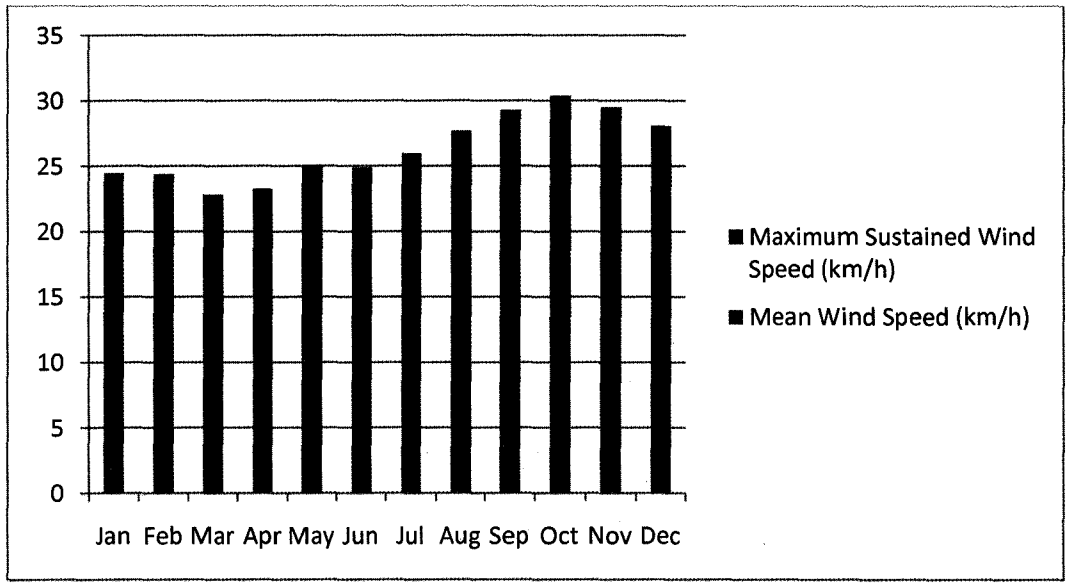



## Wind Regimes

The wind rose for Kuruman indicates that prevailing wind direction is mostly south-southeast to southeast with north-western to north-north-eastern winds the other significant wind roses. Wind speeds are generally low, but extreme wind speeds have been recorded for the north-western (above 30km/h) and north-eastern components (above 38km/h). The most extreme wind speeds occur in March and September and could affect soil stability and the seeding process.



Kathu



The impacts of the DVD Quality Engineering (Pty) Ltd manganese mine on environmental parameters are assessed in this section in accordance with the criteria of the Minerals and Petroleum Resource Development Act 28 of 2002 and where applicable, the National Environmental Management Act (NEMA).

Impacts were assessed according to the criteria listed below:

Extent

Whether the impact will occur on a scale limited to the immediate site of the proposed activity, local area and immediate communities and settlements, sub-regional (municipal), regional (provincial) or national scale.

Duration

Whether the time span of the impact will be short term (0-5 years), medium term (5-15 years), long term (in excess of 15 years) or permanent where natural processes or mitigation processes cannot eliminate the impacts.

Intensity

(Magnitude) Whether the size of the impact is low, medium, high or negligible.

Probability

The probability of the impact actual occurring, as either unlikely, probable, likely or definite.

These criteria are evaluated in terms of:

- Significance (Insignificant-low-moderate-high)
- Status (positive-negative-neutral)
- Confidence (based on academic information, specialist knowledge, site evaluations and applicant's approach.

The significance of the impact on the environmental parameters is rated as:

Low Significance

The project will not cause any major adverse or beneficial changes to the biophysical, social or economic environment. Impacts experienced will abate almost immediately after cessation of activities and the biophysical, social or economic system should recover and return more or less to the natural state. No expensive mitigating measures will be needed to address any of these impacts. Ecological functions will continue undisturbed and no complaints from Interested and Affected Parties (I&AP's) are anticipated. No rare and endangered species or sensitive areas exist in the area.

Moderate Significance

The project will induce moderate short to medium term changes to the biophysical, social or economic environment. The impact would be induced outside the development area and also possibly on a sub-regional level. Over the medium term the impacts could fade away, but the implementation of mitigation measures are normally required to eliminate these impacts. The impacts would be experienced for some time after cessation of activities but would not severely affect the biophysical, social or economic environment. With mitigation the biophysical, social or economic system should recover, but the return to the natural state would be very slow and in some instances may not be achieved. I&AP's might express some concerns and complaints may be received on an *ad hoc* basis. Rare and endangered species or sensitive areas may exist in the area and could be marginally affected.

High Significance

The project will induce extensive long-term changes to the biophysical, social or economic environment. The impact would be induced outside the development area and also possibly on a regional to national level. The possibility of secondary impacts arising from the project is high. Over the long term the impacts could fade away but the implementation of expensive mitigation measures are normally required to eliminate or mitigate these impacts. These impacts would be experienced after cessation of activities and could severely affect the biophysical, social or economic environment. With mitigation the biophysical, social or economic system could possibly recover, but the return to the natural state would be, or normally not be, achieved. Ecological functions will be permanently

disturbed and major complaints from Interested and Affected Parties (I&AP's) could be expected. Rare and endangered species or sensitive areas that exist in the area might be critically affected.

Should the impact assessment as a minimum reflect 2-3 impacts of high significance and 2-3 impacts of moderate significance, the project shall be viewed as potentially flawed and continuation of the project should be seriously reconsidered or special engineering or biophysical/social intervention must be implemented.

Descriptive terms

Spatial extent:None/Insignificant (0), Site (1), Local (2), Sub-Regional (3), Regional (4),

Duration: None/Insignificant (0), Short Term (1), Medium Term (2), Long Term (3), Permanent (4)

Intensity: None/Insignificant (0), Very Low (1), Low (2), Low-Medium (3), Medium (4), Medium-High (5), High (6), Very High (7)

Probability: None (0), Unlikely (1), Probable (2), Likely (3), Definite (4)

Significance: 0-6 = Insignificant; 7-15 = Very Low; 15-22 = Low; 23-31 = Low-Moderate; 32-40 = Moderate; 41-47 = Moderate-High; 48-55= High; above 55 = Very High

**********

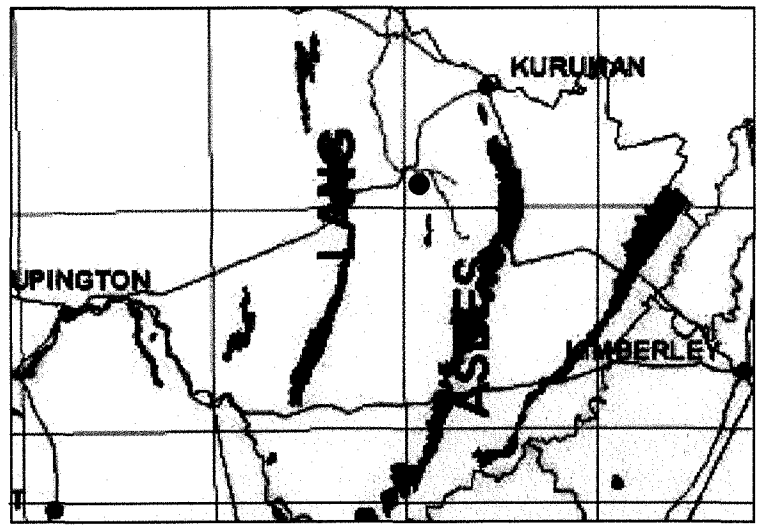
 

# 15.1 TOPOGRAPHY

## Overview

Topography can be described as the form and structure of the landscape. This structure of the landscape is influenced by the geology of the study area, whilst the form is dictated by factors such as erosion and drainage channels shaping the landscape into plains, hills, mountainous areas and valleys.

The Northern Cape is characterized by four topographical features namely the 1) Kalahari, 2) Bushmanland, 3) Griqua Fold Belt and 4) the Ghaap Plateu and Boskop Mine is positioned in the latter at elevation level 1265m to 1310m above mean sea level. The proposed mine is located in the western reaches of the Orange River catchment. Generally the greater area can be described as flatland with the Asbes Mountains and Langeberg Mountains flanking the area to the east and west respectively.

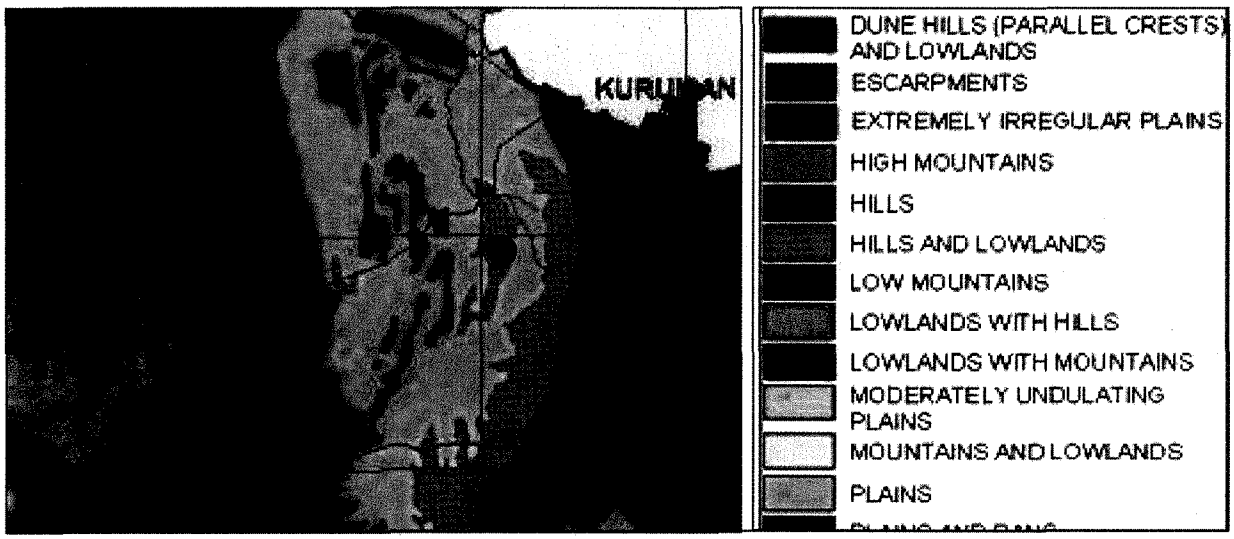



The terrrain morphological units present in the landscape of the study area are descriped as hillis and lowlands to the west and plains to the east and south. The structure and form of the landscape in the study area are directly related to the erosion resistant quartzitic and

manganese characterised hills in the western corner, whilst the eastern section was shaped by erosion of the softer shale and dolomite deposits in this particular area. The topography of the area is still largely intact and was only affected by limited historic 'pocket mining' of the outcrop areas which has changed the topography in an insignificant manner. These areas all fall within the proposed mining footprints and the objective should be to rehabilitate these surface disturbances as part of the Boskop rehabilitation process.

The crest of the hill is maintained by band of quartzite along the 1285m contour at phase 3 and replaced by shale down slope, which is much less erosion resistant. This caused a much steeper incline from the 1270m contour to the crest of the hill. At phase 4 the quartzite band is found at contour level 1300m resulting in a steeper slope to the detrital mining area to the south-east.




Further to the east the property is almost divided in two halves by a shallowly incised episodic drainage channel positioned on the contact of the manganese ore body with dolomite deposits located on the eastern half of the property, which reveals an almost flat topography. Further afield to the east and south, the plains continue on abutting land, whilst to the north the topography rises again to the crest of another hill that dominates the landscape and which is also currently mined. The hill range on which phases 3 & 4 are positioned, continues to the south-west.

Phase 1 is located between the river and access road and between contour level 1177m and 1170m with an average slope of 1:160 to the north, which will facilitate an easy detrital extraction process and will preclude active erosion processes. Phase 2 is located

between contour level 1180m and 1165m with a steeper slope of 1:26 to the north-east. This particular portion of land is still flat enough to prevent erosion to occur and is reflected by the landscape around existing excavations. Phase 3 is located on the crest of the hill and disposes of a 1:75 slope to the north. The interface reveals a slope of 1:12 and care must be taken that this area is not unduly disturbed. The crest of phase 4 gently slopes to the north (1:23), whilst the interface between the crest and detrital mine area to the south-east reveals a very steep slope of 1:7 which should not be disturbed.


Both the interfaces referred to will facilitate increased surface flow and velocity and could result in sheet erosion if disturbed unnecessarily and should be protected unless significant reserves are found in this area, although preliminary geological investigations indicate the contrary.

Mining of phases 1 and 4 will generally be two to three meters deep, but some drill results indicate it could be as deep as 10m. Since the bulk of the detrital consist of sandy red soils, the excavation will be filled to 85-90% of its original level. Best case scenario would be a depression of 0,45m, whilst the worst case scenario would be 1,5m. The impact on the topography would therefore be of very low significance compared to the large mines located to the north-west. With proper perimeter profiling and vegetation, the impact would be largely masked.

Mining of phase 2 will generally be 3m-5m deep, but some drill results indicate it could be as deep as 10m. In this particular area fill material would be less abundant and the excavation should be backfilled to 60-70% of its original level. Best case scenario would be a depression of 2m, whilst the worst case scenario would be 4m. The impact on the topography would therefore be of low significance. In this particular area outcrops frequent and these areas could be mined much deeper which could result in pocket holes in the landscape and unless linked to each other and properly profiled, would cause substantial onsite visual impact and should be avoided.

Mining of phase 3 will generally be 10m deep, but some drill results indicate it could be deeper. In this particular area there is no fill material and no backfilling will occur, which means that an extensive slot of approximately 500m x 80m x 10m would be mined in the crest of the hill. Since the outcrop areas are not fully linked, it could again result in 'pocket mining' that will tend to increase the topographical impact and should be avoided where possible. The impact is rated of moderate significance. A second scenario is advocated namely that mining will extend from the 1170m contour to the western boundary of the property, which will result in most of the hill being removed. The topographical impact would be moderate to high, but less noticeable due to the flat quarry floor that will be established and since the floor would be aligned with the topography of the land to the east and north. This would be the preferred option from a visual perspective. Mining will advance the faces into the hill and will create a series of benches 20m high on the western boundary, which will not be easily masked through rehabilitation. However, based on geological information available and considering the actual mining strategy on the property to the south-west, this scenario might not realize.

Mining the crest of phase 4 would result in a very large quarry with extent of 12,5ha and 10m deep and the significance of the impact is rated moderate to high. This will result in a

box-cut depression with steep, hard, unnatural faces with little to no vegetation to soften the impact unless soil is imported. To mitigate this impact, mining should be phased and the sides progressively profiled to slopes of 1:2 in order to try and blend it with surrounding landscape. However, a complete integration with the surrounding landscape is not possible. However, with the correct profiling and placement of overburden, additional topsoil and proper re-vegetation with climax species of the surrounding area, the impact on the topography can be mitigated to an acceptable standard. With time this topographical interference would become less prominent due to natural re-vegetation processes, provided that proper soil horizons are established. Any spoil material (topsoil and/or subsoil) generated at other development sites in close proximity to the mine should be imported to assist in the above regard. The floor areas of both phases 3 & 4 should be generally flat and will lend towards successful rehabilitation should adequate topsoil be available.

Should not all material of phase 4 be economically viable to mine, the extent of the area could result in extensive 'pocket mining' and will impose a significant topographical impact and should be avoided when possible. This scenario is depicted in the Google image and is generally not an acceptable mining method.

**FINAL TOPOGRAPHY THAT SHOULD BE AVOIDED**

The mine area and surrounds reveal a rather homogenous texture resultant of the grass and thicket cover. Mining would significantly impact on the texture of the area and will enhance the topographical impact at all four phases, but with a proper rehabilitation approach this impact could be adequately mitigated. Over the medium term vegetation will mature and surface cover will increase which would reduce the visibility of the topographical impact to some extent. Due to the lack of soil in phases 3 & 4, topographical impact would not be readily mitigated unless soil is imported.

Due to the flatness of the plains and rock bed of the hills in conjunction with low rainfall, the landscape should not be affected by water erosion and no donga formation is anticipated.

The existing access roads to the farm residence and individual quarry area will be upgraded when necessary, but it will not result in any change in the landform. The plant and office area with its associated containers, bund walls, stockpiles and mining equipment will result in a minor topographical interference, but since it is mobile and to be relocated a number of times and removed at closure, the significance of the impact is negligible.

Since no topsoil stockpiles will be created on the landscape no influence on the landform will be imposed.

Excavations in phases 3 & 4 are located on the watershed; hence changing the topography would not change run-off patterns in these areas and would thus preclude erosion down slope, provided that the interface areas remain undisturbed. Phases 1 & 2 and the southern section of phase 4 would change runoff patterns and water will tend to accumulate in the excavations, but due to the low rainfall in the area and the high porosity of the soil, the impact is rated insignificant.

Phases 3 & 4 are definite focal points in the landscape and will therefore tend to enhance the impact on the topography. It is therefore important that adequate mitigation measures are implemented to reduce this impact.

The topographical impact would only be acceptable, should the necessary precautionary measures contained in this document be implemented. The impact on the topography is

rated as permanent, local and of moderate to high significance if no remedial measures are implemented, but of moderate significance with remedial measures in place. With time this topographical interference would become less prominent due to natural re-vegetation processes, provided that proper soil horizons are established on profiled sides of quarry areas, especially in phases 3 & 4.

The topography of the larger area has been significantly altered. To the north-northwest the Kumba iron ore mine resulted in a very high topographical impact, whilst a new mine to the north-northeast and south-west imposes a moderate topographical impact. To date it seems if no sections of these excavations were successfully rehabilitated and no backfilling occurred. The cumulative impact is therefore very high, but is seemingly accepted due to the economic importance of these mines in terms of foreign currency generated, local economic boosting and job creation.

**Impact on topography**

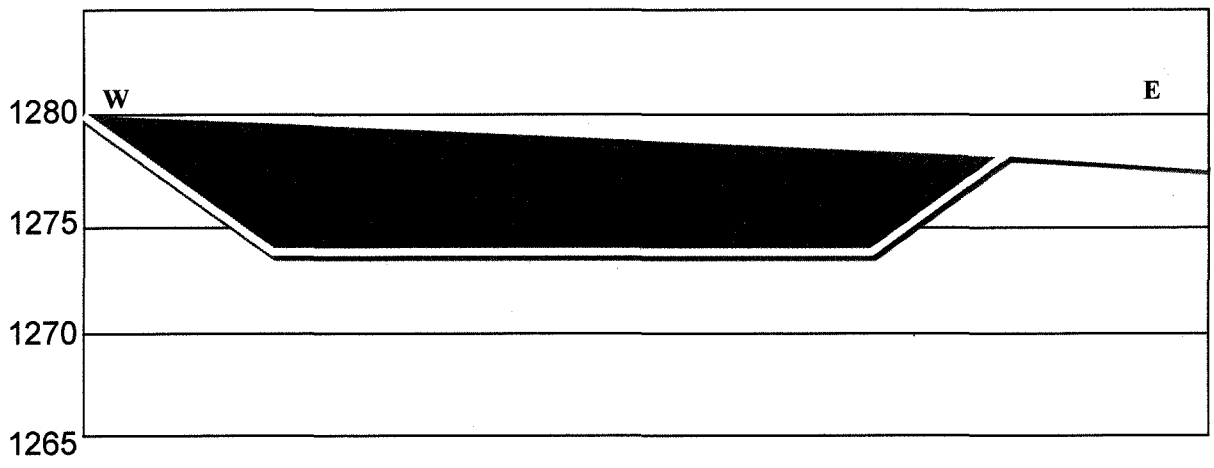
| | OPERATIONAL (no mitigation) | WEIGHT | OPERATIONAL (with mitigation) | WEIGHT | CLOSURE | WEIGHT |
|---|---|---|---|---|---|---|
| **Extent** | Site Specific | 1 | Site Specific | 1 | Site Specific | 1 |
| **Duration** | Permanent | 4 | Permanent | 4 | Permanent | 4 |
| **Intensity** | High | 6 | Medium-High | 5 | Medium | 4 |
| **Probability** | Definite | 4 | Definite | 4 | Definite | 4 |
| **Status** | Negative | | Negative | | Negative | |
| **Confidence** | High | | High | | High | |
| **Significance** | **Moderate-High** | **44** | **Moderate** | **40** | **Moderate** | **36** |

## Management plan

- Mining shall not progress beyond the approved mine area.
- Each phase of the mine area will be divided into blocks to facilitate control over the mining process and concurrent rehabilitation.
- All residue screened out during the mining of detrital shall be returned to the applicable excavations, flattened and lightly compacted.
- The sides of each block in a particular phase will be profiled immediately after mining of the ensuing phase has started.

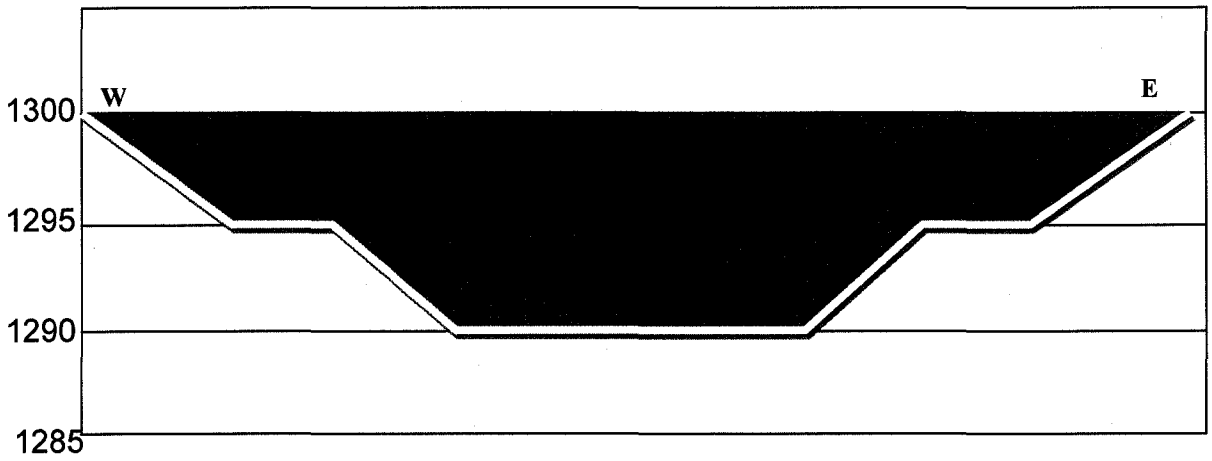
- Sides of phase 1shall be profiled to 1:3 slope. Outcrop areas where 'pocket mining' has taken place would be backfilled with residue to the same level as surrounding quarry floor.
- Sides of phase 2 will be profiled to 1:3 slope if excavation is less than 5m deep and to 1:2 slope if it is deeper than 5 meters. Where applicable, individual outcrop areas will be linked with each other to reduce the extent of 'pocket mining' and thus visual impact. Where this is not possible, residue must be used to fill these excavations to a reasonable level to facilitate future grazing in the area. If necessary, material could be sourced from phase 1 and more particularly when the excavation is less than 3m deep.
- The sides of the individual quarries in phase 3 and phase 4 must be profiled through precision blasting to 1:2 slope if less than 10m deep, or infill must be contemplated to achieve this objective. For this purpose residual material could be sourced at other surrounding mines or development sites when trucks are returning empty to the mine, which will reduce the haul costs extensively. Where excavations are deeper than eight meters, production faces shall be benched and then profiled through precision blasting or through cut & fill, depending on the geological strata in each area. The upper bench of quarry areas deeper than 10m would be profiled to a 1:2 slope and the lower bench to 1:1 slope.
- In the event that production faces are advanced from contour 1170m up to the western boundary, the 25m high faces must be benched and the middle bench must be at least 15m wide and a portion thereof must be retained when benches below and above are profiled. This will act as energy breaker for any runoff from the slope, failing which extensive sheet flow will occur on such long and steep slope. Where possible, benches must slope somewhat to the back.

**Schematic end profile of phase 2 & 3 (less than 10m deep)**

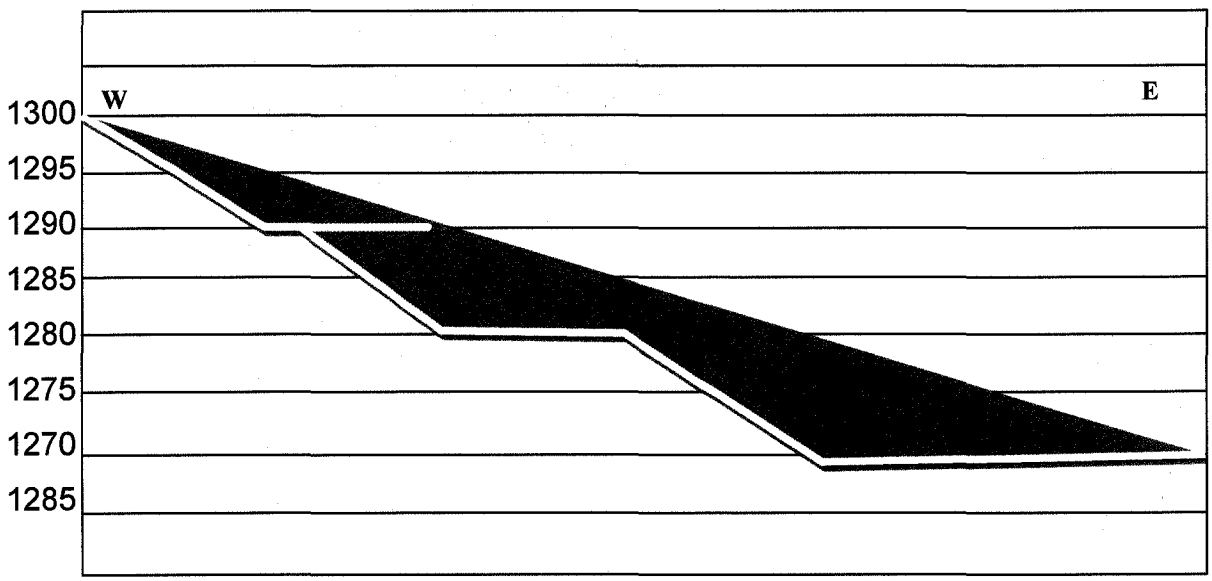


**Schematic end profile of phase 3 (more than 8m deep)**




**Schematic end profile of phase 3 (if mined along 1270m contour)**




- Profiling will be done aiming to prevent sharp angles and rather form flowing curves instead, which will blend with the surrounding landscape to a better degree.
- In the event that 'pocket mining' is indeed the only option, it is required that where possible, excavations must be linked with precision blasting to facilitate an acceptable post closure land-use. If this is not achieved, the landowner must be compensated for the permanent loss of future land use. Assessment of loss must be done by a competent person in this field.
- Any oversize rock that the quarries may generate must be stockpiled inside the quarries and once a particular phase has been completed it must be stacked at the

bottom of the excavation against the high walls, top dressed with overburden and topsoil and vegetated to improve slope profiles,

- The area will be mined according to the mine plan, but in order to reduce the man made appearance thereof, the shape will at closure be modified by shaping the corners to rounded profiles instead of rectangular shapes.
- Vegetation around the quarry areas, especially down slope of phases 3 & 4 will not be disturbed in order to curb erosion processes on site and reduce visual impact.
- The access and haul roads, where applicable, will be maintained with a proper wearing course and protected by properly designed, mitre cross drains and, where applicable, side drains.
- Erosion rills on the quarry slopes will be filled in as soon as possible, compacted and vegetated to prevent erosion gullies to develop with specific emphasis on the slopes of quarries located in phases 3 & 4.
- The storm water control measures described in this EMP must be implemented.
- The mining area will be reclaimed as close as possible to its original vegetation status, firstly by establishing a grass cover followed by infill planting of indigenous shrubs and trees.
- The post rehabilitation topography of the quarry floors and in particular quarries in phases 3 & 4 shall be generally flat to facilitate proper vegetation establishment and provide for gentle overland flow that will not stimulate erosion processes.
- At closure the following remedial measures will be applicable.
  1. The haul roads to the individual quarry areas will be obliterated and vegetated unless the landowner requests that it must remain in place as access roads to his camps.
  2. All remaining spoil stockpiles will be removed to the excavations and flattened.
  3. All remaining ore stockpiles will be sold off or removed to the excavations and flattened.
  4. All infrastructure, equipment and waste will be removed.
- The rehabilitation plan will be implemented in accordance with the time frames set. Each block of phases 1 & 2 & 4 (detrital area) shall be profiled within 6 months after mining has ceased in such particular area. Each 2ha section of each quarry area in phases 3 & 4 shall be profiled within 12 months after mining has seized in such particular area.
- A photographic record must be kept and complemented annually and must accompany the annual performance assessment report.

## 15.2 GEOLOGY

Most of the rocks that outcrop in the Siyanda and Kgalagadi District Municipal Areas form part of the Griqualand West and Olifantshoek Geological Sequence, with large areas covered under quaternary and tertiary Kalahari sand. The following rock types generally occur in the area.

**Overview**

Dolomite and chert

The dolomite series that forms part of the regional geology and of the Ghaap Plateau formation of the Transvaal Sequence, lies conformably above the Black Reef formation, outcrops in the south-eastern region and has a marked absence of detrital sediments. Three lithostratagraphic subdivisions are recognized in the series, namely 1) the Upper Dolomite Stage, 2) the Banded Iron Stage and 3) the Main Dolomite Stage. The latter is composed of dolomite with chert lenses and layers. Beds of the shale or quartzite are rarely encountered. The dolomite is bluish in colour when fresh, but weathers to a grey or pinkish grey or in some cases black. The rock consists of dolomitic limestone and small amounts of manganese and iron. Chert occurs as big masses, lenses and layers in the dolomite. The dense, fine grained hard chert tends to stand out in relief and tends to increase upwards in the succession. Many of these are broken up by the contemporaneous movement and erosion, with the angular fragments in some cases moulded together as chert breccias.

The main value of this formation is its exceptional water storage capability with high water quality yield which is of importance when engaging in mining processes from pollution and recharge perspective. This rock type is therefore also protected by the Dolomite Act of 1964. No waste sites or any material that could cause ground water pollution may be positioned directly on top of a dolomite formation.

Quartzite

Occurrence of this rock type is low, mainly restricted to the Olifantshoek area and is dominated by quartzite and shale of the Middle Matsap or Hartley Hill Stage. To the north

west of Olifantshoek a sequence of volcanic and pyroclastic rocks are split into an upper and lower division by a purplish quartzite. The lower division is subdivided by a greenish quartzite, whilst a conglomerate occurs at the base of the sequence. The upper Matsap that forms the Langeberg and the Korannaberg becomes less frequently exposed to the north where the Kalahari sand deposits become more prominent. The quartzite forms a good aquifer and water is generally of very good quality.

Banded Iron-formation

The Banded Iron Stone Stage is a laminated sequence of iron and silica rich sediments up to 350m thick in some areas. These sediments have apparently formed as colloidal chemical precipitates, however, in the Northern Cape they are found within the lower Griquatown Stage of the Pretoria Series and contain extensive fine detrital material, one of the targets of this mining application. This formation extends from the southeast to the north and covers a small part of the Siyanda and Kgalagadi District Municipal Areas.

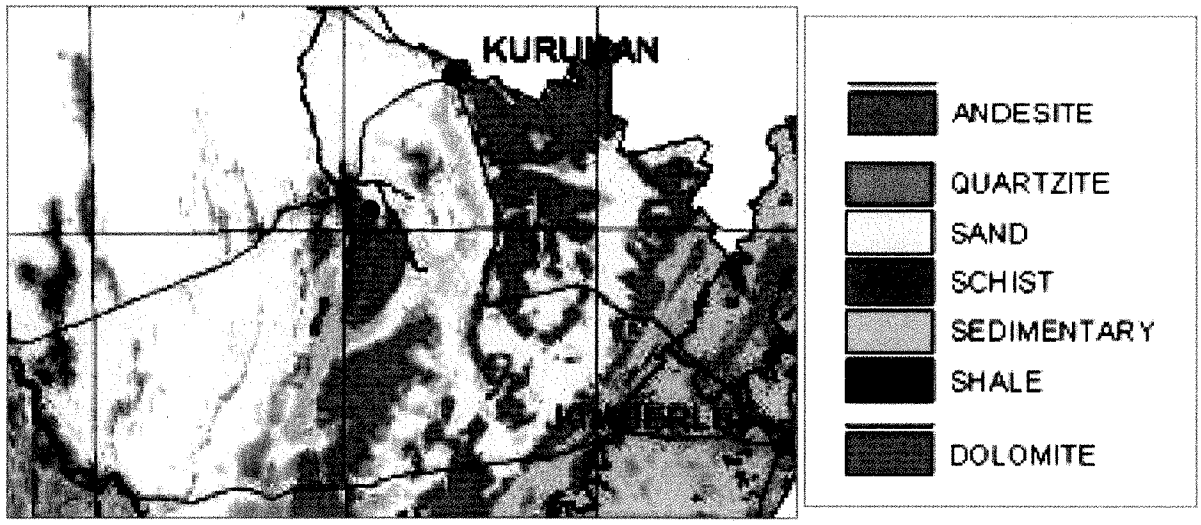
Shales and schist

Most of the shales occur either in the Ecca Group of the Karoo Super Group or in the Olifantshoek sequence. The shales dispose of pyrite resulting in poor water quality which is generally not fit for human consumption.

Andesite

Andesitic lavas outcrop in the southern regions towards Kathu and immediate surroundings and form part of the Middle Griquatown or Ongeluk Stage of the Pretoria Series and lie between the upper Griquatown Stage and the upper sediments of the lower Griquatown Stage. The Middle Griquatown lavas are directly underlain by a glacial tillite. The Pretoria Series also resulted in the forming of the Asbestos Mountains and the Kuruman Hills and between the Ghaap plateau and Langeberg further to the west.

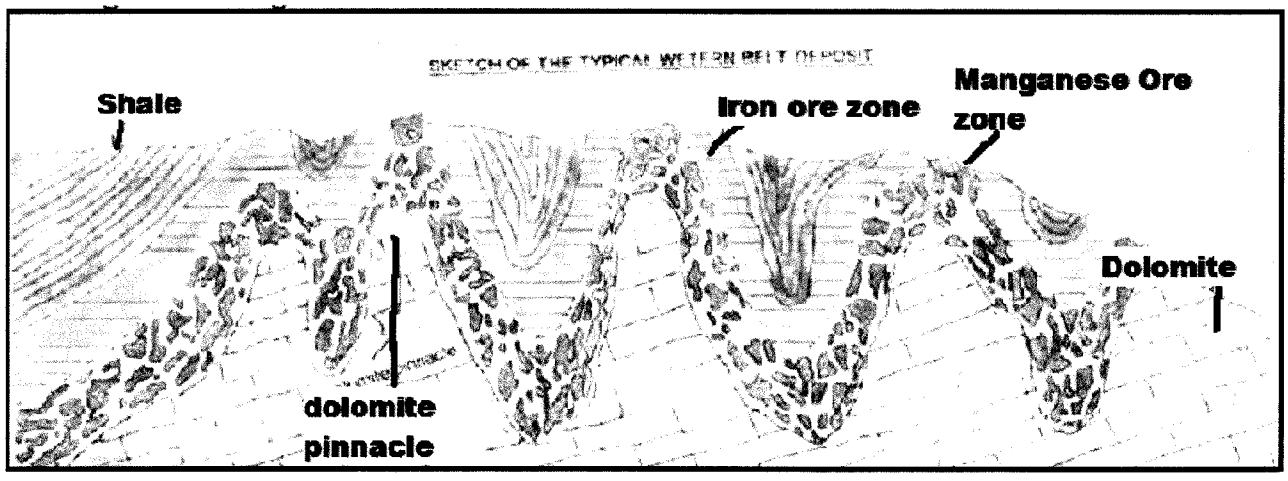



## Site Geology

### Geological setting

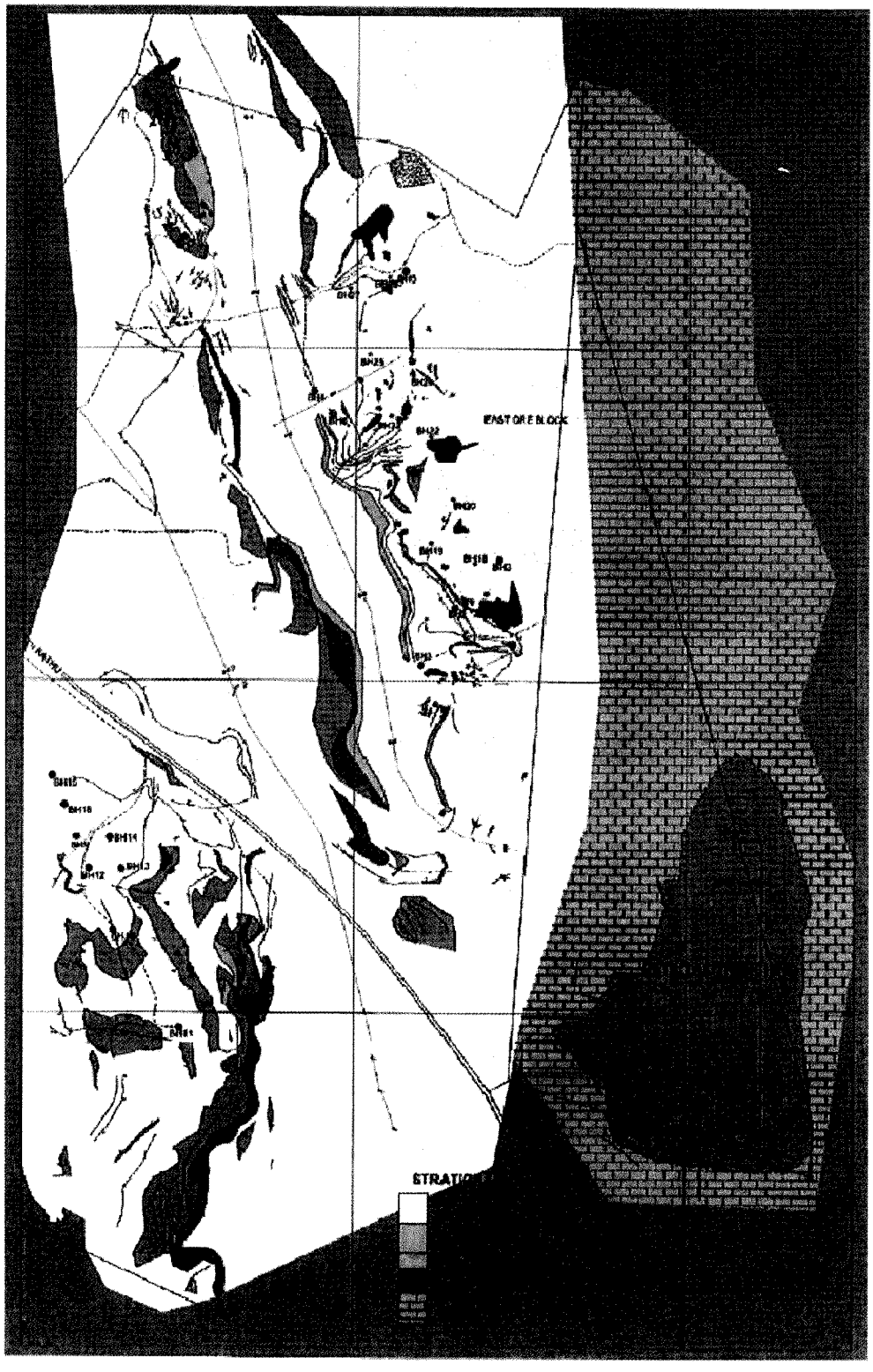
The higher ground relates to the more weathering resistant quartzite and manganese outcrops which covers the low ridges, following along the western farm boundary. The slopes down the low ridges are covered in quartzite and iron-rich manganese debris. Toward the east the topography comprises dolomite flats covered by bushy grassland. Historical manganese mining is evident from open pit excavations and remnant ore dumps adjacent to the old workings.

**Typical Western Belt Geological Structures (Source: Farrell Consultants, 2010).**



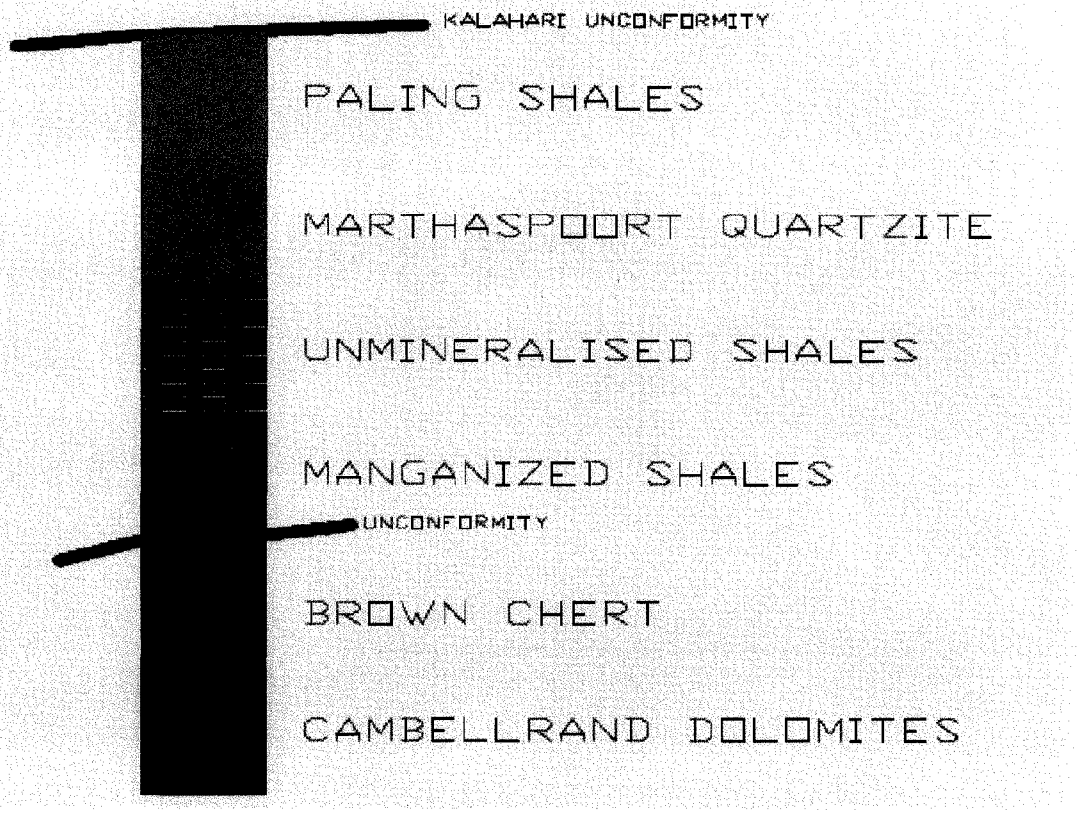
Manganese ore on the farm Boskop is located within the western manganese belt where it is present as replacement bodies within the lower part of the Sishen shales. The Sishen shales are conformably overlain by the Marthaspoort quartzite, which defines the top of the stratigraphic sequence on Boskop. The area towards the east and north-east is covered in dolomites of the Campbellrand Subgroup.

**Geological plan of area**



The local geology is structurally highly complex. Bedding plain dips are steep, generally >40 degrees. Folding is severely intense. The fold symmetry varies from tight upright folds, with fold limbs dipping vertically, to isoclinal folds with axial plains dipping at about 45° toward the west. Thrusting from the west served to add to the structural complexity within the area.

**Stratigraphic sequence on the farm Boskop**




Manganese outcrops are present within two main areas, namely :

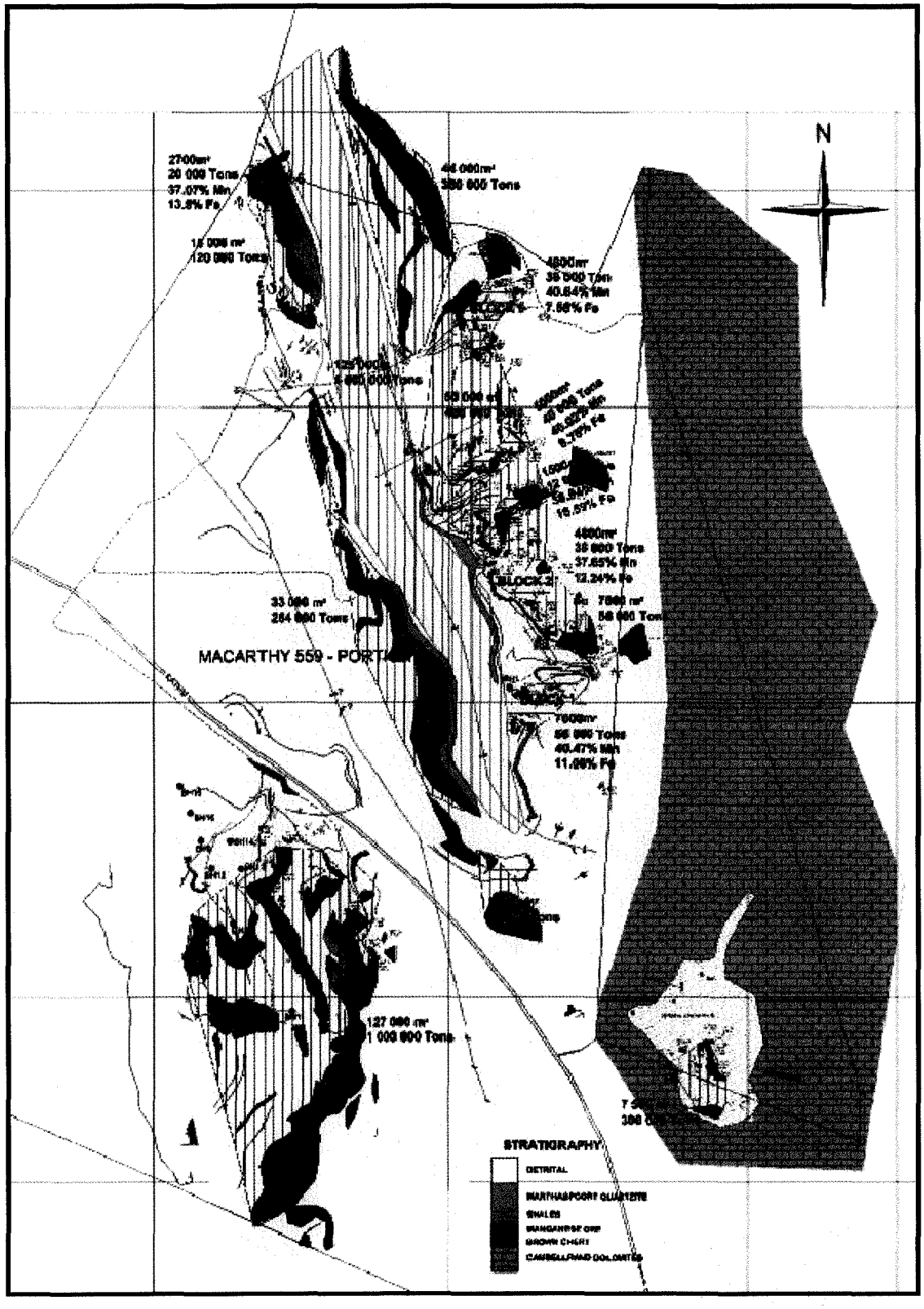
_ South of the Postmasburg bitumen road

_ North of the Postmasburg bitumen road

In the southern area, discontinued manganese outcrops are exposed along a north-south trending belt, about 800m long by 300m wide (Figure 7). Ore is also exposed in several prospecting trenches excavated during the past. Ore toward the north is in outcrop along two north-west to south-east trending belts defining the two limbs of a northward plunging, overturned, synclinal fold. Both the eastern up-dip and western overturned limbs follow along a strike length of about 1500m. Sporadic manganese outcrops are developed up-dip of the Marthaspoort quartzite, along the eastern fold limb.

**Surface geology on the farm Boskop**




Ore outcrop is exposed within a third area, located north of the main road and toward the east of the farm. Manganese ore, associated with the western belt, is thought to have formed in two ways:

1. As replacement bodies in shale (Boskop)
2. As slumped ore bodies in dolomite (Lohatla)

The ore is typically ferruginous consisting of hard, cryptocrystalline to crystalline bixbyite, however, a coarse crystalline, shiny Mn mineral, appears to be associated with more recent tectonic deformation (Namaqua event). This mineral macroscopically resembles marokite, a calcium manganese oxide with low iron content. Ore containing this mineral generally carries good grades (~ 50% Mn, < 5% Fe). Ore is also exposed within several old pit excavations.

**Crystalline bixbyite ore**

**Coarse crystalline Mn ore**

The site specific geological report was extracted from the scoping report compiled by CEN.

Mining of manganese on the farm Boskop will mostly deplete this mineral on the farm and the impact on mineral occurrence is thus moderate but unavoidable. From a regional perspective the impact is very low considering the vast deposits of manganese that still occur outside the property boundaries. However, more manganese mines are established in the area between Kuruman and Postmasburg and the cumulative impact is rated moderate to high at this stage which will increase in future.

Due to the geology of the study area and most particularly the dolomite pinnacle structures that developed in the area through leaching and infill processes, mining of manganese could result in 'pocket mining', which will impose a significant visual and topographical impact as discussed in the previous chapter. It is this essential that where possible, these infill zones be linked or profiled properly to avoid the crater type landscape that occurs on some other properties in the area.

The site is not a geo-site and the mineral not strategic; hence the impact on the geology of the study area is rated of low significance, but in a district perspective insignificant ,due to the abundance of outcrops.

**Impact on geology**

| | OPERATIONAL (no mitigation) | WEIGHT | OPERATIONAL (with mitigation) | WEIGHT | CLOSURE | WEIGHT |
|---|---|---|---|---|---|---|
| **Extent** | Site Specific | 1 | Site Specific | 1 | Site Specific | 1 |
| **Duration** | Permanent | 4 | Permanent | 4 | Permanent | 4 |
| **Intensity** | High | 4 | Moderate to High | 3 | Moderate to High | 3 |
| **Probability** | Definite | 4 | Definite | 4 | Definite | 4 |
| **Status** | Negative | | Negative | | Negative | |
| **Confidence** | High | | High | | High | |
| **Significance** | **Moderate** | **36** | **Moderate** | **32** | **Moderate** | **32** |

## Management plan

- The mining areas will be adequately demarcated and no mining or related activities will be permitted outside the approved mineralised area.
- Dolomites outside the mineralised area will not be affected or exposed without due course.
- The minimum working area for an efficient and effective operation should be utilized to limit potential impacts on geological strata outside the mine area.
- No mining will be undertaken in areas where reserves have not been adequately proved in order to avoid unnecessary/wasteful mining.
- All oversize stones/boulders will be returned to the excavation and used in profiling of production faces. In such cases this material will be neatly stacked against the vertical section of the face (phases 1 & 2) and benches (phases 3 & 4), compacted, covered with topsoil and vegetated.
- Extraction of manganese ore will take place with final rehabilitation objectives in mind to prevent unnecessary steep faces that will preclude proper vegetation processes.
- All erosion gullies within the mine area or outside the mine area that developed as a consequence to the proposed mining activities will be filled in and compacted as soon as possible. An erosion-monitoring programme will be implemented as a cradle to grave process.
- The interface between phases 2 & 3 should remain intact, unless significant manganese ore reserves are identified in this area since it in some places, disposes of more erodible shale deposits.
- Topsoil must be removed ahead of the production face and must be reinstated as soon as possible after extraction has been completed, to limit erosion potential.

*******

## 15.3.1 SOIL PROPERTIES

Topsoil is a very precious, non-renewable resource with high conservation importance and is necessary for effective rehabilitation of disturbances caused by development. The potential of soil to be used for rehabilitation of disturbed areas is defined by its depth, structure, texture and sequence of soil horizons. It is therefore essential that it be preserved and protected at the mine area and, if necessary, be supplemented from outside sources to ensure a successful rehabilitation process.

Soil is a complex mixture of eroded rock, mineral nutrients, decaying organic matter, water, air and micro organisms. Soil forms when organic matter decays, solid rock weathers and crumbles and when sediments are deposited by erosion. Mature soils are arranged in a series of zones called soil horizons, each with a distinct texture and composition that vary in different types of soils. Soil colour generally indicates fertility of soils for example; dark brown or black topsoil is nitrogen rich and high in organic matter. Grey, bright yellow or red topsoil is low in organic matter and will need enrichment to support a proper vegetation cover.

The average size of the spaces or pores in a soil determines soil permeability, i.e. the rate at which water and air move from upper to lower soil layers. Soil permeability is also influenced by soil structure: how soil particles are organized and clumped together. Soils vary in their contents of clay (very fine particles), silt (fine particles), sand (medium size particles) and gravel (coarse to very coarse particles). The proportion of these different sizes and types of mineral particles determines the soil texture. Loam soils which comprise of approximate equal mixtures of clay, sand silt and humus, are the best soils for growing most crops. Calcarious soils are those that contain free calcium carbonate and can also be regarded as alkaline soils. The term "dystrophic" refers to an imbalance in nutrients. Dystrophic soils are therefore soils that are rich in humus, which gives them a brown to black colour. They have variable amounts of nutrients and are sometimes depleted of oxygen owing to the high concentration of humus. The term "leaching" refers to a process whereby various soil components are dissolved by water moving through the upper layers, carrying the dissolved material to lower layers. Highly leached soils are those where most of the nutrients, etc. have been leached from the upper layers.

Kalahari sands

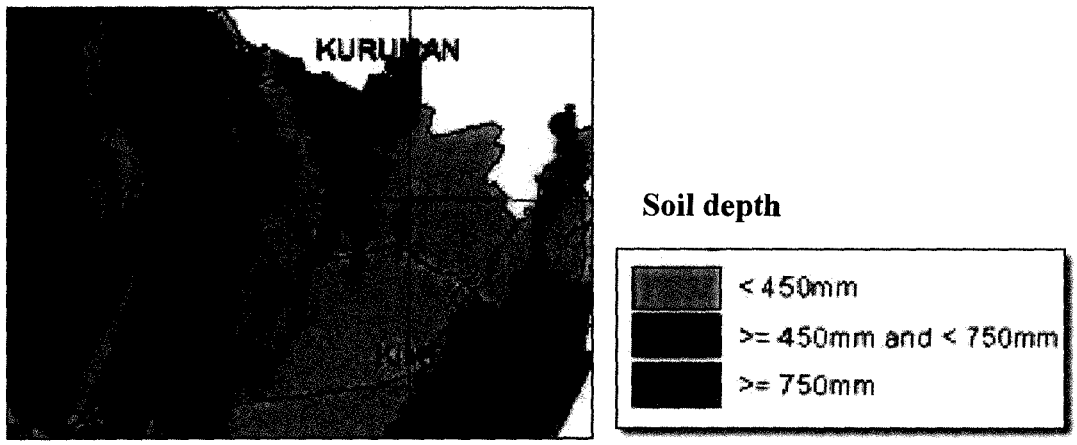
Kalahari sand extends over a large portion of the Siyanda District and forms part of the southern fringe of the Kalahari, which covers the north-western parts of South Africa and extends to the north into Botswana. The study area and surrounds form part of an erosion surface dating back to the Cretaceous which cuts across the Karoo and older rocks. Rivers draining into the region deposited clay, more calcareous marls, sands and occasional gravel bands in the basin to form the primary Kalahari beds. The Kalahari sands vary in colour, but are mostly reddish-brown due to oxidized iron particles in the sand. This sand was blown in from the north and became trapped in the basin by isolated ranges of quartzite kopjes.

Soil degradation is the removal, alteration or damage to soil and associating soil forming processes usually related to human activities. The stripping of vegetation or disturbance to the natural ground level over disturbance areas will negatively affect soil formation, natural weathering processes, moisture levels, soil density, soil chemistry and biological activity.

The soils in phase 1 have two non-distinct horizons namely a red, very sandy, poorly structured, low clay and humus deficient A-horizon of mostly 15-30cm thick, which constitutes the topsoil. This soil has a high base status. In some places the sand is very deep and gives origin to large Camel Thorn trees. Since finer manganese nodules and chips are captured in these soils, topsoil will not be removed ahead of the production faces. The next layer (B-horizon) is almost a conglomerate of structureless, reddish brown sand and dark purplish manganese nodules and larger stones and is 1-2m deep. It seems if the leaching of the sandy topsoil has resulted in the accumulation of some silt and clay in the matrix, which would benefit the rehabilitation process.

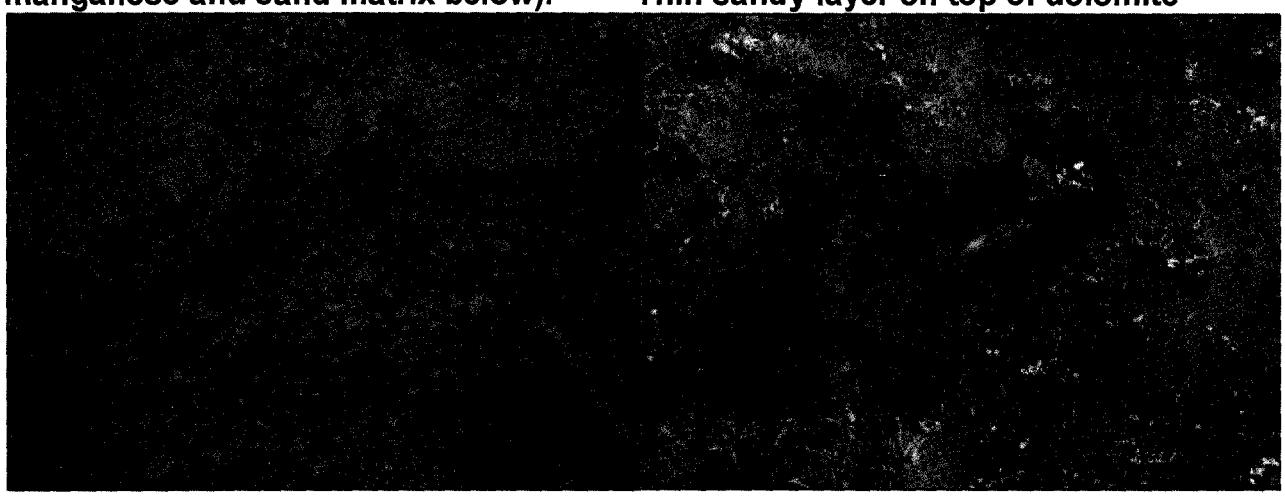
The manganese content is not the same everywhere, but generally becomes thin towards the south and east with the episodic drainage line the perimeter. In phase 1 this is followed by the C-horizon of many meters thick which constitutes dolomite. In the areas south of the drainage line, the red sand is directly underlain by solid dolomite.

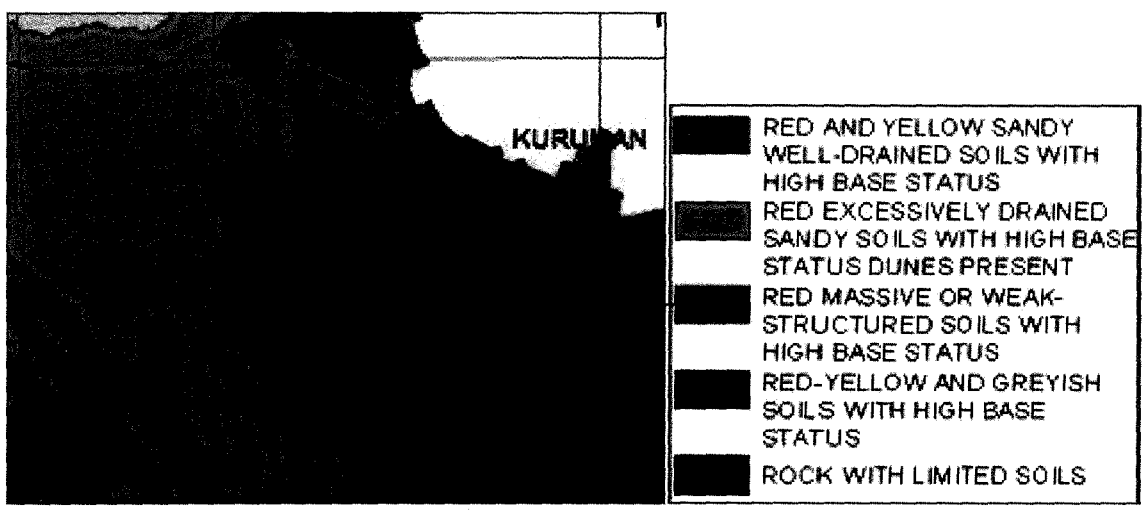
 

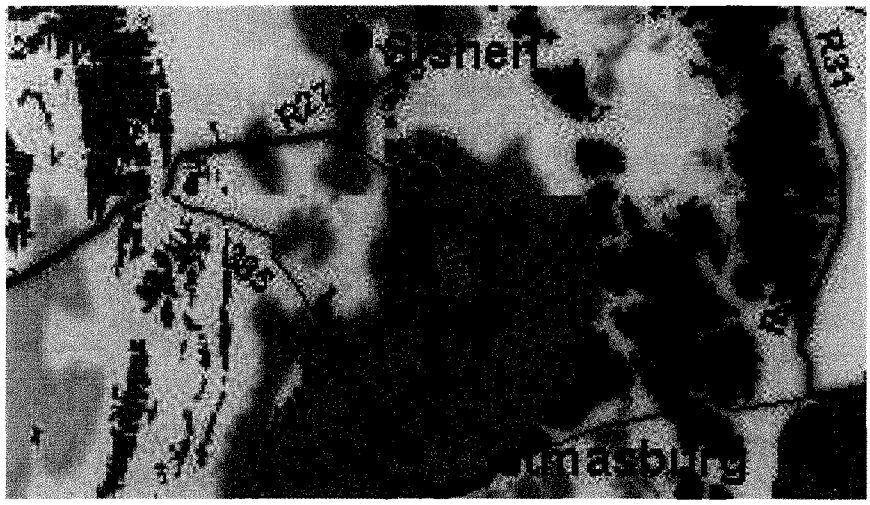



**Topsoil profile (red sand on top with manganese and sand matrix below):**

**Thin sandy layer on top of dolomite**



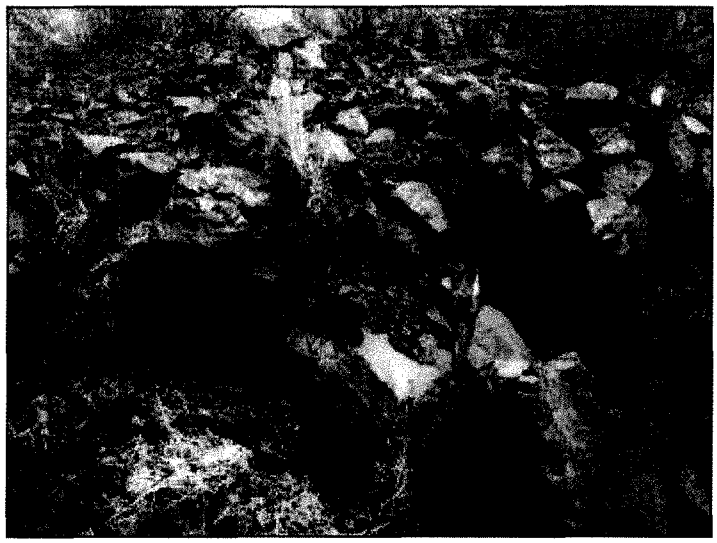





| | | | |
|---|---|---|---|
| | Ag | RED-YELLOW APEDAL, FREELY DRAINED SOILS (Red, high base status soils, < 300 mm deep) | These shallow (< 300 mm), red, freely-drained, apedal (= structureless) soils occur in arid to semi-arid areas associated with low rainfall (< 500 mm per annum) and are underlain by hard to weathered rock. A wide range of textures may occur (usually loamy sand to sandy loam). Stones or rocks are often present on the soil surface |

Soils in phase 2 differ significantly from those in phase 1 since the A horizon is very shallow and in some areas absent. In approximately 50% of the area it is underlain by solid manganese ore which will seriously hamper the rehabilitation process, but there should be adequate sandy soil in the other half of this phase to ensure a reasonably successful re-vegetation phase, but slopes would have to be properly sloped, where necessary, by precision blasting.

**Poor soil structure of outcrop areas**



In phases 3 & 4 topsoil is almost absent and only small amounts were captured in rock crevasses and will seriously affect the rehabilitation process, since most of this soil will

eventually be lost through the mining process. It would be essential that approximately 10cm of soil be sourced from the screened residue to ensure that the quarries in the mentioned phases are successfully rehabilitated. Additional subsoil should be imported to create a proper soil horizon for root development.

Soil captured in rock crevasses in phases 3 & 4

The percentage of carbon (humus content) content will be less than 1%, but could be restricted to the lower layers due to leaching. Since the soils are poorly structured, it will generally not stimulate and support vegetation growth well when disturbed for longer periods, since microbial processes will rapidly break down the minute amounts of humus in these soils. Since the organic matter is relatively fine due to the type of vegetation found in the area, it will reduce the period that the soil stays fertile. It should be reinstated within days, which is the objective at Boskop Mine. Since finding organic matter in these areas is difficult, a continuous backfilling of residue must be ensured.

Incorrect stockpiling of soil can cause its physical nature to deteriorate and become sterile due to compaction, loss of nutrients, texture and structure, chemical properties and decline in biological activity. Soil heaps should therefore in general not exceed 2m and must be vegetated or returned to disturbed areas as quickly as possible.

The AEC & CEC of these soils are generally poor and it is anticipated that both important macro (especially phosphates and nitrogen) might be absent. Soils are currently analysed and the outcome will be presented in the final EMP. Due to the influence of the manganese ore, trace elements should be well represented, but calcium and magnesium levels could be inadequate and lime application can be considered. The pH-values will be

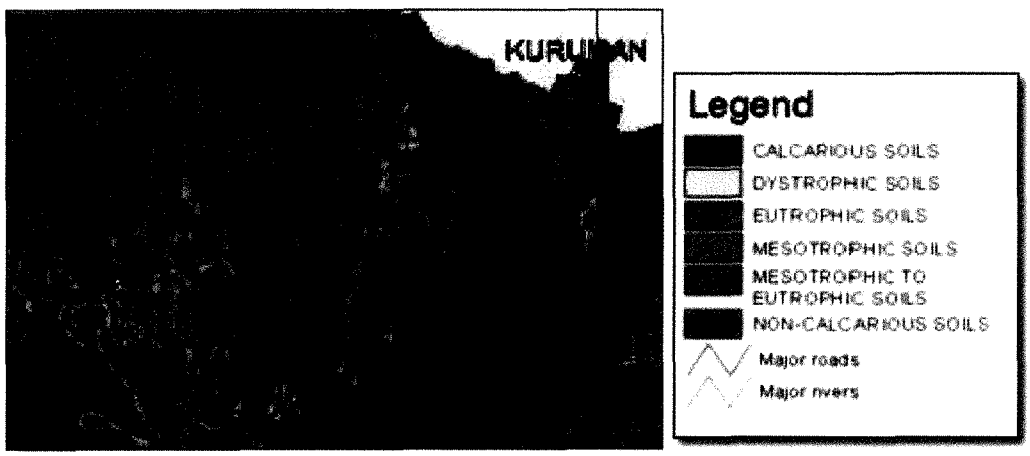
 

slightly acidic, but will become more alkaline towards the south. The use of soil pH would not be affected over the short term by mining activities.

Soils of the study area have high leaching capabilities (dystrophic soils) hence the soils will not remain fertile for long after precipitation. Soils would therefore not easily retain its positive nutrient cycles and fertility should it be disturbed and be denuded of vegetation. In order to facilitate the establishment of a proper vegetation cover, the combined use of inorganic fertilizers and organic material would be required.

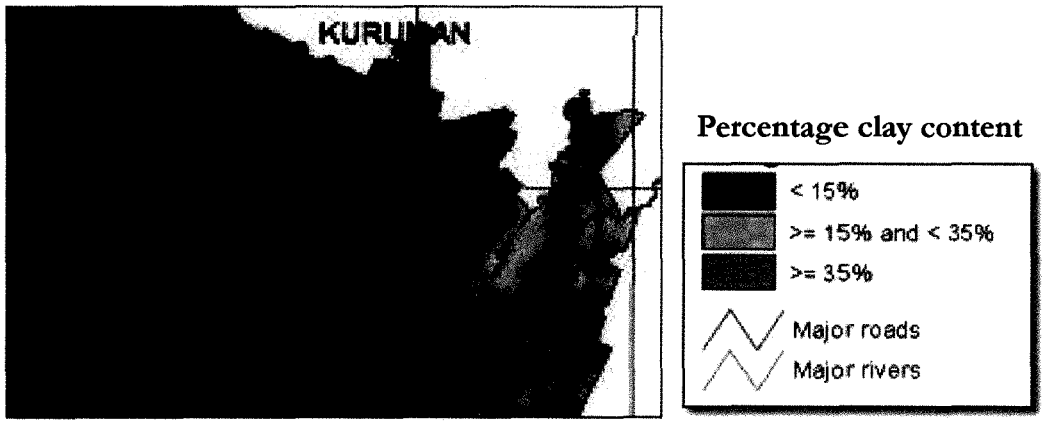
Since soil would be screened from the manganese detrital and returned to the excavation, soil horizons would be mixed, which in this case should be beneficial and a reasonably deep soil profile will be established in phase 1. Complete rehabilitation of this area would be possible and small amounts could also be sourced for the rehabilitation of phase 3.

The impact on soil properties in phase 1 is rated of low significance if it is reinstated within a week and moderate if instated later. The impact on soils in the other phases is high since soils will generally be lost in the mining process. This impact must be remedied by sourcing soil from phases 1 & 4 (south) and importing additional subsoil.




The high internal drainage capacity and low adsorption capacity (available water capacity) due to low clay content will, during the winter and less during the summer periods, cause that these soils display very low field capacity values, which will have a negative effect on biomass accumulation. It should therefore be considered to facilitate irrigation during the initial stages of the re-vegetation process. If this is done for small areas, it should not impact significantly on groundwater potential.




## Impact on soil properties (Phase 1)

| | OPERATIONAL (no mitigation) | WEIGHT | OPERATIONAL (with mitigation) | WEIGHT | CLOSURE | WEIGHT |
|---|---|---|---|---|---|---|
| **Extent** | Site specific | 1 | Site Specific | 1 | Site Specific | 1 |
| **Duration** | Long Term | 3 | Medium Term | 2 | Short Term | 1 |
| **Intensity** | Medium | 4 | Low-Medium | 3 | Low | 2 |
| **Probability** | Definite | 4 | Likely | 3 | Probable | 2 |
| **Status** | Negative | | Negative | | Negative | |
| **Confidence** | Medium | | Medium | | High | |
| **Significance** | **Moderate** | **32** | Low | 18 | Very Low | 8 |

## Impact on soil properties (Phases 3 & 4)

| | OPERATIONAL (no mitigation) | WEIGHT | OPERATIONAL (with mitigation) | WEIGHT | CLOSURE | WEIGHT |
|---|---|---|---|---|---|---|
| **Extent** | Site specific | 1 | Site Specific Local | 1 | Site Specific | 1 |
| **Duration** | Permanent | 4 | Long Term | 3 | Long Term | 3 |
| **Intensity** | High | 6 | Medium - High | 4 | Low | 2 |
| **Probability** | Definite | 4 | Definite | 4 | Probable | 2 |
| **Status** | Negative | | Negative | | **Positive (import of soil)** | |
| **Confidence** | Medium | | Medium | | High | |
| **Significance** | **Moderate-High** | **44** | **Moderate** | **32** | Very Low | 12 |

### 15.3.2 SOIL EROSION

Erodibility of soils is the function of a number of factors such as clay content, structure, slope and climatic conditions and these parameters must be taken into consideration when determining the erodibility index. Soils susceptible to water erosion are normally silty/sandy, are weakly structured, have low organic contents, have poor internal drainage and are located on a slope.

Topsoil in the study area is poorly structured, has low clay (less than 15%) and humus content, but has high internal drainage and therefore it disposes of a high erodibility factor when located on a slope, but in flat areas of phase 1 and with high porosity of the sub layers, the soil is not erodible. However, if disturbed on the hill side, soil will be washed away; hence activities on the interfaces should be prevented. Soils in phase 2 should also be reasonably erosion resistant due to the flatter slope in this area. The study area receives low rainfall and would generally not cause erosion. No erosion was observed in the larger area, irrespective of the extensive grazing that takes place. The soils in phase 1 therefore do not represent a sensitive system, but do indeed on the hill slope.

Placement of topsoil on the quarry floors in phases 3 & 4 will not pose an erosion risk since it will be rather flat. Soils outside these areas will not be readily affected. With increase in the extent of the quarry floor, runoff volumes will also increase and could wash topsoil from certain areas. Cross drains should be constructed on the quarry floor. These areas need to be monitored for erosion during the rainy season. Soil stability on the profiled slopes would be problematic. In order to maintain soil stability, faces must be profiled properly and covered with subsoil to be imported before topsoil sourced from either phase 1 or 4, is reinstated. It is also imperative to use all available organic matter as mulch on these slope areas, to reduce the splash erosion during rain events and to improve water absorption capacity and re-vegetation rate. Considering the above, it is pertinent that soil stability be achieved as soon as possible after mining has been terminated in a particular phase. Fortunately, these quarries would be located on the watershed and runoff would be limited.

If topsoil is reinstated, the underlying solid rock layer will act as a cut-off layer and will result in the displacement of topsoil through sheet flow during rain events. Such a scenario will eventually preclude the establishment of vegetation. The worst-case

scenario would be erosion gullies of approximately 10-15cm deep and material eroded will be deposited on the quarry floors and should not be totally lost. If left unattended, the mentioned gullies will increase in lateral extent and eventually bare rock will be exposed and total loss of vegetation will be prevalent. In order to increase the water holding capacity of these soils, it is imperative that at least 30cm of subsoil should be reinstated and introduced first where after topsoil can be introduced.

The sandy soils are very susceptible to wind erosion and could impact very negatively on the establishment of vegetation during periods of high winds. It is thus essential that this impact is curbed from the start. To address this impact in a cost effective manner, removed *Acacia mellifera* must not be disposed of, but must be retained and positioned over seeded areas. Once the grass has germinated and is reasonably established, it can be removed.

To reduce any potential surface flow within the mining area, it is important that the vegetation ahead of the proposed quarry areas is retained for as long as possible and that mined out areas are rehabilitated as soon as possible.

The access road to phase 3 will not be subject to severe erosion due to the underlying bedrock and the access road to the house should remain stable due to the flatness of the land and low rainfall. The impact is rated of very low significance. The combined impact of erosion on soils is rated very low with mitigation, but moderate without remedial measures in place.

**Impact on soil stability**

| | OPERATIONAL (no mitigation) | WEIGHT | OPERATIONAL (with mitigation) | WEIGHT | CLOSURE | WEIGHT |
|---|---|---|---|---|---|---|
| **Extent** | Local | 2 | Site Specific | 1 | Site Specific | 1 |
| **Duration** | Long Term | 3 | Medium Term | 2 | Medium Term | 2 |
| **Intensity** | Medium | 4 | Low-Medium | 3 | Low | 2 |
| **Probability** | Definite | 4 | Definite | 4 | Probable | 2 |
| **Status** | Negative | | Negative | | Negative | |
| **Confidence** | High | | Medium | | High | |
| **Significance** | **Moderate** | **36** | **Low-Moderate** | **24** | Very Low | 10 |

## 15.3.3 SOIL POLLUTION

Soil pollution is only possible should hydrocarbon spills occur, or when 1) used oils and lubricants are purposefully drained into the alluvium; 2) storage facilities are destabilized; or 3) if ablution facilities contaminate soils. In the production area of the quarry, none of these impacts are anticipated, since trucks and earthmoving equipment will be well maintained and serviced in a designated area in the plant area on a concrete floor with central sump. Fuel storage will take place at the plant area and the toilet facility will be a conservancy tank or chemical toilets, which are closed systems. No other chemicals or hazardous substances will be used or stored at the site. The high drainage and low absorption capabilities of surrounding soils will cause any pollution plumes to be extensive and will reach bottom layers and could potentially reach groundwater, especially since dolomite, the underlying rock, is a significant water-bearing rock.

### Hydrocarbons

The crushing plant and mining equipment will require large quantities of diesel fuel, oils and hydraulic fluids and in return it will generate substantial amounts of used oils and lubricants. It is essential that these substances are handled correctly and that workers are properly trained in this regard; otherwise they could inadvertently cause unwanted environmental impacts, such as draining used oils into the soil. Storage of these hydrocarbons as well as servicing of vehicles will be restricted to the plant area, or at designated offsite workshops in the towns of Sishen or Kathu, depending on the vehicle type that requires servicing. It is proposed that some of the outbuildings at the farm residence are used for establishing a vehicle service centre, which will reduce the potential impact on the environment.

Emergency repairs will be done over drip pans on a flat surface to ensure that spills are controlled and retained hence no impact on soils or groundwater is anticipated. Drained hydrocarbons must be siphoned into appropriate containers and stored within the workshop containers for disposal at the earliest convenience It is further imperative that certain areas are designated for maintenance of vehicles and that such areas be provided with a concrete floor with a sump to collect spilled hydrocarbons.

With normal extraction rates, the worst case scenario would lead to very small hydrocarbon spills in the plant area that will penetrate the soil and be retained within the upper layer as concentrated pollution that can be easily scooped up and be disposed of. Natural bio-degradation of hydrocarbons would be expedited due to the sandy nature of the soils. The use of fertilizers or oil surfactants could assist in breaking down limited spills in a short period of time. In the quarry area, the worst case scenario will constitute very small hydrocarbon leaks which will marginally penetrate the rock of the quarry floor and will be easily removed by spreading sawdust or Spillsorb on the spill. The use of surfactants must be considered.

Destabilizing the diesel tank and spilling the entire contents will result in a substantial higher impact than what can be expected from spills from vehicles. Groundwater as well as surface water could possibly be affected. It is therefore essential that once established, the diesel tank is protected with a bund wall and positioned in an area with low vehicular traffic. If such a major spill in some or other way occurs, it will lead to an extensive spill, which would result in a low impact on vegetation, but potentially significant impact on groundwater. It will severely affect soil fertility through impaired nutrient imbalances, pH values, as well as reduced water retention capacity and will affect soils over longer periods in comparison to smaller spills and need to be bio-remedied and where applicable, encapsulation techniques can be used. For this purpose, a specialist will be called in to remedy the impact. As alternative, polluted soil must immediately be scooped up and be disposed of at an approved waste facility.

Used oils and lubricant spills can result in the same negative soil impact and must be stored safely in appropriate receptacles in a bunded area and be provided with a roof or alternatively, it must be stored inside the workshop container. The impact is rated low under worst-case scenario conditions and insignificant under normal, controlled circumstances.

**Sewage**

Stationary chemical toilets and/or conservancy tanks will be established in the plant area and portable toilets will be positioned at quarry areas. Due to the large number of people (55) that will be on each site, it is anticipated that the sewage stream will be extensive, but

since closed systems are used, negligible soil pollution in the plant area and no impact in the quarry areas are anticipated.

These systems will be maintained according to manual instructions and Municipal regulations. Since the quarries and plant areas will be outside the footprint of any fluvial environment, the risk of surface water pollution is zero, provided that the 32m setback line previously mentioned, is maintained. The anticipated soil pollution risk is rated low under worst-case scenario conditions and insignificant under controlled conditions.

## Waste

Due to the number of people that will work onsite, a significant amount of domestic waste will be produced in the plant area and the waste stream (tins, paper, wood, plastic bags, food, cabling, batteries, etc.) could exceed 5 cubic meters per month. Domestic waste need to be stored in proper receptacles to protect it from wind dispersal and it must be removed to the nearest approved waste facility in Kathu/Sishen on a regular basis. Even in limited amounts, uncontrolled storage of waste could lead to littering of the surrounds, which could affect remaining wild animals and domestic stock and impact on the visuals of the site. All batteries must be recycled since the contents could lead to soil contamination, specifically reduced pH. Cement contaminated water and residue cement generated during the construction process could affect the structure and pH of soil and subsoil negatively and the correct operational procedures need to be implemented. Waste production will be low in the quarry areas and since limited to no topsoil is available in phases 2-4, the impact on soils in these areas is rated insignificant. Handling of waste must be included in an environmental awareness programme to be developed for the workforce.

Vegetation removed from the quarry areas will later on be reintroduced to disturbed areas as mulch or wind breaks and would only pose a positive impact in terms of increasing humus content or facilitate soil stability.

**Impact of pollution on soils**

| | OPERATIONAL (no mitigation) | WEIGHT | OPERATIONAL (with mitigation) | WEIGHT | CLOSURE | WEIGHT |
|---|---|---|---|---|---|---|
| **Extent** | Local | 2 | Site Specific | 1 | Site Specific | 1 |
| **Duration** | Short Term | 1 | Short Term | 1 | Short Term | 1 |
| **Intensity** | Medium | 4 | Low | 2 | Very Low | 1 |
| **Probability** | Likely | 3 | Likely | 3 | Unlikely | 1 |
| **Status** | Negative | | Negative | | Negative | |
| **Confidence** | High | | Medium | | High | |
| **Significance** | Low | 21 | Very Low | 12 | Insignificant | 3 |

## Management plan:

Conservation of *in situ* and removed soils

- All screened soils will be conserved and will not be disposed of.
- Soil will be piled to a maximum height of 1,5m to not negatively affect microbial action and the mineral cycle through compaction.
- Mining will be restricted to the approved mine area and particular block that is developed.
- All residual soils will be returned to worked-out areas.
- Once reinstated, residual soil will be seeded with the specified seed mixture, upgraded with inorganic/organic fertilizer and irrigated, if possible.
- Only one haul road to a specific quarry area will be used and vehicles would not deviate from it and cross virgin land.
- Disturbance of the soil and vegetation zones around quarry areas will be prohibited.
- Phase 3 & 4 quarry areas will experience a shortage of soil for the rehabilitation process. Topsoil sourcing from phase 1 and southern section of phase 4 and from surrounding mines or development areas must be investigated without causing any environmental degradation in any area. Empty trucks returning from deliveries could easily haul additional topsoil to the mine. This soil should be used as B-horizon and will improve the soil profile, which in turn will increase rehabilitation potential. Such soil must come from areas with zero alien plant infestation.

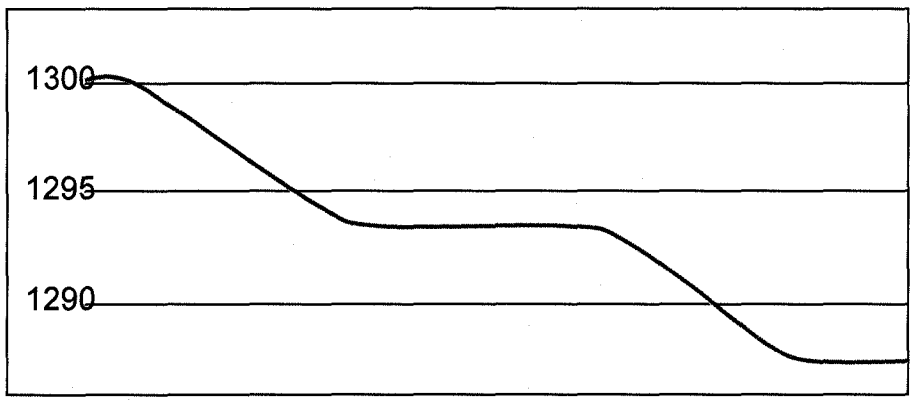
 

- Once profiled, the production faces will be rough and coarse and topsoil could easily be lost in the crevices between rocks. To counteract this impact, adequate overburden must be obtained to cover the shot rock and to establish a proper root horizon.

Protection of unstable soils

- Haul roads must be protected with a proper wearing course of at least 30cm and where applicable, mitre drains.
- Removal of soil ahead of the production face must be restricted to the minimum.
- The mining areas will be developed and rehabilitated in blocks as proposed in the development plan to reduce the extent of the disturbed area at any given point in time.
- Production faces of quarries in phases 3 & 4 must be benched to reduce the length of individual slopes and thus limit erosion risks. After profiling of the vertical face, 2-3m of the horizontal part of the bench must be retained to act as energy dissipater.

**Schematic bench profiling with extended bench width**




- It is essential that profiling be done with precision perimeter blasting and overburden/soil not simply being dumped over the edge as infill, since it might slip after a while and impact on established vegetation. If this approach will result in the destabilising of the quartzitic rim, infill must be done.
- Each block will be profiled within 6 months after rock extraction has been completed and vegetated as soon as possible to stimulate re-growth and to facilitate proper natural compaction of soils before the aftercare period commences.
- During dry periods soils should be irrigated to stimulate plant growth, provided that water is available. If groundwater cannot be used for this purpose, application should be made for water from the Vaal-Gamagara pipeline.

- Vehicles will not drive over rehabilitated areas, to prevent compaction and dieback of established vegetation.
- All crushed ore must be removed from the process area since it would impact on the stability of reinstated soils and percentage surface cover when the plant is relocated or finally removed.
- The quarries will be developed in such a way that slopes are smooth to prevent concentration of surface water on them that could stimulate erosion.
- Should erosion on the quarry slopes become problematic:
  1. Any erosion rills or gullies that develop will be filled in with subsoil and compacted, but upper layer must be scarified to bind with topsoil, top dressed with soil, fertilized and seeded.
  2. Such areas will be provided with a mulch/manure layer of at least 2,5cm thick.
  3. In worst case scenario geofabric (biodegradable netting) or Soil Saver (natural organic sheet material with seeds) will be pegged onto the slopes after spreading of topsoil and seeding were affected. A soil conservation officer/expert will be appointed to oversee the process.
- In order to curb wind erosion on profiled areas, one of the following mitigation measures must be implemented:
  1. Removed *Acacia mellifera* must be positioned on seeded areas.
  2. Chip seedless *Acacia mellifera* and other vegetation and apply as mulch.
  3. Cover area with grass cuttings obtained from the surrounds, or with manure obtained from farmers.
  4. Establish fine-mesh shade cloth (2m high) across wind path, 10-15m apart.

<u>Upgrading of soils</u>

1. Apply 2-3cm of manure or grass cuttings from the surrounding veld to seedbed and scarify to improve soil fertility and micro-climate of the soil, which in turn would facilitate improved germination and percentage soil cover. Liaison with farmers on the provision of manure should take place timeously.
2. Apply fertilizers at a rate of 150kg 2:3:2 and 100kg 4:1:1 per hectare before seeding. Application of bone meal can also be considered due to the lack of humus in the soil.
3. Once the grass seedlings have reached a 15cm height, applications of super phosphate at a rate of 100kg per hectare twice per annum (March & September)

should be effected. Seeding must coincide with the rain season or when soil moisture regimes are good.

4. Application of lime at a rate of 1-2 tons per hectare should be considered, but will depend on the outcome of the soil analysis that is in process. This section would therefore be amended at a later stage.
5. All vegetation removed from the mine area will be stockpiled, protected against wind erosion and re-introduced as mulch to seeded areas. For this purpose a chipper should be obtained to chip seedless *Acacia mellifera*.

- Upgrading of soils and re-vegetation of disturbed areas will be done concurrently with mining.

Contamination of soils

- Oil and lubricants will be stored inside the workshop container.
- Used oils and lubricants will be stored in receptacles with proper lids within a bunded area. It will be disposed of at a registered recycling facility on a regular basis.
- All filters or oil/lubricant contaminated material will be stored in a separate receptacle within the bund wall and disposed of at a registered recycling facility on a regular basis.
- The fuel tank shall be established as described under the construction phase. The fuel pump shall be provided with an apron to capture all spilled fuels. The fuel tank will be positioned where the least vehicle movement is taking place.
- All vehicle maintenance and servicing will be done on the concrete pad provided for this purpose. If required, a wash bay will be constructed alongside it with an oil trap designed to specification.
- The diesel tank and all vehicles will be leak-free
- Hydrocarbons shall not be drained into the soils nor shall used filters and hydrocarbon-contaminated parts be buried in the soil, but will be removed to an approved waste site or recycling facility.
- Making use of bio-remediation facilitated by a specialist company will negate larger spills, whilst smaller spills could be treated with fertilizer to break it down or be scooped up by front-end loader to a hazardous waste site.
- Spillsorb/Peatsorb or sawdust will be used to contain larger spills and some of these materials must be on site as a contingency measure.
- Spills will be prevented by properly maintaining vehicles and restrict servicing of vehicles to the farm residence' workshop or offsite workshop.

- No other hazardous chemicals will be used on site without authorization granted by the DMR and other regulating authorities.
- Waste will be removed from the mine area on a continuous basis to the Kathu/Sishen waste facility with specific emphasis on household waste, plastics and unusable scrap metal and tire casings.
- All quarry/plant debris must be removed before topsoil is re-introduced to disturbed areas.
- The toilet facilities will be constructed/maintained according to Municipal regulations.
- The surrounds will not be used for ablutions.
- Cement mixing during the construction phase will not take place on bare soil, but on a steel plate.
- The handling of hydrocarbons will be included in an environmental awareness programme.

*****

# 15.4 LAND USE AND LAND CAPABILITY

## LAND USE

### Overview

Siyanda District Municipality forms the mid-northern section of the Northern Cape Province and covers an area of more than 100,000 square kilometres (almost 30% of the entire Province) out of which 65,000 square kilometres compromise the vast Kalahari Desert, Kgalagadi Transfrontier Park and the former Bushman Land. The Siyanda District mainly consists of areas in the Kalahari, private farmlands and the Community of Riemvasmaak.

Land use is an important factor contributing to the condition of the land, since land use impacts on soil stability and fertility and subsequently land cover, which in turn affects the condition of the land. Different uses have varying effects on the integrity of the land. Most of the Northern Cape is dominated by vast open areas of natural vegetation (69.7% of the total area is covered by shrubland and low fynbos). A further 14.2% of the Northern Cape is dominated by thicket vegetation and bushland. A total of 0.7% of the Province is classified as degraded, whilst 0.2% is dongas and sheet erosion areas. In addition, 12% of the land cover in the Province is unimproved grassland characterised by less than 10% tree and/or shrub canopy cover, with greater than 0.1% of total vegetation cover. Urbanisation in the Province is relatively low (0.1%).

**Percentage of transformed and degraded land per vegetation type**

| Vegetation Type | Transformed and degraded land in hectares (ha) | Percentage of Transformed and Degraded Land (%) |
|---|---|---|
| Bushmanland | 13038.51 | 0.2 |
| Orange River Nama Karoo | 82172.44 | 1.5 |
| Shrubby Kalahari Dune Bushveld | 121160.2 | 3.2 |
| Upper Nama Karoo | 46111.67 | 1.3 |
| Upland Succulent Karoo | 86669.21 | 2.5 |

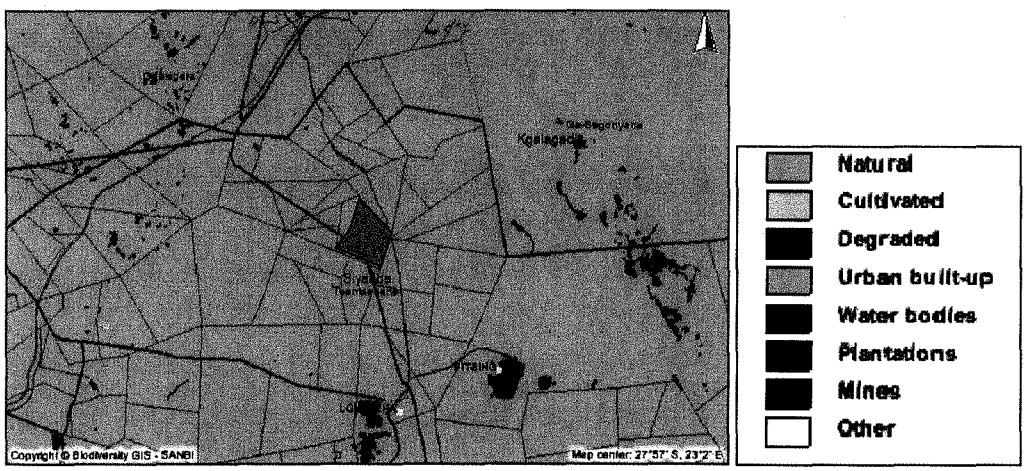
Although the proportion of transformed land appears to be low relative to the total, one must bear in mind that in most cases this transformation and degradation is localised and therefore severe.

The primary land use within the Province is stock and game farming. Thus threats to the majority of vegetation types are usually in the form of overgrazing. Mining activities and cultivated land also contribute towards land transformation and degradation.

Boskop mining area & surrounds

The land concerned falls outside any urban edge and the study area is mostly supporting shrub land on manganese covered hills and Savanna on the flatter, lower levels with *Acacia erioloba* the dominant tree.

The larger area mainly hosts farm land where stock farming is the dominant land use. However, from Postmasburg in the south through to Kuruman, extensive mining is taking place with the most prominent mines immediately north-north-west of the farm. The proposed mining activities would thus fit in well with abutting mining concerns located to the south-west, north north-east and north north-west.



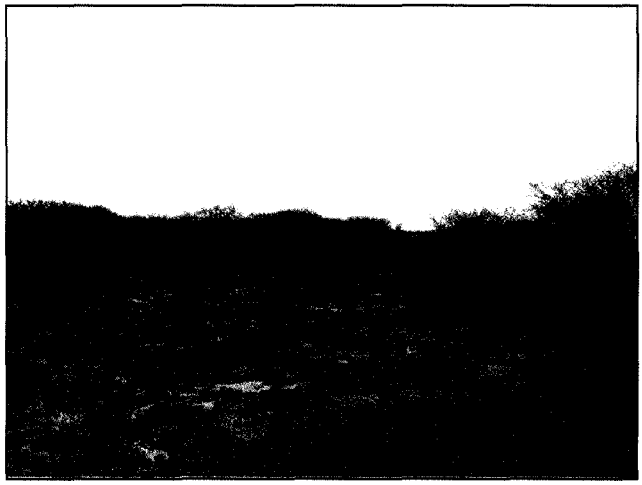

The Boskop farm is mainly used for stock farming and particularly cattle and goat farming since the proliferation of *Acacia Mellifera* has made sheep farming almost impossible on the mining area, due to low penetrability and poor grass cover. The remainder of the farm located east of the episodic watercourse and to the north of the 1255m contour disposes of a much better grazing cover due to the influence of the underlying dolomite deposit and could still host sheep. To the south and south-east of phase 1, the area was slightly

transformed, seemingly for pasture establishment close to the borehole that was sunk in this area.

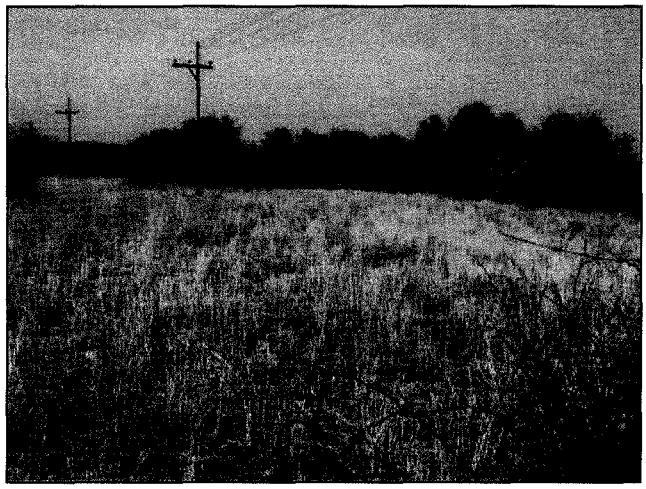
It was noticed during the site visit that grazing capacity on the plains was extremely low, since *Acacia Mellifera* has shed its leaves and due to the extent of invasion, grass cover was also very low. On the western hills land cover was somewhat less due to the poor soil horizon in this area, but the quality of cover was similarly poor. No stock was found onsite during the two-day site visit. It is therefore anticipated that during the winter the land to be affected would not lend itself to proper grazing. From this perspective, the impact of mining on land use would be very low during the operational phase. However, with proper rehabilitation, the affected detrital mining areas can be turned into proper grazing units which will improve grazing capability for both sheep and cattle. Mining in phases 2-4 could have a more severe impact on future land use due to the absence of soil in these areas and due to the rocky nature of the subsoil. If total extraction is possible, the land can be restored to grazing, if additional soil is sourced as previously discussed and the impact would also be of low significance. If 'pocket mining' has to take place, a portion of the land would be unusable in future and the landowner would have to be compensated for this loss which would be determined at the cessation of mining on the farm. The significance of the impact is rated moderate and permanent. This scenario should be prevented by implementing the mitigation measures previously described.

**Poor land cover in phase 1 (western perimeter & centre)**

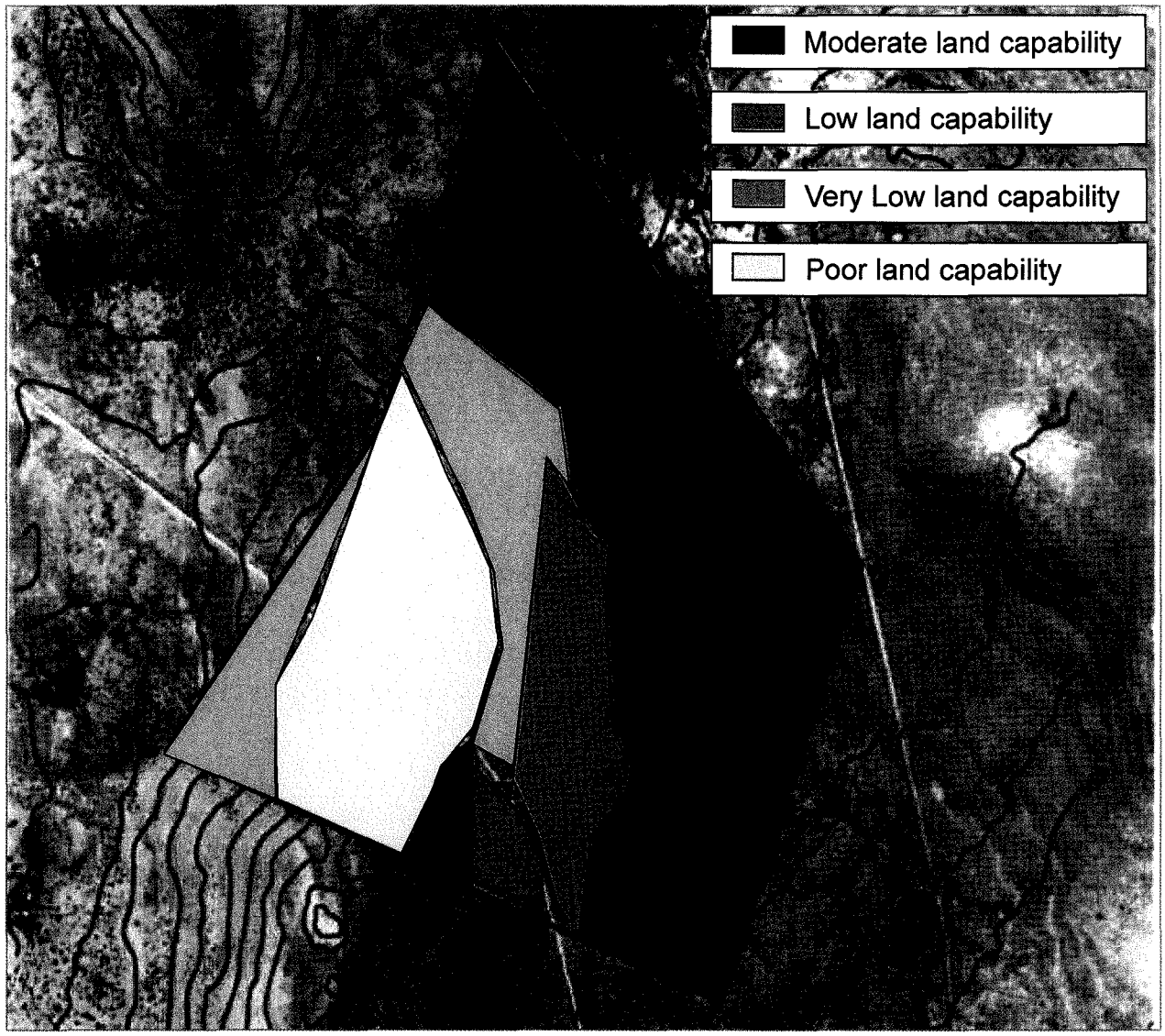
**Poor land cover in phase 2 & 3**



**Good grass and thorn tree cover south of phase 1**



**Land capability of farm Boskop**




At closure of the mine, and if the affected area has been adequately rehabilitated, it is anticipated that the landowner would have full use of approximately 57% (phase 1) of the mining area, ± 80% use of ±17% (phase 2) of the mining area and ± 60-70% use of ± 26% (phase 3-4) of the mining area. If 'pocket mining' has to be conducted in phases 3 & 4, the reduction in land-use could be as high as 60-70%.

Apparently *Acacia Mellifera* leaves dispose of high nutritional value due to high protein content and the area would thus dispose of a much better carrying capacity during the summer, but would not match the carrying capacity of the grassland of the plains. The impact during the summer would thus be higher on availability of grazing land. In terms of the agreement that was presented to the landowner, as well as the fact that only a quarter of the farm would be unavailable for farming at any given time, the impact is rated medium

term and of low significance. It is proposed that the landowner be granted the right to graze areas not utilised for mining, while taking into consideration safety aspects.

The farm residence was previously used by the landowner, Mr. Venter, as his homestead and he left the farm due to prospecting activities that were ongoing during the past four years. He is currently residing on the abutting farm that is also owned by him. This use would not be available to him, but he is compensated for this loss.

## LAND CAPABILITY

### Overview

Different land uses have varying effects on the ecological functioning of any land parcel. It is therefore essential to understand the nature of different land use activities in order to effectively control soil erosion, overgrazing, loss of vegetation cover and desertification. Land capability in the Northern Cape is particularly affected by the extent of land degradation, percentage land cover, desertification, climate, soil type and geology.

#### Land degradation

Land degradation results in a significant reduction in vegetation cover and thus the productivity of the land. Human activities such as agricultural mismanagement, overgrazing and collecting of firewood, as well as extreme weather conditions, could all contribute to land degradation. The Northern Cape is predominantly arid and thus only 2% of the land is used for crop farming, whilst the majority of the Province is used for stock farming. Overgrazing is therefore one of the main causes of land degradation in the Northern Cape. However, historic and well as current mining has serious negative environmental consequences in areas where proper rehabilitation principles are not upheld.

In the Province soil degradation is not a major consideration, but veld degradation is severe and mainly four types of veld degradation occur, namely 1) loss of cover, 2) change in species composition, 3) bush encroachment and 4) alien plant invasions. The overall land degradation in the Province is deemed light, whilst 30% is moderately degraded and

24.2% is "extremely" degraded. Results from the National Botanical Institute concluded that the Northern Cape is one of the least degraded provinces in South Africa . However, veld degradation was found to be serious, since the Province has the third highest provincial veld degradation indices in South Africa. It was found that change in species composition and bush encroachment was the most common problems.

Boskop Mining Area

The original agricultural potential of phase 1 is deemed to moderate, whilst that of the western hills would have been low due to the poor soil status in these areas, except for on the slopes, where somewhat improved soil conditions occur. Due to the poor availability of natural, as well as surface and groundwater, its cash crop or pasture establishment capability is very low.

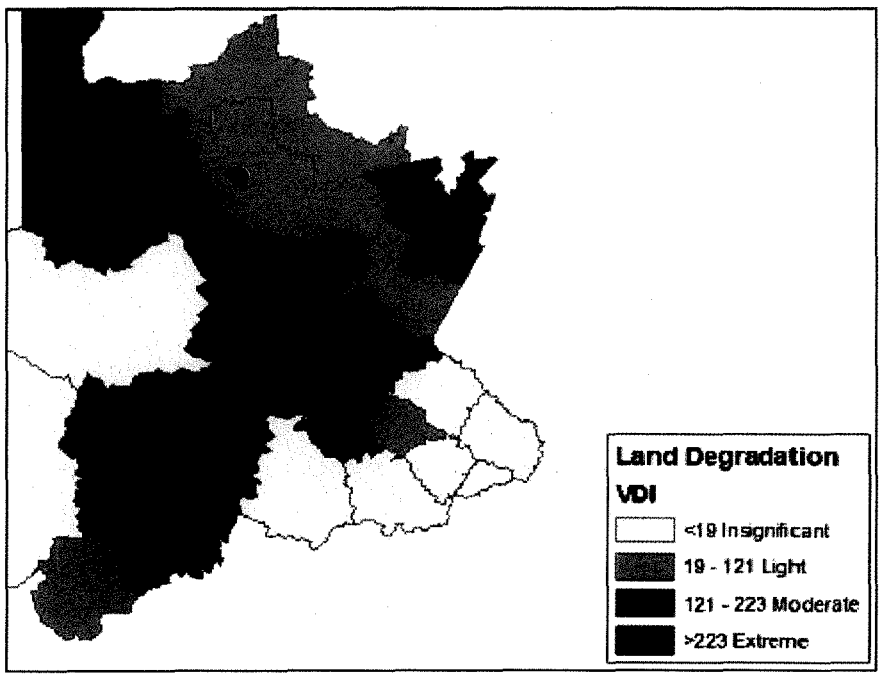
In the study area severe veld degradation has taken place due to over grazing, which resulted in the proliferation of *Acacia Mellifera,* which in turn severely affected species composition and grazing capability and eventually type of stock farming. The reduction in grass and shrub cover has resulted in increased goat numbers, since the *Acacia Mellifera* thickets are mostly impenetrable and unpalatable due to its vicious thorns. Sheep, and to a certain extent cattle farming, is severely restricted in these areas. Goats seemingly flourish on this vegetation type. This again has a very negative impact in the sense that goats are extremely heavy on any veld type and by increasing goat numbers, more pressure is exercised on remaining veld. This process turns into a vicious circle with continuous increase in overgrazing and reduction in capability every year. It was for example calculated that the Knersvlakte has experienced a 50% loss of grazing capacity over the past 100 years, which could very well be the situation on the farm concerned.

Alien plant invasions also pose a threat to the status of veld types and apparently the Northern Cape is also one of the worst affected areas in terms of bush encroachment, which implies that large areas of grazing land are lost, species diversity is reduced and habitats are transformed. In the study area it was not experienced that land capability is significantly affected by alien plant invasions. Mining the area could change this particular impact since soil disturbance and loss of surface cover normally stimulates alien vegetation invasions, mostly due to their ability to flourish in disturbed, shallow and infertile

soils. It would therefore be important to ensure that a dedicated alien control programme is put in place.

Mining *per se* would disrupt soils in phases 1 & 2 which would drastically affect the structure, fertility and stability of soils, which in turn would negatively affect the re-vegetation process. It would also remove all surface cover which would stimulate erosion and increase soil temperatures, which would also impact negatively on the re-vegetation process. Mining would thus have a high impact on land capability over the short to medium term, but with proper rehabilitation it could be turned around. Post closure mining would have a positive impact should the proposed grass cover be established. Mining of phases 3 & 4 would remove the surface cover and would totally disrupt the very shallow and poor soil structure in this area with very little possibility of turning around this impact and land cover could be permanently lost which will cause a very high impact on land capability which would not be acceptable. The only manner in which this impact could be turned around, is to source soil from the dentritel areas and to import soils from other mining concerns where an abundance of subsoil/residue is available. In doing so, the post closure impact could be reduced to moderate.



Desertification

Desertification refers to land degradation in arid, semi-arid and dry sub-humid areas resulting from natural climatic variations, but mostly human activities such as overgrazing. The continuation of this poor land management practice causes degraded land to form localised bare areas where wind erosion sets in and with further pressures these blow-out areas connect and the land becomes desertified. The arid characteristics of the Northern Cape contribute to this phenomenon. Approximately 93% of the Northern Cape can be classified as affected dryland, with 7,4% of the Province having a mean annual precipitation to potential evapotranspiration ratio below the limit for areas defined as affected dryland. This is an indication that most of the Province is potentially susceptible to desertification hence land degradation must be prevented.

In the study area overgrazing has fortunately not lead to desertification and should not be a major consideration, but then wind erosion has to be curbed. Mining *per se* would therefore not directly stimulate desertification, but could induce it as a secondary effect through clearing of land and subsequent wind erosion and it has to be controlled. With mitigation, the impact would be very low, but in the absence therefore it could be of low-moderate significance.

Climate

Due to the very harsh climatic conditions of low rainfall and very high temperatures, any disturbance to the vegetation and soils are not readily rectified and the longer soils are denuded, the lower the fertility and soil water potential and thus the ability to natural remediation. Since each block in each phase will be denuded for at least a year, the impact of mining would be severe on land capability. This can be mitigated by a continuous backfilling and re-vegetation process. Initial irrigation should also be contemplated for compaction and improving soil water regimes.

Geology

In phase 1, the specific geology supports a good vegetation cover and would assist with the rehabilitation process, but in phases 3 & 4 the solid rock bed limits natural vegetation cover and would cause rehabilitation to be difficult.

Environmental Capability

The study area reflects a highly transformed land parcel with limited species diversity and thus forage potential. In addition, most areas are almost impenetrable for medium size to large animals and the area almost seemed sterile, but this scenario could change with the first rains. With this perspective the mining area *per se* can be categorized as an unimportant environmental niche with very low capability. On cessation of the mining activities if proper rehabilitation is effected, the area will be turned to grassland with infill of some species related to the original vegetation component onsite. If rehabilitation is afforded adequate time and effort, the post mining environmental capability should definitely be better than the present capability.

Secondary activities that could impact on land capability

Cooking fires of workers onsite may pose a severe fire hazard to grazing areas, especially during winter when the grass is dry and may impact on abutting land uses and land capability. This impact is rated high in the absence of mitigation measures hence no open fires will be permitted in the study area. All fuel storage areas and workshops where fires may start will be located distant to any grassland which should reduce the risk to very low.

Anticipated minor increases in dust will not affect vegetation on abutting land due to the distances involved, except potentially on the northern side when the crusher is relocated to phases 3 & 4 at a very late stage of development. It was noted that dust pollution from the larger mines settles on land distant to mining and crushing activities and seemingly results in either vegetation mortality or retarded foliage production. The proposed mine is very small in relation to the larger mines and dust impact would be significantly less. Normally dust deposition does not impact on photosynthetic rates as is clearly observed along gravel roads, but since plants would receive an overdose of a trace element, it could affect plant metabolism. This impact need to be monitored when the crusher is relocated. Provisionally the impact is rated of low significance. Since there is no crop production in the immediate vicinity of the mentioned quarry areas, no real threat to the livelihood of any resident/landowner is anticipated. The proposed site is located distant to residential areas and will therefore not impose any social impacts.

The mobile mine infrastructure will pose no permanent impact on land capability and land-use, provided that hydrocarbon pollution is prevented. The area used for this purpose will be fully restored during the rehabilitation phase.

The fact that mining would only affect approximately 50% of the farm and that land capability could be fully restored on a large portion of the affected area, will reduce the severity of the impact to some extent.

**Impact on land capability and land use** (no 'pocket mining' and with soil acquisition)

| | OPERATIONAL (no mitigation) | WEIGHT | OPERATIONAL (with mitigation) | WEIGHT | CLOSURE | WEIGHT |
|---|---|---|---|---|---|---|
| **Extent** | Local | 2 | Site Specific | 1 | Site Specific | 1 |
| **Duration** | Permanent | 4 | Long Term | 3 | Permanent | 4 |
| **Intensity** | Medium-High | 5 | Medium | 4 | Low | 2 |
| **Probability** | Definite | 4 | Definite | 4 | Likely | 3 |
| **Status** | Negative | | Negative | | **Positive** | |
| **Confidence** | Medium | | High | | High | |
| **Significance** | **High** | **44** | **Moderate** | **32** | Low | 21 |

**Impact on land capability and land use** (with 'pocket mining' and no soil acquisition)

| | OPERATIONAL (no mitigation) | WEIGHT | OPERATIONAL (with mitigation) | WEIGHT | CLOSURE | WEIGHT |
|---|---|---|---|---|---|---|
| **Extent** | Local | 2 | Site Specific | 1 | Site Specific | 1 |
| **Duration** | Permanent | 4 | Long Term | 3 | Permanent | 4 |
| **Intensity** | Medium-High | 5 | Medium-High | 5 | Low-Medium | 3 |
| **Probability** | Definite | 4 | Definite | 4 | Likely | 3 |
| **Status** | Negative | | Negative | | Negative | |
| **Confidence** | Medium | | High | | High | |
| **Significance** | **High** | **44** | **Moderate** | **36** | Moderate | 32 |

## Management Plan

- No mining activities within 32m from any drainage channel may take place.
- Mining will be restricted to the approved mine area.
- Where *in situ* topsoil occurs it shall be conserved and protected.
- Topsoil would be re-introduced to disturbed areas and upgraded by the application of fertilizers and organic material as discussed previously.
- A limited amount of soil shall be sourced from the phases 1 & 4 for the rehabilitation of the hard rock quarries in phases 3 &4. Additional soil or subsoil must be obtained to create proper soil horizons required for root development.
- All quarry areas shall be seeded with the prescribed seed mixture complemented with limited infill planting of indigenous trees/shrubs.
- Alien infestation will be prevented through a monthly alien eradication programme.
- Rehabilitation will be done concurrently with mining and in phases as proposed by the mine plan. Progress will be monitored and audited against proposed rehabilitation schedule to improve land use options and land capability.
- 'pocket mining' must be avoided, if possible, and a decimated effort must be made to link quarry areas and keep quarry floors as flat as possible.
- The impact on the topography of worked out areas will be remedied by means of profiling and stabilizing production faces.
- The necessary storm water structures as prescribed in the chapter on handling of soils would be constructed to reduce water erosion and be maintained to ensure soil stability.
- The slopes will be profiled to such an extent that the area could be used for grazing purposes. Rehabilitated areas would be fenced and not grazed by domestic animals within 5 years after rehabilitation has been completed.
- Vehicles would only make use of designated haul roads to ensure that neither rehabilitated areas nor natural environments are adversely affected.
- Open fires will only be allowed at the plant or quarry areas to safeguard the grazing capacity of the property, as well as those of abutting properties. Meals must be prepared in a designated area.
- All stock theft that can be attributed to the presence of the mine will be the responsibility of the applicant and the necessary remuneration will be paid to affected parties. In addition, any person that engages in such activities shall be dismissed.
- Vegetation outside the mine boundary shall not be affected by mining activities.

- Visual impact shall be reduced through proper re-vegetation strategies as outlined in the chapter on vegetation.
- Production areas/faces will be stabilized/made safe as stipulated in the chapter on handling of soils.
- Waste will be continuously removed from site and no littering would be tolerated since it could result in stock mortality.
- Dust generation will be minimized through the mitigation measures stipulated under dust management.
- At closure, all infrastructures will be removed from site.
- The landowner will be compensated for the loss of grazing capacity for the life of the mine. In addition, should 'pocket mining' result in permanent loss of land use and land capability; he would be compensated according to a valuation done by a competent person.

## 15.5 FLORA

Vegetation plays an important role in maintaining ecosystems, stabilizing soils, maintaining the aesthetics of an area, serving as forage for animals and providing income to landowners. It is therefore important that the vegetation structure of an area to be disturbed, needs be analyzed, rare or endangered mine area species be identified and ecological value of mine area cover be determined. Vegetation structure is mostly determined by the variable geology and climatic factors. This generally results in a diverse mosaic of vegetation communities.

Biodiversity is the variety of life in the natural resources system and includes species diversity, genetic diversity and habitat diversity. The loss of diversity from any ecosystem minimises future options for land use and compromises the quality of life for future generations. Arid regions are generally characterised by fewer species than high rainfall regions, underpinning the importance of giving higher priority to the biodiversity of arid regions, since for each species lost, the percentage loss is higher than in more species-rich regions.

Literature surveys revealed very few site specific floral surveys in the immediate area concerned to establish the original floral composition of the affected areas. The 2006 edition of Mucina & Rutherford was used for this purpose. The extent and location of areas where vegetation has been degraded through overgrazing, agriculture and bush encroachment have also not been published. The extent of land transformation in each vegetation type is known and provides an indication of the conservation status of vegetation types and thus whether development can be considered.

The Kgalagadi District Municipal Area's vegetation is classified as part of the Savanna Biome that extends for a considerable distance in the Northern Cape with the closest other biome the Nama-Karoo Biome located to the south-west of Postmasburg.

Biomes of the immediate study area

Site analyses

According to Mucina & Rutherford, phase 1 and southern section of phase 4 hosts Kuruman Thornveld. The veld type disposes of a least threatened status and 98% is remaining in the wild with an extensive distribution. This vegetation type is therefore not under threat and can still accommodate development. However, none of it is conserved hence care must be taken to limit the impact on the veld type and to restore it where possible.

**Important taxa in this veld type include the following**

Tall Tree:

*Acacia erioloba*

Small Trees:

*Acacia mellifera* subsp. *detinens*, *Boscia albitrunca*.

Tall Shrubs:

*Grewia flava*, *Lycium hirsutum*, *Tarchonanthus camphorates*, *Gymnosporia buxifolia*.

Low Shrubs:

*Acacia hebeclada* subsp. *hebeclada*, *Monechma divaricatum*, *Gnidia polycephala*, *Helichrysum zeyheri, Hermannia comosa, Pentzia calcarea, Plinthus sericeus, Geoxylic Suffrutex: Elephantorrhiza elephantine.*

Graminoids:

*Aristida meridionalis*, *A. stipitata* subsp. *stipitata*, *Eragrostis lehmanniana*, *E. echinochloidea*, *Melinis repens*.

Herbs:

*Dicoma schinzii*, *Giseka Africana*, *Harpephyllum procumbens subsp. procumbens*, *Indigofera daleoides*, *Limeum fenestratum*, *Nolletia ciliaris*, *Seddera capensis*, *Tripteris aghillana*, *Vahlia capensis* subsp. *vulgaris*.

**Biogeographically Important Taxa**

(GW Griqualand West endemic, K Kalahari endemic, S Southern most distribution in interior of southern Africa)

Small Trees: *Acacia luederitzii* var. *Luederitzii* K, *Terminalia sericea S*.

Tall Shrubs: *Acacia haematoxylon K*.

Low Shrub: *Blepharis marginata GW*.

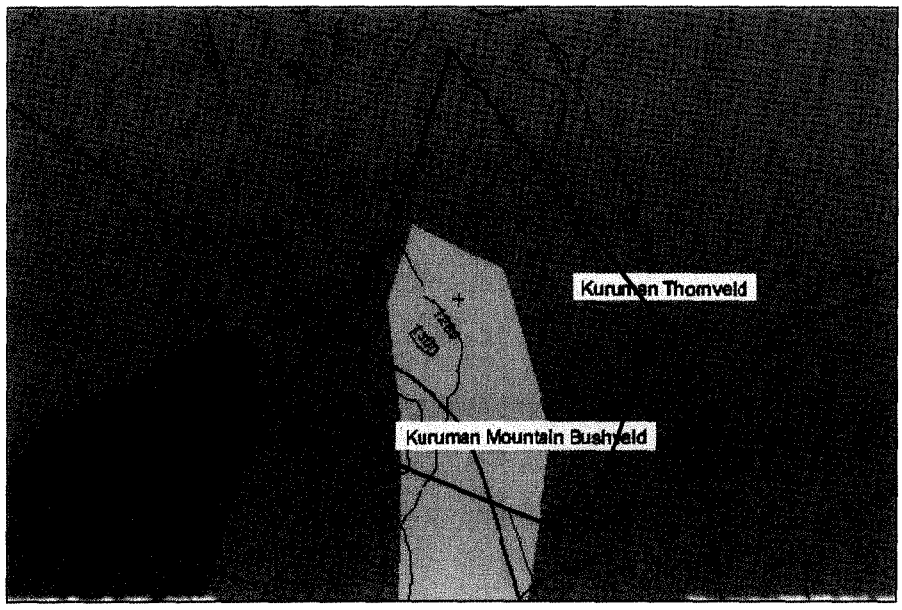
Graminoid: *Digitaria polyphylla GW*.

Herb: *Corchorus pinnatipartitus GW*.

**Endemic Taxa**

Herb: *Gnaphalium englerianum*.

**Mucina & Rutherford**



Phases 2, 3 & 4 host a different vegetation type due to the influence of the underlying manganese bedrock and limited soil profile. According to Mucina & Rutherford these sites host Kuruman Mountain Bushveld. The veld type disposes of a least threatened status and 99% remains in the wild with an extensive distribution. This vegetation type is therefore not under threat and can also accommodate development. However, none of it is conserved hence care must be taken to limit the impact on the veld type and to restore it where possible, especially since more mines are being developed on these particular geological features.

**Important taxa in this veld type include the following**:

Small Trees:
*Rhus lancea.*

Tall Shrubs:
*Diospyros austro-africana, Euclea crispa subsp. crispa, E. Undulate, Olea europaea subsp. Africana, Rhus pyroides* var. *Pyroides, R. Tridactyla, Tarchonanthus camphorates Tephrosia longipes.*

Low Shrubs:
*Rhus ciliate, Amphiglossa triflora, Anthospermum rigidum subsp. pumilum, Gomphocarpus fruticosus* subsp. *fruticosus, Helichrysum zeyheri, Lantana rugosa, Wahlenbergia nodosa.*

Succulent Shrubs:
*Ebracteola wilmaniae, Hertia pallens.*

Herbaceous Climber:
*Rhynchosia totta.*

Graminoids:
*Andropogon chinensis, A. schirensis, Anthephora pubescens, Aristida congesta, Digitaria eriantha* subsp. *eriantha, Themeda triandra, Triraphis andropogonoides, Aristida diffusa, Brachiaria nigropedata, Bulbostylis burchellii, Cymbopogon caesius, Diheteropogon amplectens, Elionurus muticus, Eragrostis chloromelas, E. Nindensis, Eustachys*

*paspaloides, Heteropogon contortus, Melinis repens, Schizachyrium sanguineum, Trichoneura grandiglumis.*

Herbs:
*Dicoma anomala, D. Schinzii, Geigeria ornativa, Helichrysum cerastioides, Heliotropium strigosum, Hibiscus marlothianus, Kohautia cynanchica, Kyphocarpa angustifolia.*

Geophytic Herbs:
*Boophone disticha, Pellaea calomelanos.*

**Biogeographically Important Taxa** (Griqualand West endemics)

Tall Shrub: *Lebeckia macrantha.*
Low Shrubs: *Justicia puberula, Tarchonanthus* obovatus.
Succulent Shrub: *Euphorbia wilmaniae.*
Graminoid: *Digitaria polyphylla.*
Herb: *Sutera griquensis.*

**Endemic Taxon**
Succulent Shrub: *Euphorbia planiceps.*

**Site survey**

The study area was surveyed for approximately one day and it was evident that species diversity is limited due to the extensive proliferation of *Acacia mellifera*. *Acacia mellifera* is generally a low branched tree that can be multi-stemmed, with more or less spherical crown. Leaves are characterized by 2 pairs of pinnulae, each with a single pair of leaflets. Spines are present, at least some, if not all recurved. Black bark on stem becomes ash-grey to light brown on the branches, bearing small, short, sharply hooked spines in pairs. It has a shallow but extensive root system radiating from the crown, allowing the plant to exploit soil moisture and nutrients from a large volume of soil. The roots rarely penetrate more than 1 m.

Although severely affecting land capability in overgrazed areas, it still remains an interesting plant in that it has (had) the following uses:

- Wood used for axe and pick handles.
- Heartwood is termite and borer proof, larger stems therefore make excellent fencing posts.
- Sap was mixed with a powdered grub for use on Khoisan poison arrows.
- Gum is edible and sometimes mixed with clay to make floors.
- Extractions made from roots were used for stomach pains and to treat gonorrhoea, colds and eye inflammation.
- Extracts from roots and leaves used to treat colds, eye inflammation, diarrhoea and bleeding.

In the phase 1 area proliferation is so extensive that it has completely outcompeted all shrubs and trees and only a very minor understory of grassveld. Within the riverine environment three species were observed namely *Acacia erioloba, Tarchonanthus camphorates and Rhus lancia.* The area east of the watercourse and north to north-west of the farm house disposes of a largely intact Savanna veld with moderate land capability in terms of grazing potential. It is therefore clear that mining would not pose any threat to floral distribution or species composition within this particular phase.

Mining the proposed area would result in all the *Acacia mellifera* to be removed which will be a significant benefit to the landowner. Since soil depth would increase due to the screening of the manganese detrital, it would provide an ideal opportunity to reinstate the Savanna grassland. The impact during mining is therefore almost zero with a positive post closure impact. It is, however,important that soils be reinstated as quickly as possible to prevent loss of fertility. In addition, seeded areas need a head start and these areas should be irrigated. Considering that only 0,2ha will be mined per month, it would indeed be possible, provided that water is available.

Within phases 2-4 *Acacia mellifera* is stunted due to the poor soil conditions and has also mostly removed other vegetation species in the area, but a few individuals remained here and there and includes the following: Boscia albitrunca, *Grewia retinervis, Rhus, tenuinervis, Terminalia sericea, Lycium hirsutum, Tarchonanthus camphoratus Rhus undulate, Rhus ciliate, Cadaba aphylla, Gymnosporia buxifolia and Euclea undulata.* Some of these species are the lifeline for browsers during dry periods and an effort must be made to reinstate some of these species within the rehabilitated areas. As pointed out previously, it would be a difficult process since there is little to no topsoil in these areas.

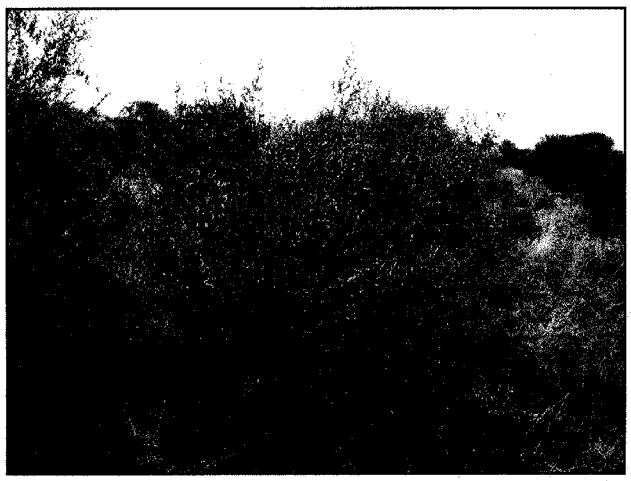
 

As the mentioned plants have developed root systems over many years into the rock and took up water percolating into rock cracks and small pockets of soil, they would not be successfully reinstated without creating a soil profile. It would therefore be a requirement to source soils from the detrital areas and from other sources in the immediate surrounds.

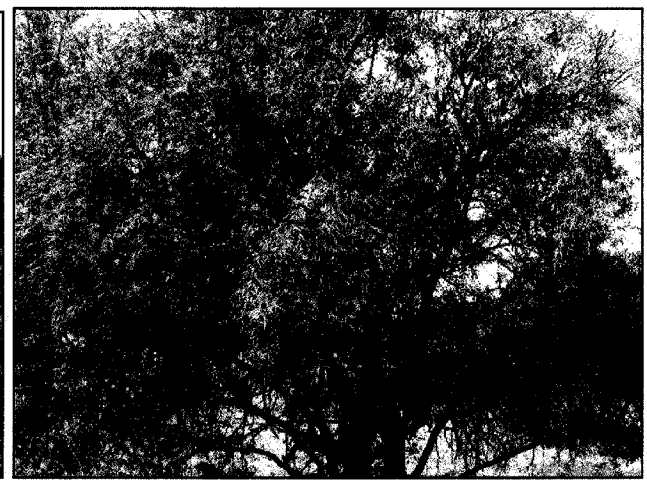
No specie was collected that is listed as a red data species. A limitation of the survey was that it was extremely dry and many plants could have retracted underground. Should there be a concern in this regard, the areas should be re-surveyed during the wetter summer season.

## Dominant plant species

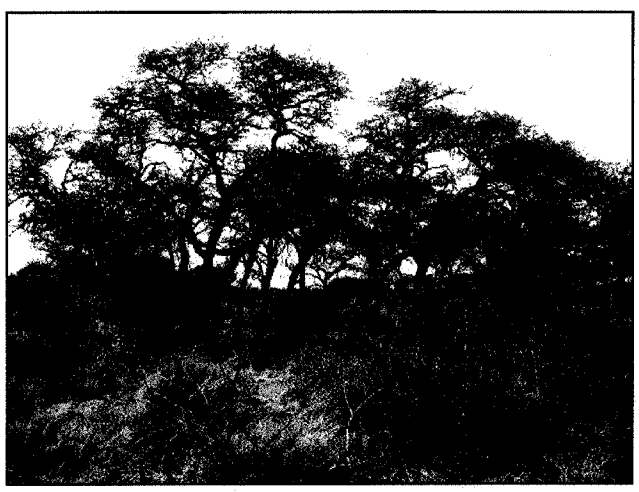
**Tarchonanthus camphorus**



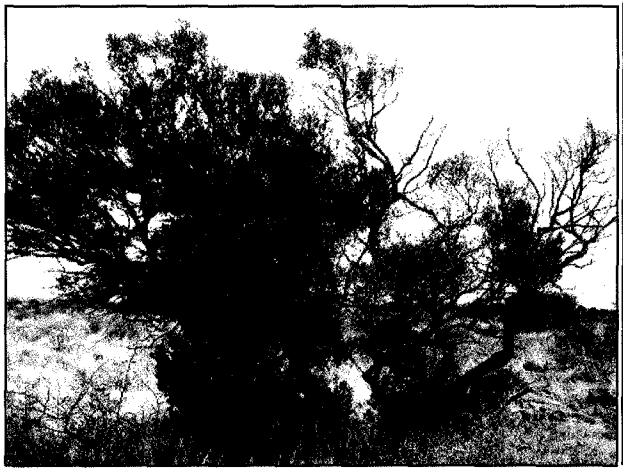
**Rhus lancea (only outside mine aera)**



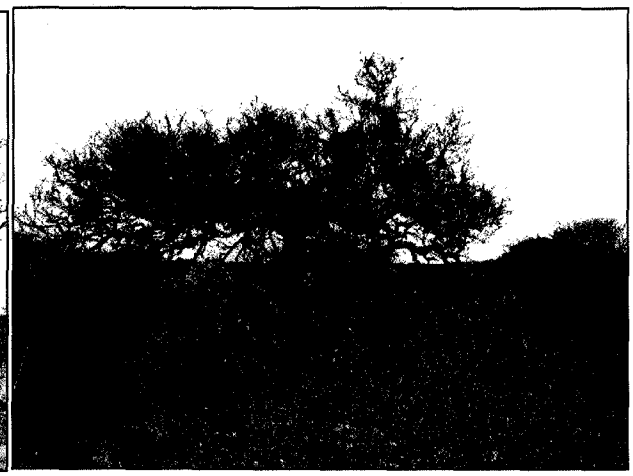
**Acacia erioloba to the east and south-east of mine area – No good specimens in mine area**



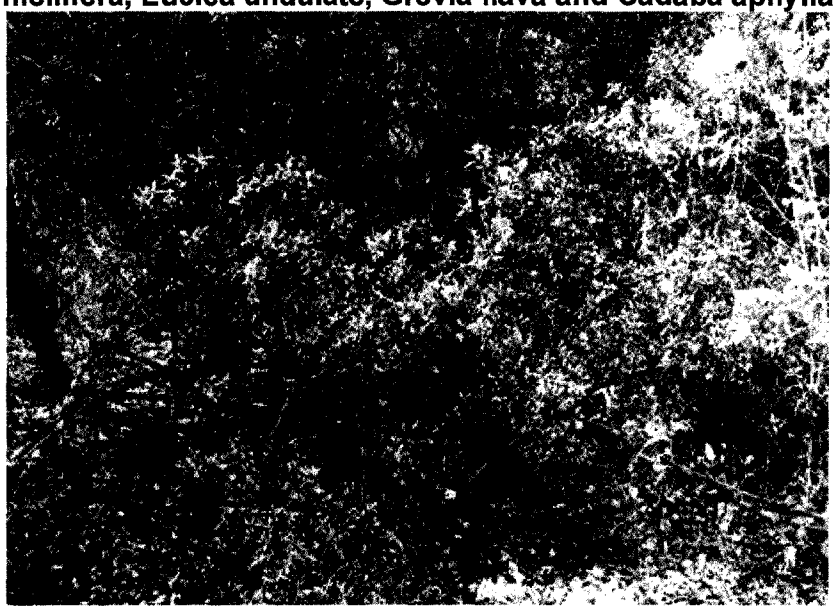
**Rhus ciliate**



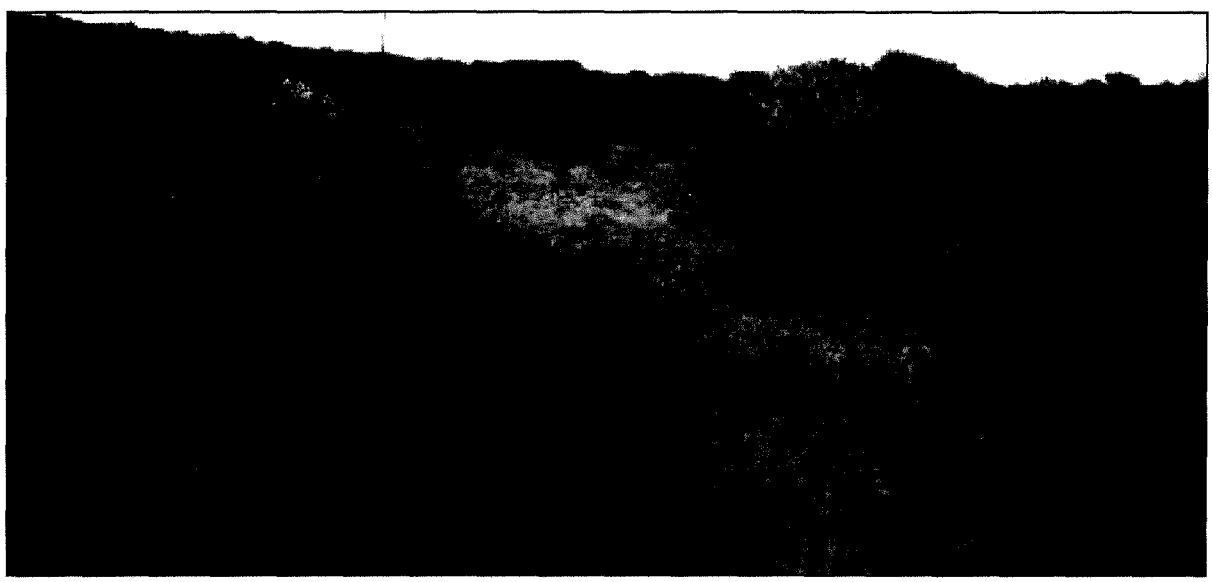
**Boscia albitrunca(few specimensin phases 2&3**



**A few busshclumps were found in phases 3 & 4 with Acacia mellifera, Euclea undulate, Grevia flava and Cadaba aphylla**



Dominant Acacia mellifera in the entire mining area



Corridors

Phase 1 does not constitute a floral corridor since it represents the eastern extent of the veld type in this particular area. Phase 3 & 4 could be viewed as a minor corridor but due to the degradation of this veld type and representing the most northern extent of the hill range and not being connected or close to the next hill to the north-east it has a much lower value and mining would not affect species distribution negatively.

Red data species

None of the species collected is considered a red data species and the area can be safely mined. Red data species from the Northern Cape is provided as an annexure.

Alien plant invasion & proliferation of *Acacia mellifera*

Due to the extensive seed bank that has developed over many years of infestation, it is guaranteed that it will germinate in huge numbers when soil is reinstated. If no dedicated control programme is implemented, the rehabilitated section of land will be recolonized and the objective of establishing proper grassland for future grazing would not be achieved. Mining could then be viewed as environmentally unsustainable. Considering the potential loss of land in phases 2-4, it is important that phase 1 and phase 4 be properly rehabilitated to offset any such loss. Disturbing the soil would also provide an opportunity for invader species to enter the area which should be avoided through the *Acacia mellifera* control programme. The most important invaders of the wider area are listed below and none should pose a serious threat on the land concerned except for *Prosopis* cf. *Glandulosa*.

| | |
|---|---|
| *Argemone ochroleuca* | Mexican poppy |
| *Datura ferox* | Large thorn apple |
| *Eucalyptus* cf. *camuldulensis*. | Red river gum |
| *Melia azedarach* | Seringa |
| *Nicotiana glauca* | Wild tobacco |
| *Opuntia* cf. *ficus-indica* | Prickly pear |
| *Pennisetum setaceum* | Fountain Grass |
| *Prosopis* cf. *glandulosa* | Mesquite |
| *Ricinus communis* | Castor oil plant |
| *Tamarix ramocissima* | Tamarisk |
| *Xanthium spinosum* | Spiny cocklebur |

The site survey did not reveal any significant alien plant colonies.

Exclusion zones

The embankments of the ephemeral/episiodic stream located to the immediate east of phase 1 may not be disturbed and a buffer zone of at least 32m must be maintained in terms of current legislation. Should this not be done it is possible that river diversion could occur considering mined out areas to be lower than the immediate surrounds which could affect the ecology of the stream environment.

The slope below phase 4 should be retained since it disposes of better quality vegetation and has been less impacted by pastoral activities. The same should apply to the slope below phase 3, unless significant manganese reserves are proved in this area.

**Impact on flora**

| | OPERATIONAL (no mitigation) | WEIGHT | OPERATIONAL (with mitigation) | WEIGHT | CLOSURE | WEIGHT |
|---|---|---|---|---|---|---|
| **Extent** | Site Specific | 1 | Site Specific | 1 | Site Specific | 1 |
| **Duration** | Permanent | 4 | Medium Term | 2 | Medium Term | 2 |
| **Intensity** | Low | 2 | Very Low | 1 | Very Low | 1 |
| **Probability** | Likely | 3 | Likely | 3 | Probable | 2 |
| **Status** | Negative | | Negative | | Negative | |
| **Confidence** | High | | High | | High | |
| **Significance** | Low | 21 | Very Low | 12 | Very Low | 8 |

## Management plan

It will be possible to restore the Savanna veld over the short term to medium term and the soil structure will lend itself towards infill planting with *Acacia erioloba.* A positive factor is that the affected area is abutted to the east by tracts of Savanna veld that could act as a seed bank for newly rehabilitated areas. It will be much more difficult to restore the shrubland, but will be possible if topsoil is imported into the area. The success of the re-vegetation process will, however, depend on the effort spent on the process, adequate funding and post closure maintenance and a dedicated alien eradication programme followed.

- Mining activities will be restricted to the mineralised area.
- No indigenous vegetation outside the mineralised area will be removed.
- All available topsoil will be conserved and used in the rehabilitation phase, since it will be vital to stimulate natural re-growth.
- Vehicles will not traverse virgin land outside the mine area.
- No vegetation will be cut outside the mine area for fire wood.
- No vegetation will be removed from the hill slopes except for access to quarry areas or unless significant mineral reserves are proved in these areas.
- No vegetation will be affected within the riparian zone.
- Should dust generation impact on abutting vegetation, the source of dust will be curbed by means of irrigation of affected areas or by means of mist sprayers on transfer points on the crushers and screens.
- A phased re-vegetation programme as discussed under 'mine development' will be followed to ensure timeous rehabilitation of disturbed areas in order to increase control over the process and to limit the visual impact.
- The minimum vegetation will be removed ahead of each quarry area to retain soil viability.
- Once individual areas have been backfilled, profiled or provided with topsoil, seedbed will be prepared from October onwards to facilitate seeding in November until start of March. Seed mixes shall be mixed with sand before it is hand broadcasted to ensure equal distribution. Once seeded, the seeded area shall be scarified to cover seed.
- Seeded areas must be covered with non-seed bearing *Acacia mellifera* as wind breaks and must therefore not be disposed of.
- If water is available, seeded areas must be irrigated once a week for a month to head start the re-vegetation process.
- The following seed mixture can be used. Usually 5-7 species should be selected and seeded at a rate of 5kg/ha. These grasses will gradually be replaced by grasses of the immediate surroundings:

*Schizachyrium sanguineum* – hard grazed that is poorly grazed
*Heteropogon concortus* – only palatable in summer and grows in poor soils
*Elionurus muticus* – sandy soils and overgrazed veld
*Tragus berteronianus* – grows in disturbed, sandy soils
*Anthephora pubescens* - grows in sandy dry soils, palatable
*Perotis patens* – grows in poor, sandy soils and disturbed areas

*Cenchrus cilliaris* – grows in sandy, well drained soils – palatable
*Aristida congesta* – grows in bare and overgrazed patches, sandy soils
*Enneapogon cenchroides* – grows in sandy disturbed soils.
*Eragrostis nindensis* or any other common Eragrostis– shallow soils and rocky beds
*Schmidtia pappophoroides* – grows in hot areas in sandy soils
*Stipagrostis uniplumis* – grows in sandy arid soils
*Milinis repens* – grows in disturbed places – pioneer
*Digitaria eriantha* – sandy arid parts

- Seeding must coincide with rainy periods since irrigation might not be possible. Seeding, germination and surface cover will be monitored on a continuous basis. This vegetation cover would require the minimum maintenance and will within a short time improve the visual appearance of the site. Maintenance will be carried out until the area is fully vegetated.
- As an alternative, grass can be cut in the surrounding veld after seed has ripened and been worked into the soil. This will also ensure that the soil receives some organic material that will be beneficial for soil structure and soil moisture regimes.
- Should the above seeding approaches not work, hydro-seeding must be done and the mix must include a binder and organic component (mulch).
- Once a grass cover has been established infill planting can be done with *Acacia erioloba,* which is available at some nurseries. It is important that such plants are not planted directly once obtained from the nurseries, since they have to acclimatize in the new environment, hence a nursery area must be stabilised and a worker must be dedicated for this task. Alternatively they can be grown onsite from seed obtained from nearby trees.
- In phases 2-4, some of the plants identified during the site survey could be used for infill planting if they are available from nurseries .or alternatively an effort must be made to grow them onsite.
- For every tree/shrub a planting hole ( 0,4 x 0,4 x 0,4m) must be prepared by digging out some of the soil and filling it with a 75:25 mixture of topsoil and compost and very light application of 2:3:2. Before the plant is introduced the soil mixture must be watered well. Once planted, and the remainder of the soil introduced, the trees must be watered again and be repeated at least every week for 2 months.

- Once the mine area has been vegetated, a continuous alien control programme will be implemented by pulling any seedlings on a two weekly basis with specific attention to *Acacia mellifera*. No alien tree will be left until it reaches seed bearing age.
- Once an area is vegetated, no traffic will be permitted in such area.
- Veld fires will be prevented and will not be permitted within the mine area. The required fire extinguishers will be made available within the quarry areas, at the plant area and the residence. It will be required that the applicant formulates a fire fighting protocol and must make it available to workers onsite. It is important that they should understand the process and must receive the required training in this regard and reporting channels must be clearly stipulated.
- The applicant will be liable for all stock loss, as well as loss of grazing, should veld fires result from mining activities. It would be advisable to take out the required insurance to cover such occurrences.
- The applicant will maintain fire paths on the boundaries as per applicable legislation.
- Should re-vegetation be exceptionally slow due to dry conditions, seeded areas will be monitored and if needed, reseeded/planted the following growing season.

*****

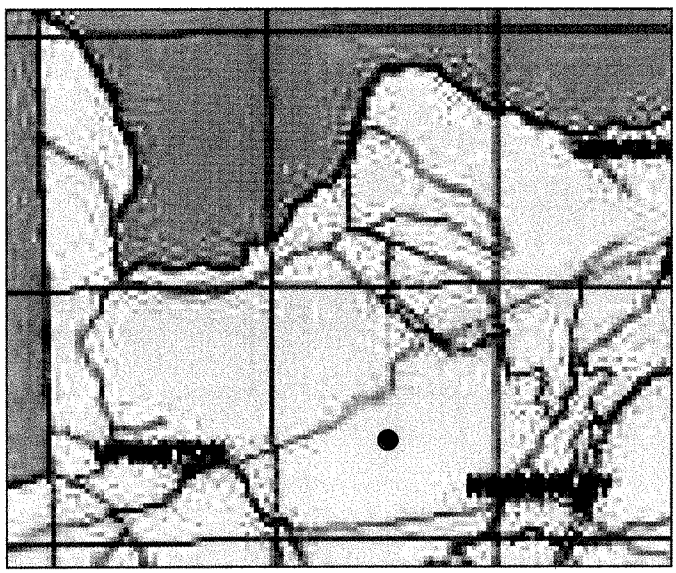
 

## 15.6 FAUNA

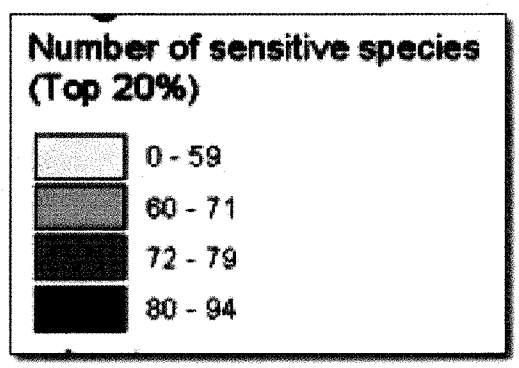
Animals play an important role in maintaining ecosystem functioning for example pollination, spreading of seeds, eliminating pests/insects, forming part of a specific food chain, trimming of vegetation and therefore determining penetrability of vegetation and generation of manure which naturally upgrades soils.

### Broad EMPAT Assessment

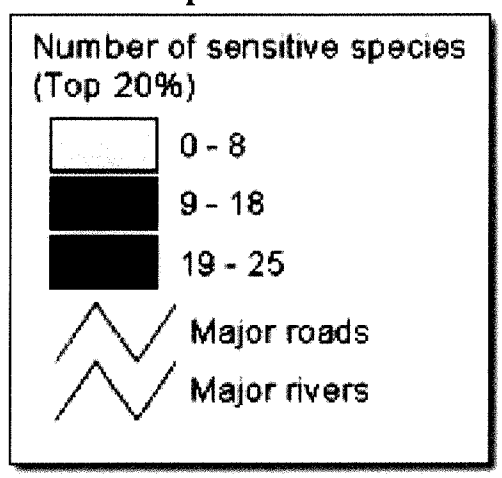
In terms of the broad EMPAT assessment, the site has a low faunal importance as depicted in the relevant maps, except for mammal species. In recent years the avian fauna of the Northern Cape, with specific reference to raptors, has become increasingly important and the EMPAT assessment is therefore not correct.

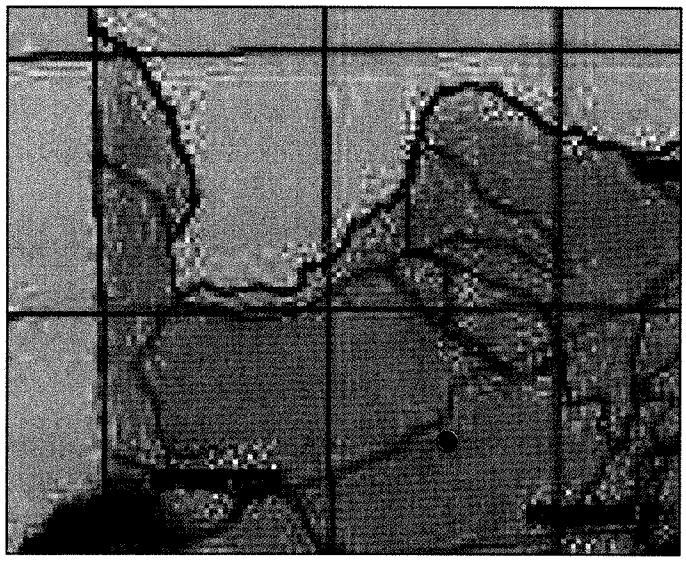


**Avian species**

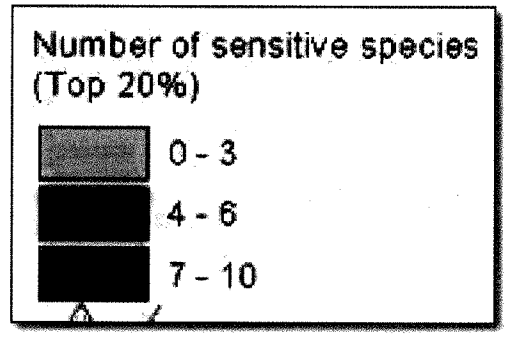


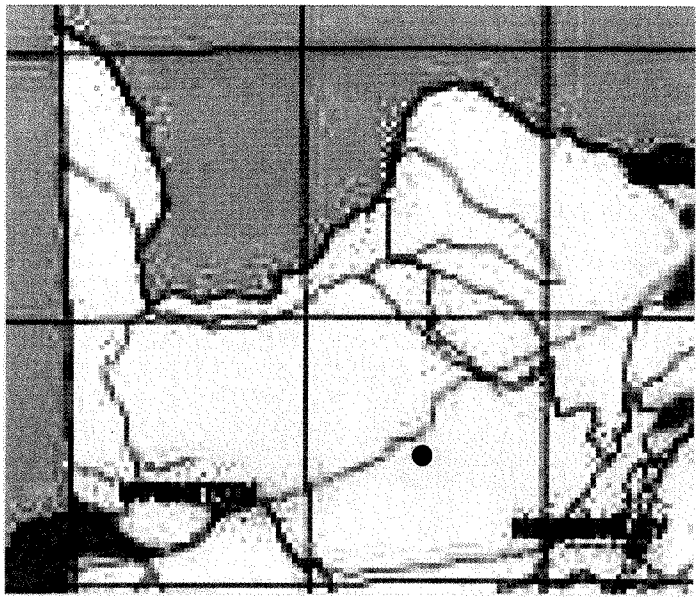

**Mammal species**



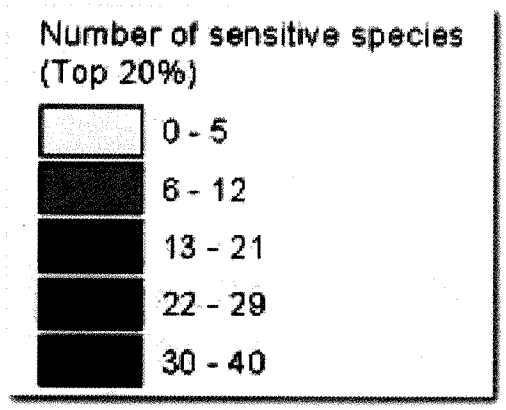


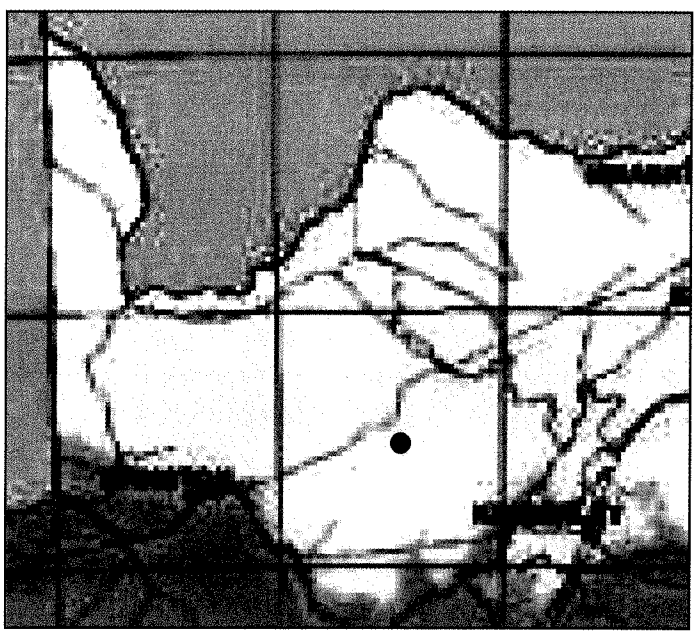
**Reptile species**



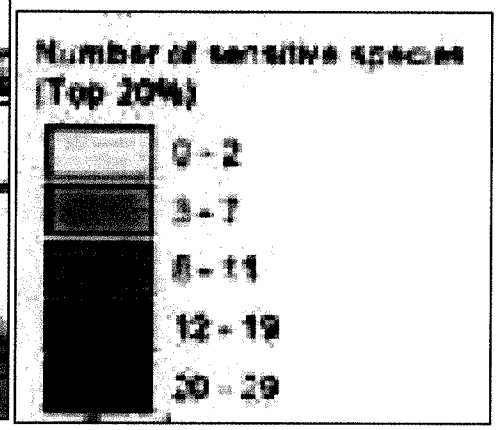



**Butterfly species**



**Scarab species**



Herpetofauna

Approximately 40 reptile and six amphibian species may be encountered in the area. Of these only *Varanus exanthematicus (rock monitor)*, is classified as Vulnerable outside reserves. Snakes should be common. List of Red Data species that could occur in the area is appended.

Amphibians

Due to absence of surface water it is not anticipated to find any species in the mine area, but possible in the episodic drainage channel.

Mammals

The McGregor Museum Kimberley's mammal database indicates a composition of approximately 64 mammal species for the wider area, with most falling within the small mammal category. Red Data species that could occur in the area is appended.

Avifauna

The database of the McGregor Museum Kimberley totals approximately 200 bird species for the wider area. The area is known for its raptor species and all are protected. Red Data species are appended.

Below follows a list of common animals that should occur in the area:

Ringhals (*Hemachatus haemachatus*), Cape Cobra (*Naja nivea*), Common Night Adder (*Causus rhombeatus*) and Puff adder (*Bitis arietans*), Horned adder, Common Duiker (*Sylvicapra grimmia*), Steenbok (*Raphicerus campestris*), Large Spotted Genet (*Genetta tigrina*), Scrub Hare (*Lepus saxatilis*), River Rabbit, Kudu (*Tragelaphus strepsiceros*), Porcupine (*Hystrix africaeaustralis*), Caracal (*Felis caracal*), Serval (*Felis serval*- Rare), Honey Badger (*Mellivora capensis* - Vulnerable), aardvark (*Orycteropus afra-Vulnerable*), Antbear (Orycteropus afer afer ), African Wild Cart (*Felis lybica cafra - Vulnerable* ). Rare Small Spotted Cat (*Felis nigripes*), Grysbok (Raphicerus melanotis), Namaqua and Burchell's sandgrouse.

The Kalahari is known for its raptors and below follows a list of these raptors that occur in the wider area.

Site evaluation

The site was visited on two separate days and in total some eight hours were spent in the mining area. The site was found to be mostly sterile in terms of faunal activities, except for avian species in the riparian zone, one shrub hare and a lizard species. The extreme dry conditions and the extensive degradation of the natural flora might have significantly contributed to the low sighting of faunal species. This scenario may change during the rainy season since the leaves and flowers of *Acacia mellifera* is sought after by browsers and birds respectively. However, due to the poor land capability it is not anticipated that any important faunal species would be found onsite. Although deemed unnecessary, a faunal assessment can be repeated in summer.

In order to ensure that the minimum impact is imposed on animals, mining would be restricted to the smallest area possible and the slow extraction rate would provide adequate time for migration of any animals remaining on site to be sustained in similar adjoining habitats. In addition, noise generated by vehicles and the crusher will cause most animals to vacate the site on a temporary basis. Noise levels on site will range between 55 and 85 decibels at the mine boundaries and will tend to drive animals away from it, which would preclude them from getting affected within the mine area. Blasting (120-140dB) on the other hand could startle domestic as well as wild animals with the potential result of running into fences. It is therefore important to ensure that no domestic animals are within 300m of the site during blasts. The mentioned impact will only be imposed once a quarter when low extraction rates prevail or once a month should a large contract be received and the impact is therefore rated of low significance, since animals will tend to return to their former niches.

Most of the noises would be low-pitched and would have a lesser impact on animals than what high-pitched noises would have. Audio systems of animals are much more sensitive to the latter. Subject to that remaining animals are not disturbed/hunted by the workforce, animals onsite should grow accustomed to increased noise levels and would simply vacated the proposed mining areas during the day and eventually return to the surrounding niche areas during quieter times or when disturbed areas are adequately rehabilitated.

Indiscriminate hunting/trapping/poaching could be a potential problem and the necessary discipline has to be enforced and monitoring must be implemented. This impact is a reality due to the close proximity to proper Savanna veld to the north and east. The applicant will take responsibility for any animal that is proved to be killed by members of mine staff. Strict control measures will be put in place and severe penalties will be applicable if any animal on site is poached.

Limited hydrocarbon spillages anticipated would not detrimentally affect fauna on site as it would be localized in the excavation or plant area and dealt with in an expedited manner. Storage of hydrocarbons and the servicing of vehicles will be strictly controlled within the plant area where no wild life will be present hence no impact is anticipated. As the plant and quarry area is not directly linked to any drainage channel and movement of vehicles will not take place in close proximity to stream environments, no aquatic fauna will be affected. With regards to silt transport all silt will be trapped within excavations and will not affect any outside areas.

Faunal corridor

Due to the degradation of the mining area, neither phase 1 nor phases 3 & 4 constituted a designated faunal corridor. Mining of these areas will therefore not interrupt migration patterns nor species diversity. The riparian zone will constitute a definite corridor for many of the species due to the protection and shade that it offers. As previously indicated, this particular area may not be affected.

The post mining grassland that would be established would provide improved forage for both domestic and wild stock and would thus benefit the environment and landowner in general. The area would in general constitute a slightly better ecological niche than what prevailed prior to mining, which will provide the opportunity for animals to return to the rehabilitated environment. The impact of mining on animals is thus rated very low, provided that a dedicated effort is made to facilitate the rehabilitation proposals captured in this document.

The positive economic impact of the proposed operation will definitely outweigh the negative impact on fauna of the area.

**Impact on Fauna**

| | OPERATIONAL (no mitigation) | WEIGHT | OPERATIONAL (with mitigation) | WEIGHT | CLOSURE | WEIGHT |
|---|---|---|---|---|---|---|
| **Extent** | Local | 2 | Site Specific | 1 | Site Specific | 1 |
| **Duration** | Long Term | 3 | Medium Term | 2 | Short Term | 1 |
| **Intensity** | Low | 2 | Low | 2 | Very Low | 1 |
| **Probability** | Likely | 3 | Likely | 3 | Probable | 2 |
| **Status** | Negative | | Negative | | Negative | |
| **Confidence** | High | | High | | High | |
| **Significance** | Low | 21 | Low | 15 | Insignificant | 6 |

## Management plan

- Vehicles will not display fuel, oil or lubricant leaks and will be maintained to an acceptable standard.
- Any fuel spills will be cleaned up immediately and the contaminated soil removed to an approved waste facility.
- Handling of hydrocarbons will be in accordance with all applicable legislation to prevent pollution incidents.
- No polluted discharges will be done in the veld or riparian environment.
- Movement of vehicles will be restricted to the authorized mine area and haul roads.
- No animals entering or settling in the mine area will be trapped or killed and this requirement will be included in the environmental awareness programme, which has to be discussed with workers on an annual basis and presented by the applicant or any competent environmentalist.
- No hunting or snaring would be allowed outside or inside the mine area, with specific emphasis on the ephemeral drainage line and the area south of phase 4. The applicant will implement a severe penalty system for people transgressing this requirement. In addition, the owner or manager will remove any of the staff caught interfering with wildlife from the site immediately. The surrounding area will be regularly inspected for snares.
- All animals found on working areas where they may be injured, will be relocated to areas outside the mine area.

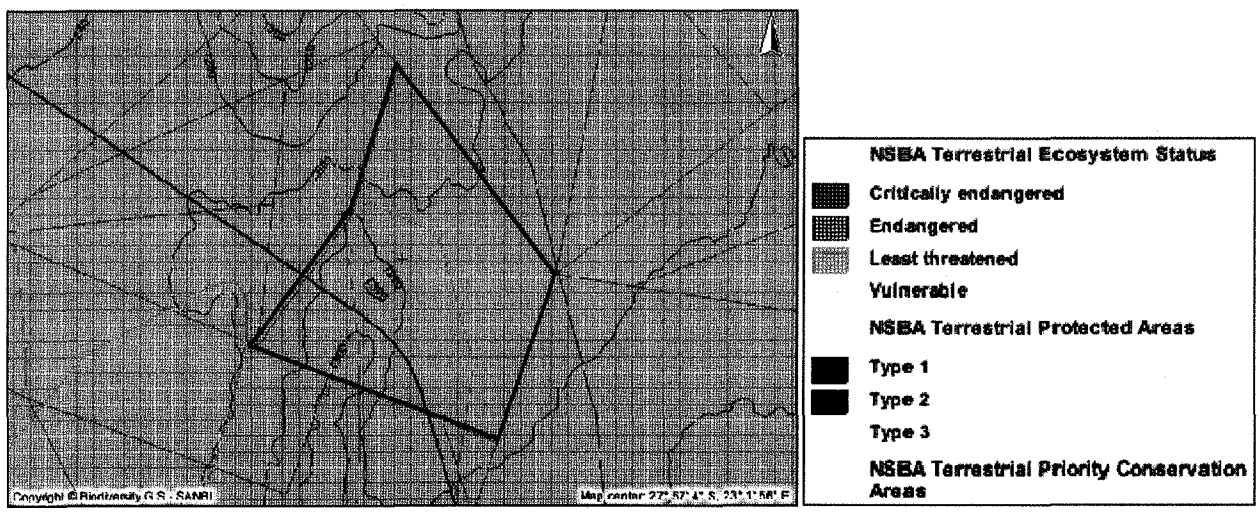
- If possible, identified nesting sites will be temporarily excluded from the mine area, or be carefully relocated.
- The quarry area will be developed in phases and clearing of vegetation will be restricted to the minimum area required for optimal extraction of stone.
- Areas to be cleared will be swept by a competent/responsible person before vegetation is removed. Relocate any herpentofauna and slow moving animals to areas outside the mining areas.
- Disturbed areas will be properly rehabilitated as per the process outlined in the re-vegetation programme.
- No vegetation outside the mine areas will be removed and spread of alien vegetation will be prevented.
- Veld fires will be prevented by not allowing any cooking fires outside the plant area. Preferably all food must be prepared in a designated amenity container. The applicant will take full responsibility for any financial losses that proofs to be the result of negligence in this regard.
- Mining areas will be clearly demarcated and areas outside of it will be out of bounds.
- Production faces will be properly profiled to ensure that it does not pose any danger to domestic/wild animals and to facilitate proper re-vegetation.
- Mining will not impact on any ephemeral surface water area.
- Due to the occurrence of raptors in the area, no pesticides or poisons will be used onsite that could lead to the occurrence of contaminated animal carcasses in the veld.
- Noise generation will be curbed by servicing and maintaining mining equipment effectively and keeping blasting charges as small as possible.
- No domestic stock would be allowed in rehabilitated areas within 5 years after the first grass stand was established.

## 15.7 ENVIRONMENTAL SENSITIVITY

Environmental sensitivity of the proposed area was evaluated in terms of available sensitivity information for this particular area or immediate surrounds and would provide a fair overview of the importance of the proposed mining site and would support the other chapters of the EIA and EMP. It seems, however, that the Siyanda District Municipality has not engaged in major effort to develop a district specific environmental framework plan. Information in this regard is therefore not entirely satisfactorily, but considering the ecological status of the mine area, it would not affect final decision making on the proposed development plan.

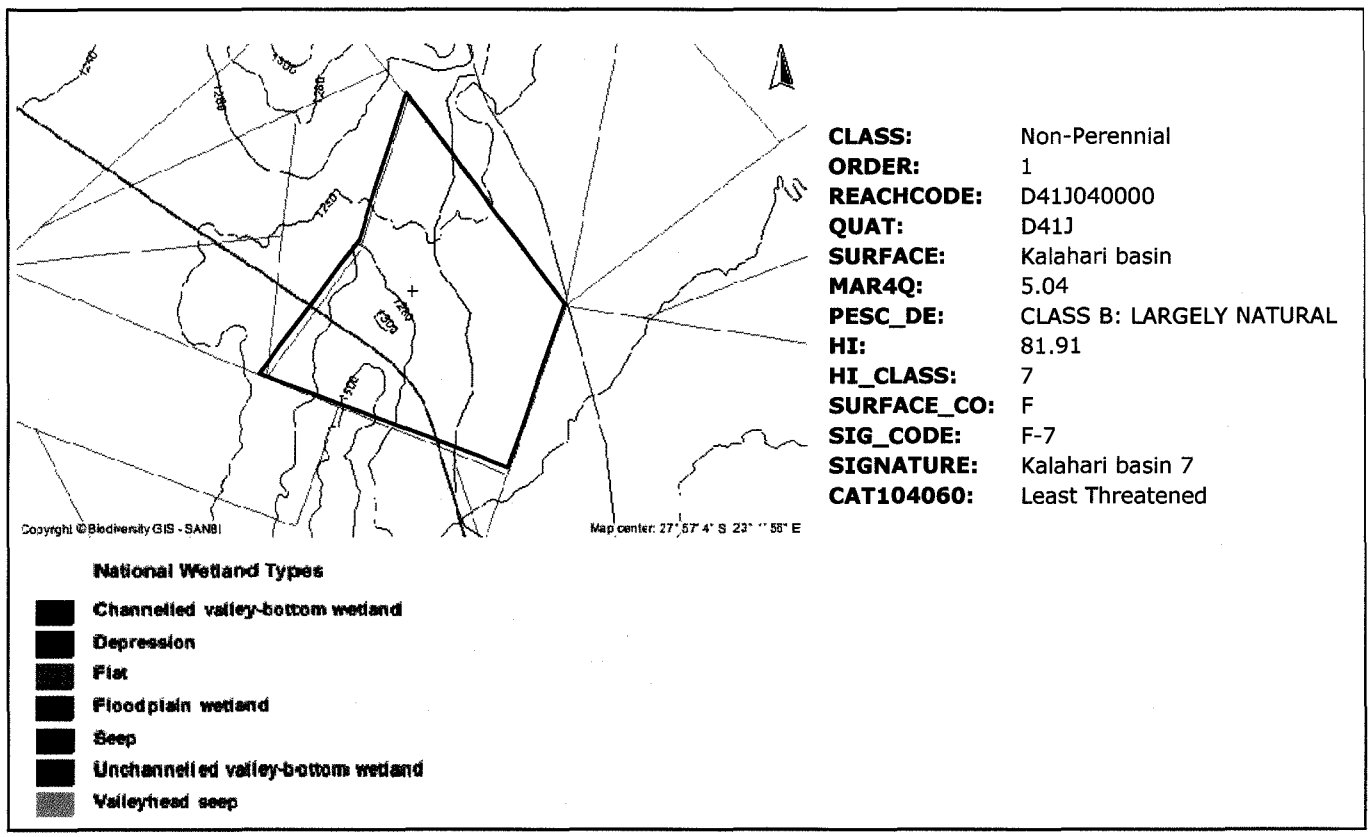
National perspective

In terms of the National Conservation Plan, the study area is not located near any National Park. In terms of the NSBA Boskop mine quarry site is not located within a Terrestrial Priority Conservation Area or important veld type, but within an area with conservation status of 'Least Threatened'.

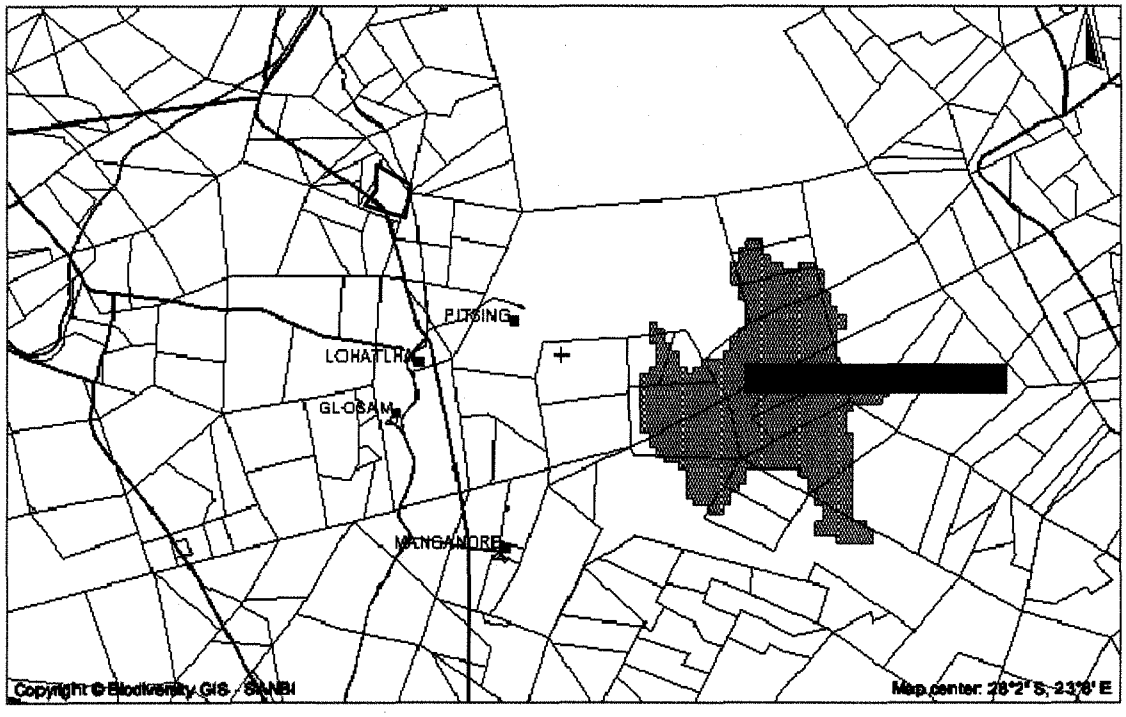



In terms of the NSBA River Ecosystem Status the quarry site is located close to a river system that is largely natural (class B) with a conservation status of 'Least Threatened'. The required 32m setback line will be maintained to ensure that its status remains the same. In terms of the National Wetland Inventory the mining site does not host any off-stream or in-stream wetlands of importance, hence the proposed development will impose a zero impact on sensitive aquatic systems.

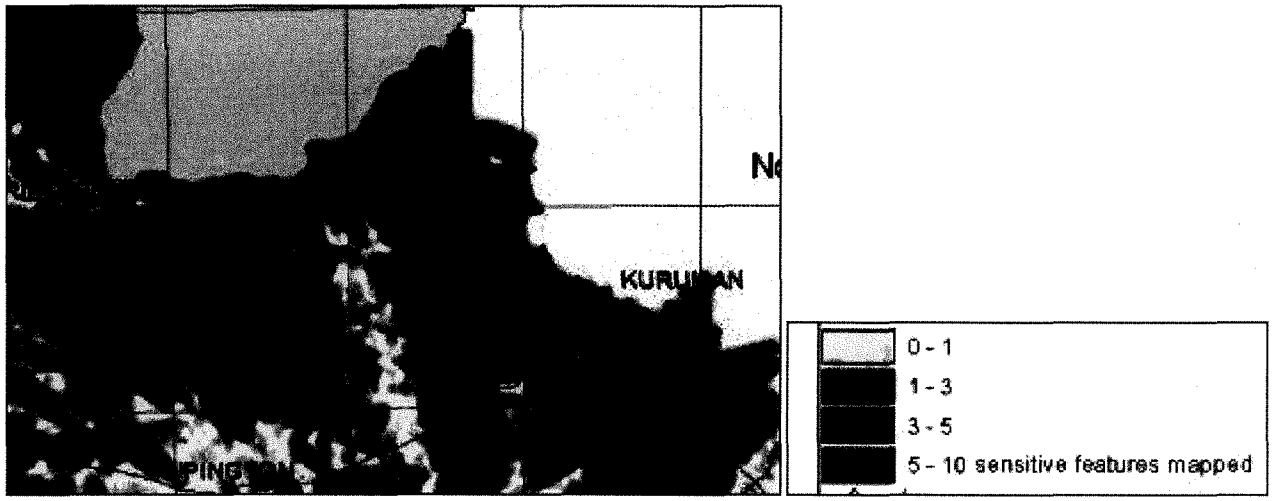
 




The proposed Boskop Mine is located distant to any National Focus Area. The Eastern Kalahari Bushveld area is located to the south-east.



The Boskop Mine is located within an area where very few sensitive environmental features were mapped.

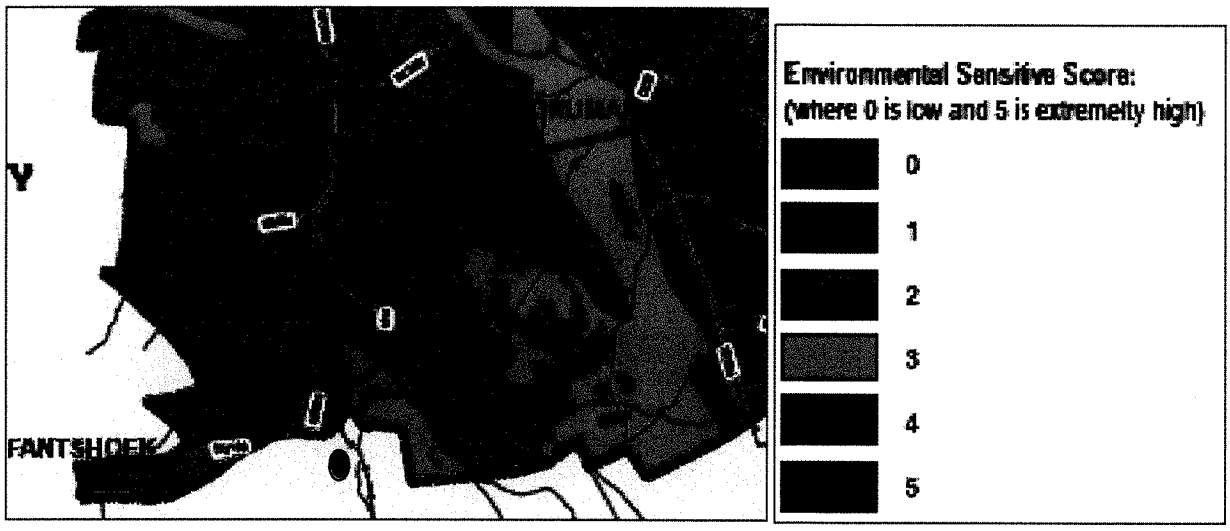



Provincial perspective

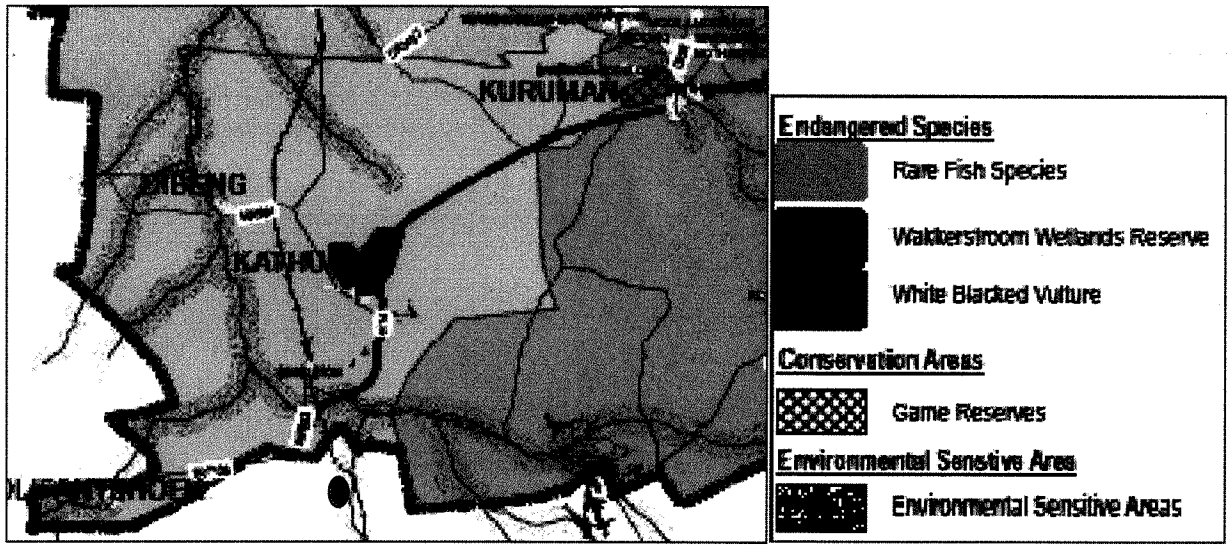
Due to the unavailability of information, environmental statistics available for the Kgalagadi District Municipality will be extrapolated to the proposed mining area since Boskop Mine is located only a few kilometres from the boundary.

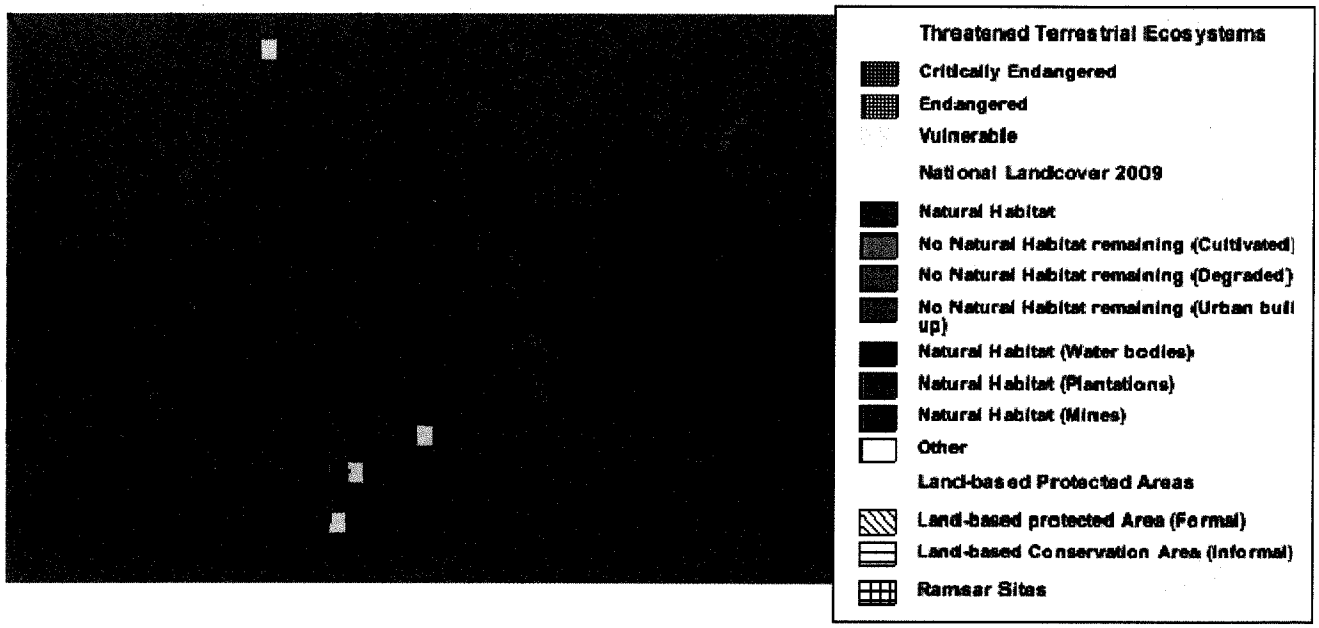
Boskop Mine is only located in an area with a bio-physical scoring of 30% and an environmental sensitive scoring of between 2 and 3, where 5 is extremely high.

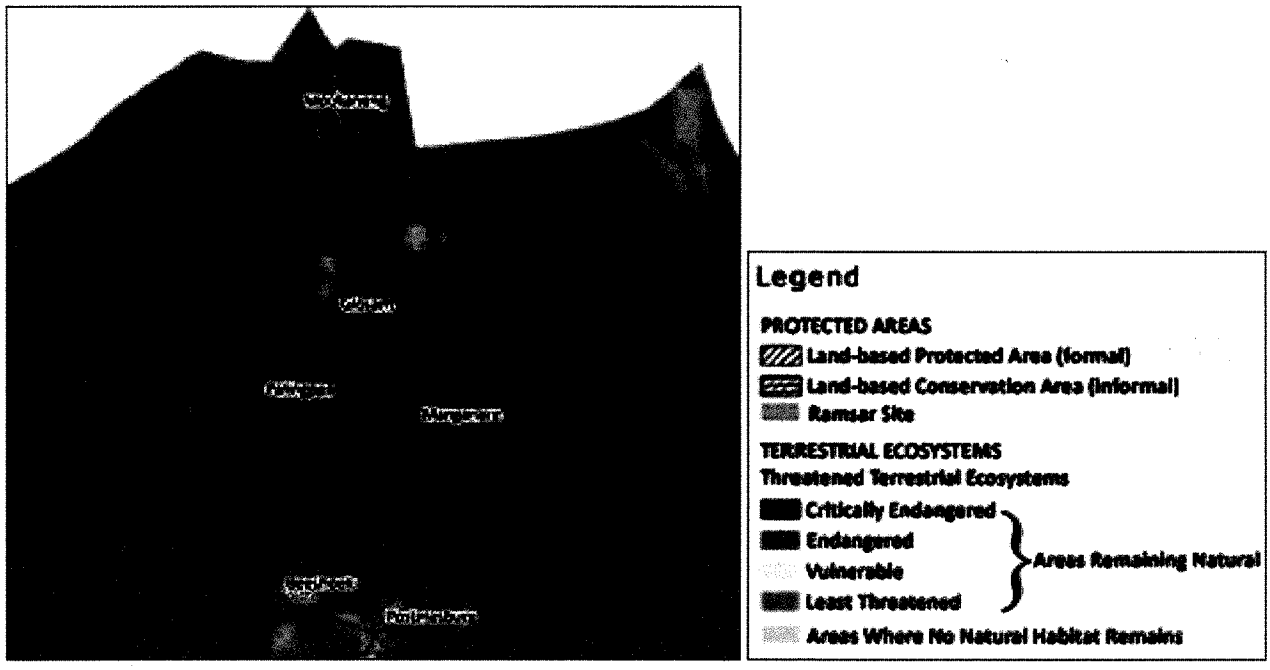

 



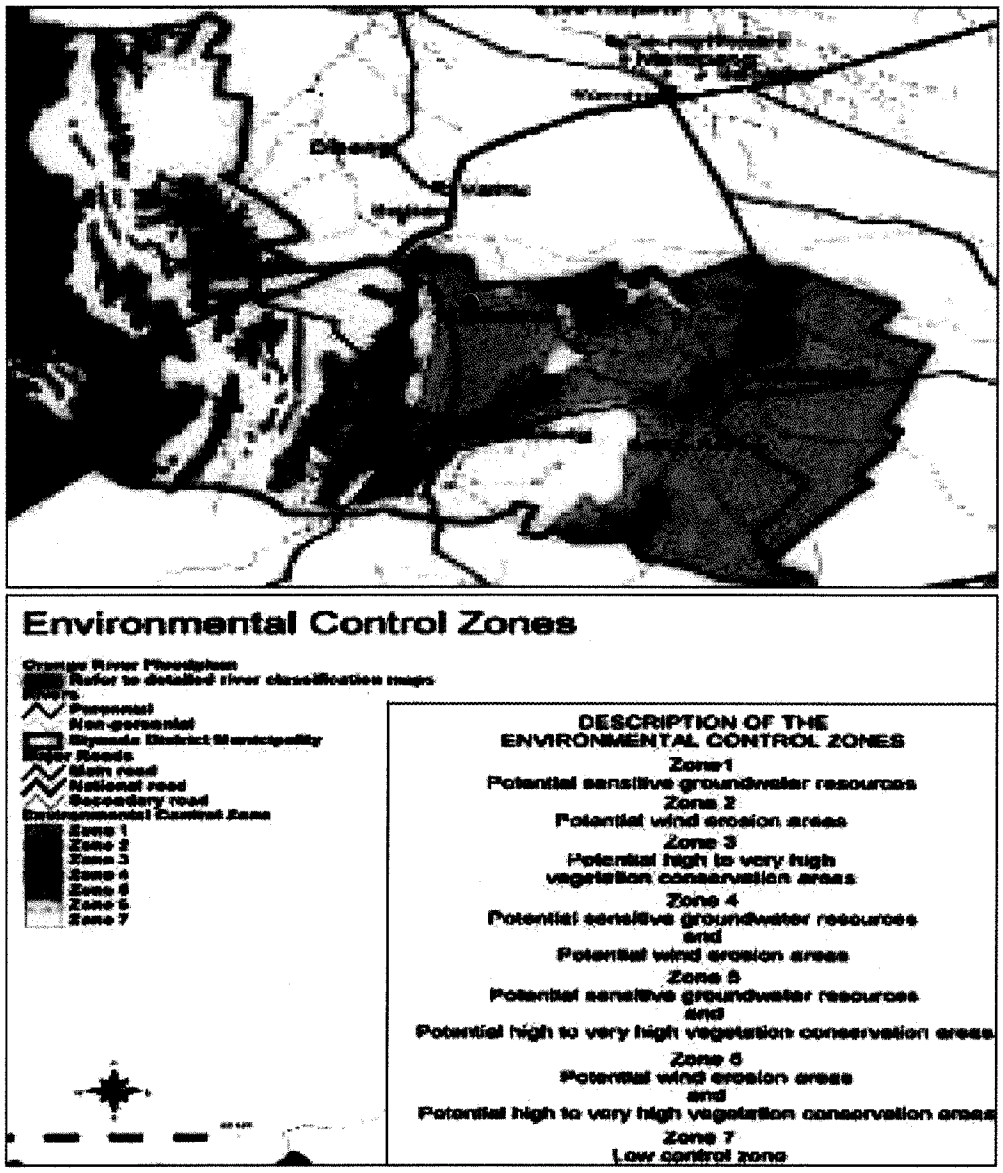

The site is not located near any game reserve and seeming no sensitive faunal habitats occur in the area.






Boskop Mine is, however, located in an area with sensitive groundwater resources.



Considering the environmental status of the mine area and immediate surrounds, as well as the distance to protected areas, the impact on sensitive environments is rated of very low significance if the stipulated mitigation measures are implemented.

## Management plan

As discussed in other chapters of this report.

# 15.8 HYDROLOGY

The largest part of the Northern Cape is an arid to semi-arid region with low summer rainfall, extremely high temperatures in summer and high evaporation potential. Variability in rainfall results in periodic episodes of severe and prolonged drought. Due to the lack of surface water over many areas, ground water is an important resource and in some areas is the only source of water for consumption.

## Water availability

Water that was available for use in the Northern Cape in 2000 amounts to 4483million $m^3$/annum. This available water, however, was unevenly distributed for example with 3534million $m^3$ available per year in the Vanderkloof sub-WMA and only 7million $m^3$ per annum available in the Knersvlakte sub-WMA. From the table it is noted that the Molopo WMA has the third highest volume of water available, but in comparison to the top WMA's the area disposes of only 1% of available water in the Northern Cape of which 72 % relates to groundwater.

**Water availability per sub-WMA in the Northern Cape (2000)**

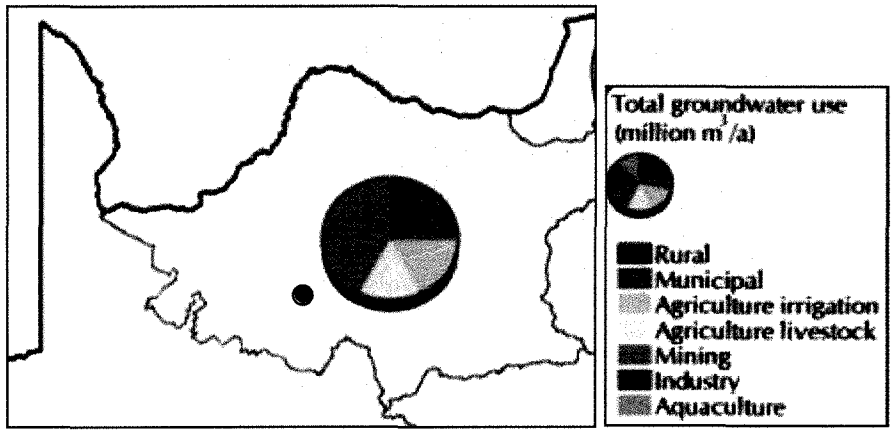
| Reporting scale | | Natural resource | | Usable return flow | | | Transfers in | Total resource available |
|---|---|---|---|---|---|---|---|---|
| WMAs | Sub-WMAs | Surface water | Ground-water | Irrigation | Urban | Mining and bulk industrial | | |
| Lower Vaal | Molopo | 2 | 31 | 0 | 5 | 2 | 3 | 43 |
| Upper Orange | Vanderkloof | 3474 | 43 | 17 | 0 | 0 | 0 | 3534 |
| Lower Orange | Orange | -1117 | 9 | 76 | 1 | 0 | 1886 | 855 |
| | Orange Tributaries | 9 | 13 | 0 | 0 | 0 | 0 | 22 |
| | Orange Coastal | 0 | 2 | 0 | 0 | 0 | 6 | 8 |
| Olifants/Doorn | Knersvlakte | 1 | 3 | 0 | 0 | 0 | 3 | 7 |
| | Doring | 8 | 3 | 0 | 0 | 0 | 3 | 14 |
| Total water available in all sub-WMAs in NC boundary | | 2377 | 104 | 93 | 6 | 2 | 1901 | 4483 |

The major user of the Northern Cape's freshwater resources is the irrigated agriculture sector, which requires 1129million cubic metres per annum ($mm^3$/a). The greatest volume of water required for the irrigated agriculture sector is in the Orange sub-WMA. Compared to the irrigated agriculture sector, the mining and bulk industrial sector requires the least volume of water and totals to approximately 15%.

**Sectoral water requirements per sub-WMA within the Northern Cape**

| WMAs | Sub-WMAs | Sectoral requirements (volumes in million m³/a) | | | | | | Transfers out | Total local requirements |
|---|---|---|---|---|---|---|---|---|---|
| | | Irrigation | Urban | Rural | Mining & bulk industrial | Power generation | Afforest-ation | | |
| Lower Vaal | Molopo | 0 | 17 | 17 | 6 | 0 | 0 | 0 | 40 |
| Upper Orange | Vanderkloof | 333 | 6 | 5 | 0 | 0 | 0 | 2656 | 3000 |
| Lower Orange | Orange | 764 | 15 | 9 | 7 | 0 | 0 | 60 | 855 |
| | Orange Tributaries | 16 | 8 | 7 | 0 | 0 | 0 | 0 | 31 |
| | Orange Coastal | 0 | 5 | 1 | 2 | 0 | 0 | 1 | 9 |
| Olifants/Doorn | Knersvlakte | 3 | 0 | 1 | 3 | 0 | 0 | 0 | 7 |
| | Doring | 13 | 1 | 1 | 0 | 0 | 0 | 0 | 15 |
| Total sector requirement | | 1129 | 52 | 41 | 18 | 0 | 0 | 2717 | 3957 |

This figure could now be substantially higher since a number of new mines have been established in the region, especially between Kuruman and Postmasburg and it is therefore reasonably certain that the buffer of 3million cubic meters has been reduced substantially and little spare water is available. In the Molopo WMA consumption could be as high as 40%.

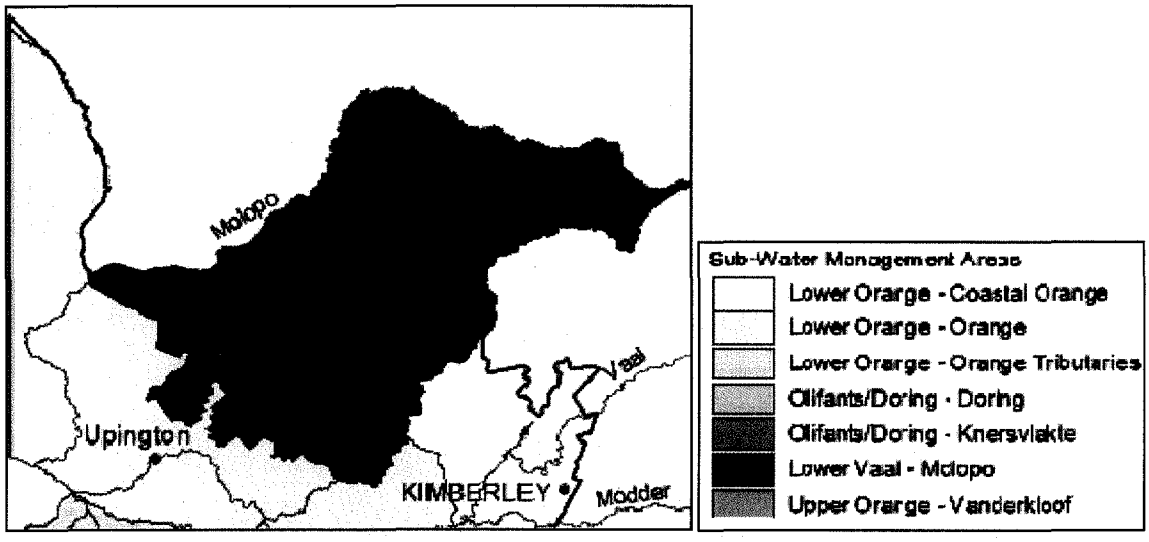



## 15.8.1 SURFACE WATER

The northern part of the Siyanda District Municipal Area falls within the catchment of the Kuruman River, tributary to the Molopo River, which eventually drains into the Orange River. The Molopo River Catchment mainly consists of ephemeral and episodic river watercourses which very seldom experience flow floods and flow within these watercourses are not monitored hence insufficient information is available on flow

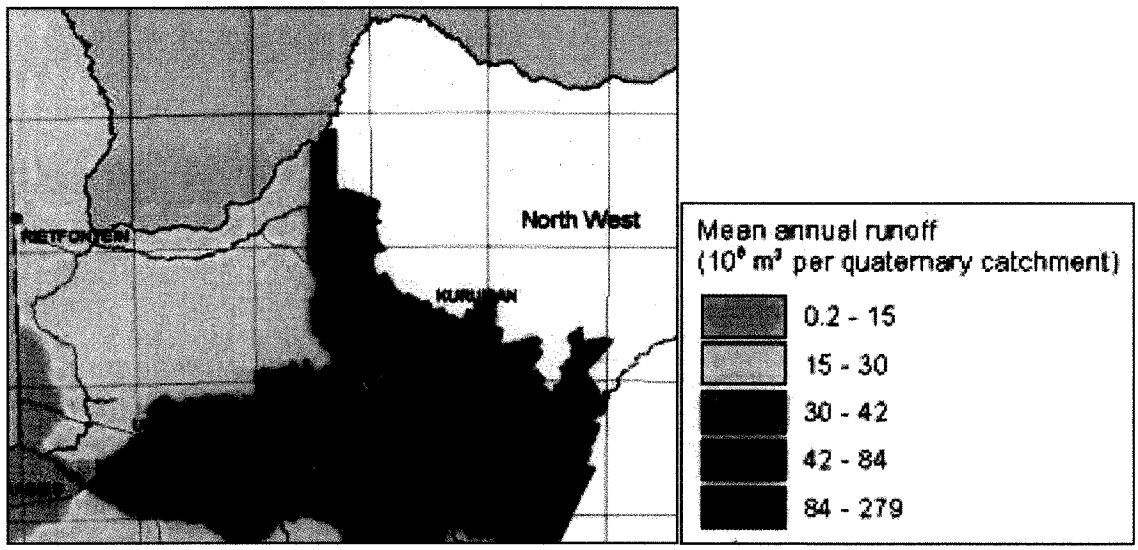
statistics. This also relates to the Molopo River Catchment, within which the study area falls.




Wetlands are important natural water purification systems that constitute sensitive ecosystem and result in increased biodiversity within their immediate surrounds. They are categorised in various types which include pans, fountains, bogs, sponges, marshes and inland deltas. An example of the latter is the Molopo and the Kuruman Rivers, which previously used to flow into the Orange River and are situated in the north of the area. A sand dune cuts off the river which can no longer flow through. Wetlands in the Northern Cape are mainly fountains and pans, of which eight important pans are found in the Kalahari Region.

According to hydrology maps, the area falls within tertiary catchment which receives an annual precipitation of approximately 350mm. The area experiences an annual evaporation of approximately 1900mm per annum. The low rainfall that the area receives would hamper re-vegetation processes during the summer periods and irrigation of re-vegetated areas might be necessary.

Mean annual runoff in the map area is approximately 42-84 mil.$m^3$. The northern Cape produces approximately 0,5% of SA's runoff indicating good infiltration and positive water balances during and immediately after rainy periods.



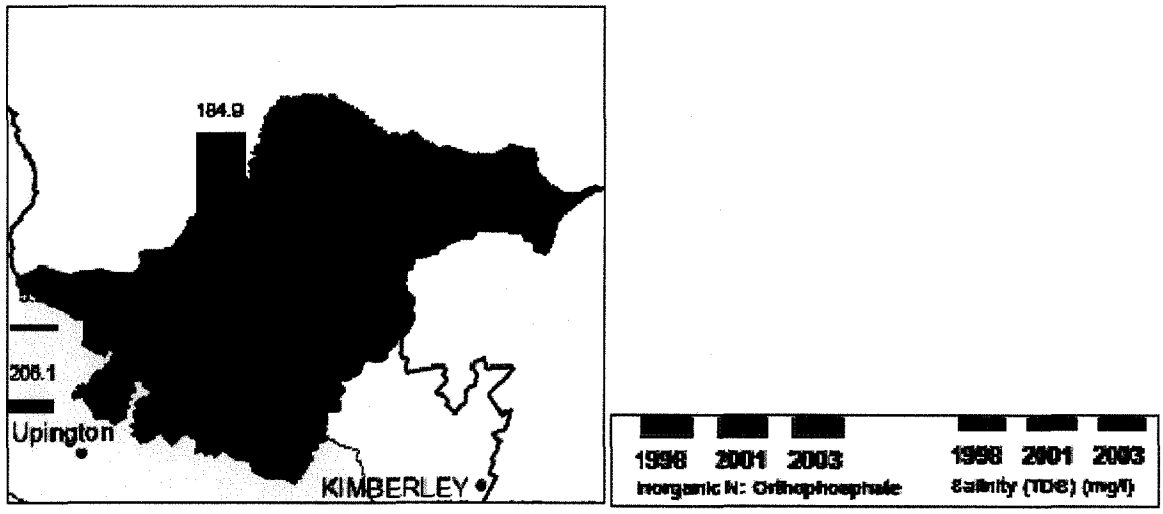

## Surface Water Quality

### Overview

Surface water quality is average in the Molopo catchment, but has deteriorated over recent years as reflected by decreasing inorganic nitrogen to orthophosphate ratios. In addition, soil disturbances caused by overgrazing and other agricultural activities resulted in increased TDS and salinity. It is therefore important that the proposed mining does not contribute to this existing impact.

**Total inorganic nitrogen to orthophosphate ($TIN:PO_4$) ratios and absolute orthophosphate levels per sub-WMA in the Northern Cape (2003)**

| WMA : Sub-WMA | $TIN:PO_4$ ratio | | | Orthophosphate Concentration (mg/l) | | |
|---|---|---|---|---|---|---|
| | 1998 | 2001 | 2003 | 1998 | 2001 | 2003 |
| Lower Vaal : Molopo | 184.88 | 122.89↓ | 110.56↓ | 0.011 | 0.016↑ | 0.021↑ |
| Upper Orange: Vanderkloof | 18.63 | 14.67↓ | 13.04↓ | 0.022 | 0.027↑ | 0.023↓ |
| Lower Orange: Orange | 7.85 | 4.62↓ | 5.91↑ | 0.024 | 0.026↑ | 0.026 |
| Lower Orange: Orange Tributaries | 0.95 | N/D | N/D | 0.045 | N/D | N/D |
| Lower Orange: Orange Coastal | N/D | N/D | N/D | N/D | N/D | N/D |
| Olifants/Doring: Knersvlakte | 2.86 | N/D | N/D | 0.014 | N/D | N/D |
| Olifants/Doring: Doring | 4.44 | 3.64↓ | 3.86↑ | 0.013 | 0.019↑ | 0.021↑ |




## Mine area

Surface flow within phase 1 and southern section of phase 4 would generally not occur due to the high porosity of these soils, but heavy precipitation could result in minor flow towards the ephemeral/episodic watercourse located to the immediate east. Surface flow from the hill on the other hand could be expected due to the underlying bedrock, but any flow would be absorbed within the sandy detrital areas. The mentioned watercourse confluences with the Gamagara River to the north-east, which eventually confluences with the Kuruman River to the north.

The watercourse disposes of a 'Least Threatened' environmental status, but the Gamagara River disposes of an environmental status of 'Modified and Endangered' hence the Boskop Mine should not further contribute to the impact on the latter system by increasing TDS and TSS. It should, however, be recognized that due to the low surface cover of the proposed mining area, any potentially runoff will naturally dispose of higher TSS.

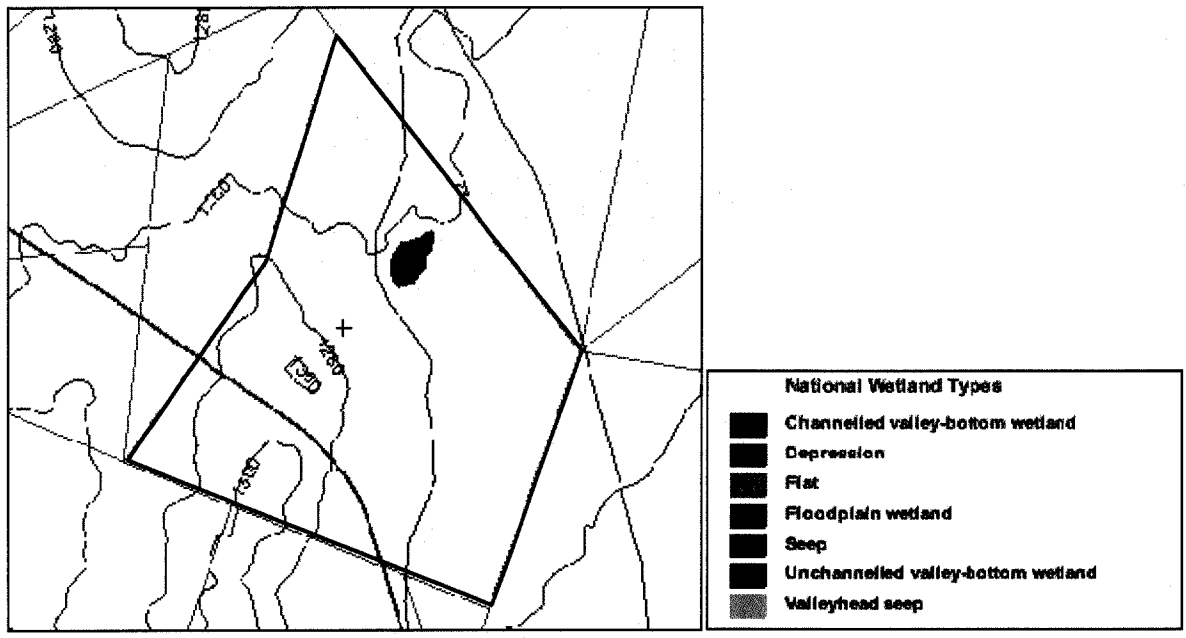
In order to preclude an impact on the watercourse and prevent white water to mix with grey water, a setback line of at least 32m, as prescribed by NEMA, must be maintained from the river. It is, however, not anticipated that polluted runoff from the mine would reach the watercourse due to the slot mining approach that will be followed. Any silt generated in the proposed mine areas, will be retained in the excavation. Once the mining areas have been re-vegetated, potential silt load of runoff will decrease as the surface cover increases. The proposed phase and block development and rehabilitation plan will also assist in keeping sediment loads lower.

Although it is important that the areas in-between the mining area should be disturbed to the minimum, it is anticipated that all runoff, if any, will be absorbed within the sandy detrital areas located to the south, that will act as a sump and silt will be naturally filtered out. No impact is therefore anticipated on water quality of the watercourse during periods of high or extreme precipitation.

Potentially runoff could also be contaminated with hydrocarbons, but this impact is rated of very low significance considering the proposed mitigation measures that were discussed in the chapter on soils and the fact that the plant would be positioned at least 300m away from the river. The volume of *in situ* material in the buffer zone would act as absorbing material and no impact is anticipated.

There are no dams or weirs in the immediate vicinity of the mine and therefore no surface water abstraction is taking place. A seep/depression is located south-east of the farm residence, but this area falls outside the mine area and would not be affected or disturbed.




The watercourse located to the east of phase 1 seems reasonably intact with good riparian growth, which will not be disturbed due to the buffer zone that will be retained. In terms of the Kgalagadi Environmental Plan, these riparian areas are sensitive areas and should not be disturbed, which is in line with the Boskop Mine development plan. The watercourse is shallowly incised due to its dolomite bed and the width does not exceed 10m. The

watercourse is fed on the southern side by a number of minor drainage areas, which would not be disturbed by mining since no detrital is found in this area.

**Watercourse with rocky dolomite bed**

Sewage

The ablution systems will be closed systems and will result in negligible coliform contamination of soils and surface water, provided that these systems are properly maintained. The distance to any surface water will simply preclude any significant impact on water of any drainage line.

Hydrocarbons

Limited quantities of spilled hydrocarbons can cause the pollution of large quantities of surface water due to the hazardous contents thereof, which could affect aquatic life and water availability/consumption negatively. Bulk fuel storage facilities will be housed within the plant area, but will be appropriately bunded and servicing of vehicles will be performed at the appropriately designed service area or off-site workshop/garage. The impact on surface water is deemed negligible to zero.

Emergency repairs onsite could lead to marginal contamination of bedrock/sand and subsequent runoff, but the use of appropriate receptacles such as drip pans will also cause this impact to be negligible. In the event of a spill, the necessary mitigating measures stipulated in the EMP will be implemented. In any case of large spills, a designated specialist company will be tasked to engage in bio-remediation processes.

Waste & waste water

Since no chemical processing plant will be housed on site, no contaminated or toxic wastewater will be generated hence no treatment facilities for this purpose are needed.

Household or industrial waste would be generated due to the magnitude of the operation and therefore management facilities would be required to preclude an impact on any potential surface water that could occur in the area. For this purpose waste skips as well as waste bins will be positioned at the plant and mine areas respectively. It will be ensured that these facilities are diligently used by staff and that it will be covered appropriately. A negligible impact on surface water is anticipated.

A washing plant will be established in the plant area next to the crushing plant and discharges will be directed to a lined sump area. From there silt polluted water will be deposited in the excavation or used as irrigation water. Due to the setback lines between the mine areas and watercourse and between the plant and watercourse, as well as the filter capacity of the sand deposit, no surface water pollution will occur.

Water consumption

There are no dams or weirs in the immediate vicinity of the mine, therefore no surface water abstraction will take place.
Due to the specific setting, dust suppression at the plant and phase 1 will be required but will be obtained from the boreholes in the mining area and from the sump in the plant area.

Haul Road

The haul roads could be a source of silt contaminated runoff, but it will be controlled by means of cross and mitre drains where required. Polluted water will be diverted to the surrounding grassland which will effectively filter out any silt. Currently the roads are largely erosion free and this impact is rated of very low significance.

Stockpiles and Production Faces

Residue stockpiles (resulting from screening) could be a potential source of silt, which could increase the TSS & TDS of runoff. These stockpiles will be positioned in the plant area, which will be surrounded by extensive volumes of sand-detrital matrix hence any

polluted runoff will filter into the soil and will not reach the watercourse. The impact is rated zero.

Crushed manganese fines could also be a source of silt and trace element pollution, but will be filtered out as well by the surrounding sand-detrital matrix. The watercourse area could be impacted through wind dispersal of these fines, as was noted at large mines located to the north. Being a much smaller concern and the fact that dust suppression will be affected at the plant and stockpile areas, the potential impact is rated of low significance.

Any fines generated at the hard rock quarries will remain in these excavations and the limited amount that could fallout in the surrounding veld through wind dispersal, would not reach any watercourse readily due to the absorption capacity of the surrounding veld and distance to watercourses.

Based on 1) the low rainfall and thus surface flow that the area receives, 2) the mitigation measures provided for reducing the silt load of runoff,3) the retention of generated silt in the excavations and 4) the well vegetated buffer zones that will remain in place, the impact on surface water quality is rated of very low significance during operations and insignificant at closure.

**Impact on surface water quality and quantity**

| | OPERATIONAL (no mitigation) | WEIGHT | OPERATIONAL (with mitigation) | WEIGHT | CLOSURE | WEIGHT |
|---|---|---|---|---|---|---|
| **Extent** | Local | 2 | Site Specific | 1 | Site Specific | 1 |
| **Duration** | Long Term | 3 | Medium Term | 2 | Short Term | 1 |
| **Intensity** | Low-Medium | 3 | Low | 2 | Very Low | 1 |
| **Probability** | Probable | 2 | Probable | 2 | Unlikely | 1 |
| **Status** | Negative | | Negative | | Neutral | |
| **Confidence** | High | | High | | High | |
| **Significance** | Low | 16 | Very Low | 10 | Insignificant | 3 |

## 15.8.2 GROUNDWATER

Groundwater resources are particularly important and vulnerable in the Northern Cape which has a high evaporation potential, low recharge and variable rainfall. Abstraction of surface and groundwater varies within the Province and between sectors. For example, the abstraction of water resources in the Orange sub-WMA is used primarily for irrigation while the majority of water abstracted in the Molopo sub-WMA is used for consumption in the urban and mining sector. Groundwater resources are more abundant than surface waters in the Lower Orange WMA and the Knersvlakte and Molopo sub-WMA's.

Groundwater utilisation in the study area and immediate surrounds is important and constitutes the only source of water over much of the rural areas. In these areas groundwater is mainly used for rural domestic water supplies, stock watering and water supplies to inland towns and recently for mining related activities. Recharge of groundwater is generally limited. However, aquifer characteristics (borehole yields and storage of ground water) are more favourable in the western part of the area that is underlain by dolomitic Karst aquifers. Dolomite is an excellent aquifer in terms of capacity, quality and recharge and is protected and must therefore be used with circumspection. The more favourable groundwater conditions are clearly demonstrated by the fact that Kumba's Sishen mine is dewatering its excavations on a continuous basis.

**Water quality**

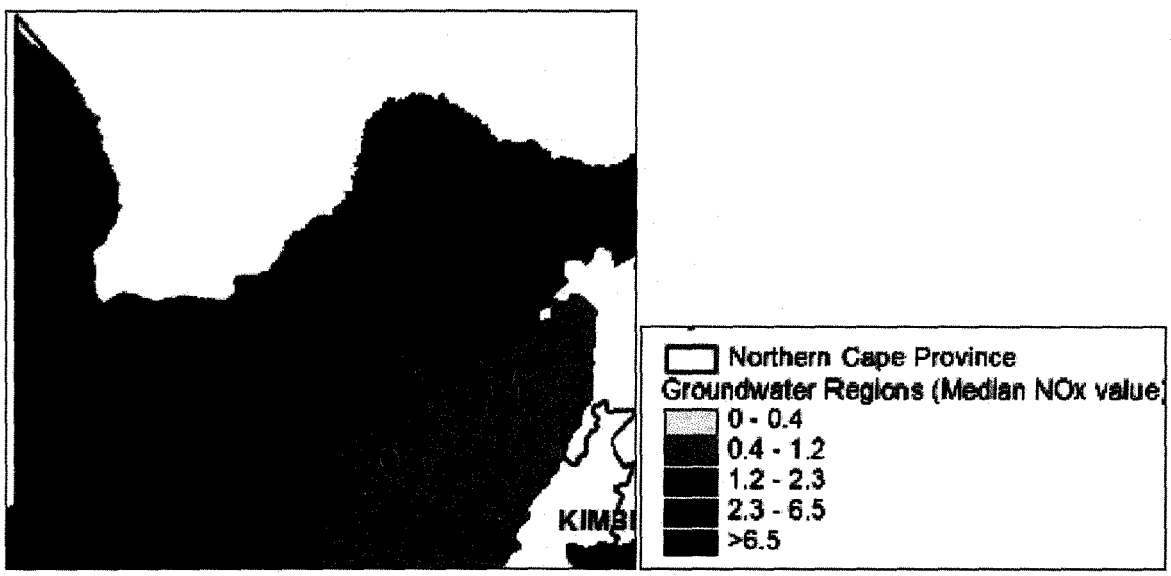
Geo-hydrological environments are sensitive to any form of pollution and remedial actions are mostly unsuccessful and time consuming due to the nature of recharge processes. Agricultural activities are a source of water contamination through fertilisation processes, silt generation and salinization. Nitrate is the most common and contaminant of highest concern. Since it is highly soluble and does not bind to soils, nitrate has a high potential to migrate to groundwater and are likely to remain in water until absorbed by plants and fixed into plant metabolites. The primary inorganic nitrates are potassium and ammonium nitrate that occur in most fertilizers. Extensive cultivation activities are therefore one of the main courses of inorganic nitrate pollution of ground water aquifers.

Animal and human excrement (animal concentration areas, pit toilets, septic tanks and discharges from sewage works) are the other main contributors to aquifer pollution.

Contaminants such as pesticides, herbicides, hazardous industrial substances and leachate from waste sites could also result in significant water quality deterioration.

Of the 13 groundwater regions in the Province, 2 have total nitrate and nitrites levels (mg/l NOx-N) above the 6mg/l target water quality range that is said to have a health risk. The highest concentrations of groundwater nutrients were experienced in the Western Highveld groundwater region (15.1mg/l) in 2003. However, the Boskop study area disposes of a good water quality with mean nitrate levels between 0,4-1,2mg/L, which is significantly lower than the target water quality range.




DWAF's database revealed two boreholes on the farm Macarthy 559, but no groundwater analysis is available. Data provided for a borehole located on the abutting farm to the west is as follow.

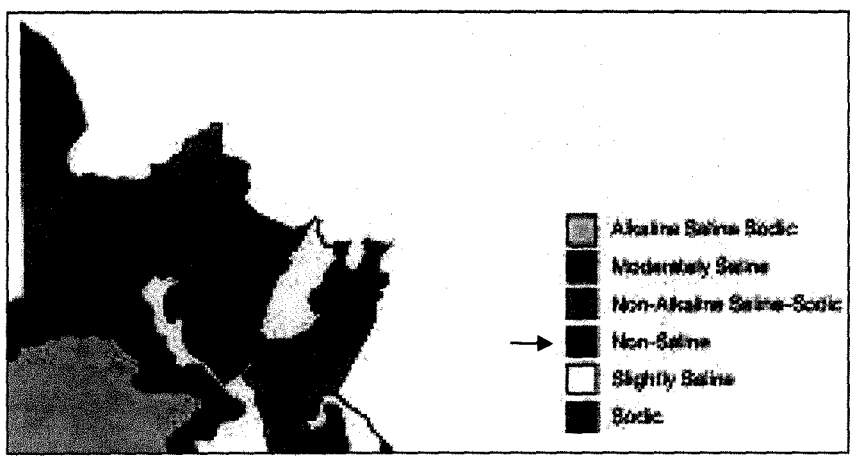
| Water Quality Data (mg/L) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | TAL | DMS | EC | $SO_4$ | $PO_4$ | Na | $NO_3$ $NO_4$ | $NH_4$ - N | Mg | K | Ca | Cl | F |
| 8,22 | 380,7 | 693 | 76,9 | 227,3 | 0,008 | 22,1 | 1,077 | 0,068 | 61,2 | 3,1 | 71,4 | 0,83 | 0,41 |

The electrical conductivity of groundwater in the immediate area and surrounds therefore seems low indicating low salinity and good water quality. This correlates with the fact that the area is underlain by dolomite that is known as a good aquifer with good storage and

recharge capacity. Apparently water quality becomes poorer towards the north and northwest and correlates with a change in geology to the north. The dolomites of the study area and surrounds therefore serve as an area of recharge with psizometric head to the Kalahari. On its way more salts are dissolved which increases salinity and decreases water quality.

The immediate study area hosts no agricultural or industrial activities that could affect groundwater quality. With regards to the proposed mine area, the only activities that could affect groundwater quality is the sewage system, hydrocarbon pollution, manganese fines and waste. Since it is anticipated to head start re-vegetation processes by limited irrigation, it could potentially affect groundwater if the soils are saline. However, soils in this particular area seem non-saline hence limited irrigation would not affect ground water quality.



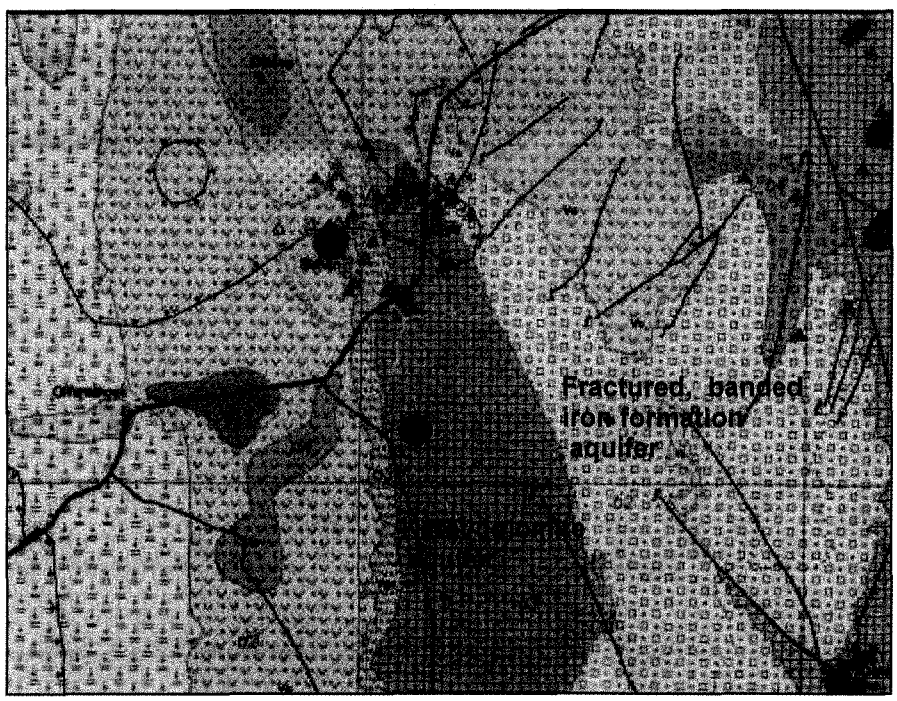

## Groundwater quantity & water levels

No data is available on the capacity of groundwater aquifers in the immediate study area. Two boreholes were observed on the property, one south-east of the homestead and on the bank of the watercourse and in the south-western corner of the property and are used to cater for stock watering facilities and human consumption. Depth of water levels of these boreholes range from 74m to 86m and from 60m to 81m respectively and it is clear that external factors do affect the depth of water levels at both boreholes. It has been reported that some boreholes to the north showed increased water level depth every year and although it recovers during the rainy season, it drops faster than previous years which indicates that abstraction exceeds recharge volumes.

Two boreholes drilled during the prospecting phase in blocks 1 & 2 of phase 2 showed good capacities and will be registered for use. Water levels were recorded at 45m and 23m respectively. It would therefore be beneficial not to mine deeper than 10m in phase 1 and 15m in phase 2. Considering that the study area is located in a rural area and that no communities are reliant on this groundwater aquifer, as well as the fact that extensive dewatering of the aquifer is allowed 13km from the site at Kumba's Sishen mine, water use on the farm would most surely not pose a detrimental impact. This is supported by the fact that the same water use is relevant at 27.9744s, 23.02028e, 3km away, but the required monitoring would have to take place to ensure that the aquifer is detrimentally affected over time.

Water in the study area is located in dolemite of the Gaap Group (Va) and disposes of good groundwater potential and yields in excess of 2L/s are common. The aquifer could potentially service the aquifer without resulting in a detrimental impact. In addition, the contact with the banded iron zone could facilitate additional water since yields of up to 2L/s in joints and fractures associated with faults and diabase dykes are possible.




Neither perched nor main aquifer will be affected by mining operations since the detrital in phase 1 and partially phase 2, nor manganese rock in phases 3 & 4 are water bearing strata. Infiltration and retention in phase 1 will not be affected since all screened residue will be returned to the excavation. Excavating phases 2 - 4 might increase infiltration since

all runoff would be captured in the excavation. Mining will therefore not significantly affect recharge of the aquifer.

Sewage facilities

Considering that ablution facilities at the plant and quarry areas are closed systems, coliform and nitrogen/phosphate levels of perched or main aquifers will not be increased. Any potential spills in the plant area will be captured and retained by the extensive sand/detrital matrix in this particular area. Considering the low rainfall and high evaporation rate, the area disposes of a severe negative water balance that will effectively retain any potential spills in the upper strata layers. This scenario will also be applicable to any hydrocarbon spills. A negligible impact on groundwater quality is anticipated in such instance if sewage systems onsite are maintained properly.

Hydrocarbons

Hydrocarbon storage will take place within the plant area, but all these facilities will be appropriately bunded and provided with a concrete floor. The same would apply to the generator onsite therefore a negligible impact is anticipated. All servicing would be done on a concrete floor with a central sump to capture all spills effectively. The refuelling area will be provided with an apron and sump for capturing of diesel spills. In the event of emergency servicing, it will be done over drip pans as per approved protocols.

In the event of any minor, inadvertent spills, it will filter into the sand matrix in phase 1 and crevices in the rock at phases 3-4, but due to the extent of the sand matrix and rock mass to groundwater level, such minor spills would have a negligible impact on groundwater quality. Within phase 1, affected soils could be effectively removed with a front-end loader.

Should a wash bay for vehicles be constructed, it would dispose of a concrete floor connected to a properly designed oil trap with floating filament to remove surface oils, which will from time to time be disposed of at a registered waste facility.

Waste

The mining operation will generate very little waste that could affect groundwater quality. The waste stream will be restricted to household waste and minor amounts of 'industrial waste', of which the former will be deposited in covered skips and waste bins. When filled, it will be emptied at the nearest approved waste facility in Kathu or Sishen. 'Industrial

waste' will be restricted to very limited scrap metal, tires and machine parts, which will be stored onsite in a demarcated area and when necessary, be disposed of at a registered recycling facility. No hydrocarbon contaminated parts will be stored on open soil. Considering the above, no treatment facilities are required for the site and the impact is rated negligible.

Water consumption

Groundwater will be abstracted for washing of the mineral once screened. It is anticipated to extract approximately 230 ton ore per day and considering that at least 0,4 cubic meters of water is required per ton, 90 cubic meters would be required per day, which might exceed the productivity of the aquifer which is deemed to be around 65 cubic meters per 9 hours shift. This will result in a significant drawdown in the immediate area, although the deficit will be made up overnight and weekends.

In order to reduce the demand per day, a sump would be constructed at the washing plant and process water will be circulated, but not more than 3 times per ton, which will reduce the demand to approximately 30 cubic meters per day. The aquifer will be able to sustain this demand and future increase in production capacity. This demand will only be sustained during the mining of phase 1 and possibly phase 2 and consumption will be reduced by another 50%, should the solid rock quarries be developed. With this perspective the impact on the capacity of the aquifer is rated of moderate significance during the development of phase 1 and possibly phase 2 and of low significance during phases 3 & 4. Considering the amount of water that will become available from the washing plant, water for irrigation or dust suppression need not be extracted.

Due to the low rainfall that the areas received and thus the low recharge potential, the aquifer might still be marginally affected at closure, but should stabilize within a 3-5 year period.

**Impact on ground water quality and reserves (phase 1)**

| | OPERATIONAL (no mitigation) | WEIGHT | OPERATIONAL (with mitigation) | WEIGHT | CLOSURE | WEIGHT |
|---|---|---|---|---|---|---|
| **Extent** | Local | 2 | Local | 2 | Site Specific | 1 |
| **Duration** | Long Term | 3 | Long Term | 3 | Medium Term | 2 |
| **Intensity** | High | 6 | Medium | 4 | Low | 2 |
| **Probability** | Definite | 4 | Definite | 4 | Likely | 3 |
| **Status** | Negative | | Negative | | Negative | |
| **Confidence** | High | | High | | High | |
| **Significance** | **Moderate-High** | **44** | Moderate | 36 | Low | 15 |

**Impact on ground water quality and reserves (phase 3-4)**

| | OPERATIONAL (no mitigation) | WEIGHT | OPERATIONAL (with mitigation) | WEIGHT | CLOSURE | WEIGHT |
|---|---|---|---|---|---|---|
| **Extent** | Local | 2 | Local | 2 | Site Specific | 1 |
| **Duration** | Long Term | 3 | Long Term | 3 | Short Term | 1 |
| **Intensity** | Medium-High | 5 | Low-Medium | 3 | Very Low | 1 |
| **Probability** | Definite | 4 | Definite | 4 | Likely | 3 |
| **Status** | Negative | | Negative | | Negative | |
| **Confidence** | High | | High | | High | |
| **Significance** | **Moderate-High** | **40** | Moderate | 32 | Very Low | 9 |

## Management Plan

- The sewage systems must be regularly serviced and maintained to Municipal regulations.
- No hydrocarbon facility will be established within 100m from any drainage line.
- The plant will be established as per the mine development plant, as far away as possible from drainage lines.
- Plant operations will be restricted to the proposed footprint.
- Bulk fuel containers will be positioned away of main internal haul routes to reduce the risk of it being destabilized. These containers shall be bunded and a storage capacity of at least 115% of storage volume will be provided. Fuel pumps will be provided with an apron and sump to contain spills. Vehicles will be serviced on a concrete slab provided with a sump to contain spills. Wash-bays, if applicable, will be provided with an oil trap. All used hydrocarbon storage will be restricted within a bunded area and where applicable, under roof and provision will be made for disposal to a registered recycling facility on a regular basis.
- At cessation of mining activities within a particular phase and block, disturbed areas will be vegetated through a dedicated re-vegetation programme.
- No foreign or unapproved material/substance will be dumped or stored within the footprint of the mining area.
- No stockpile of any nature will be placed outside the mine area, in the flow path of runoff or near any drainage line.
- Vehicles will not use alternative roads or damage vegetation outside the approved mine boundary, with specific emphases on the 32m setback line from the watercourse.
- The haul roads will be protected against rutting and erosion.

- Waste will be contained in receptacles stationed at appropriate areas within the quarry and plant areas and be removed from the mine on a weekly basis or whenever necessary. No household or industrial waste will be burnt or buried on the site.
- Refuelling of vehicles will be done at the plant where the required facilities will be established according to mentioned protocol, or if it needs to be done elsewhere onsite, it will be done with appropriate fuel bowser and funnels to prevent any spills.
- Vehicles/equipment will be maintained to a high standard and will not display any major leaks.
- All servicing will take place within a controlled environment.
- Any contaminated spares, oil filters and gaskets will be placed in a suitable receptacle and immediately be removed from the property to an approved waste facility.
- If spills do occur in the plant area, the affected soil will be removed to an approved waste site. Super absorbing material such as Peatsorb or Spillsorb or alternatively sawdust will be kept onsite and used to contain larger spills, especially in the hard rock quarry areas where hard impenetrable surfaces will be encountered.
- In case of large, critical spills the Departments of Mineral Resources and Water & Environmental Affairs will immediately be informed for assistance and advice and a competent company, conversant with bio-remediation will immediately be appointed to address the possible impacts of such spill. In such case the required encapsulation techniques appropriate for each area will be followed, whilst waiting for assistance from an appointed bio-remediation facility. All costs would be for the account of the applicant.
- Management will not entertain hydrocarbon spills on site and where necessary, disciplinary action/financial penalties will be imposed on workers in cases of negligence.
- No hydrocarbons or hydrocarbon-contaminated material/parts will respectively be drained in the soil or buried on the property.
- All dysfunctional equipment and vehicles will be removed from site as soon as possible.
- Drawdown statistics of boreholes will be determined before boreholes are used for water supply in order to understand the aquifer capacity in the area.
- Abstraction will be restricted to around 35-40 cubic meters per day and more than one borehole should be used to reduce the localised impact. Where necessary, use should be made of the landowners' boreholes after obtaining consent in this regard.

- A sump will be established at the washing plant to recalculate water and reduce all over consumption.
- Waste water from the washing plant must be used as irrigation water for seeded areas.
- During periods that require large volumes of water for dust suppression, additional water should not be abstracted for this purpose, but irrigation should be temporarily suspended and water used for dust suppression.
- Boreholes should be monitored on a monthly basis and should it be found that unacceptable drawdown is experienced, the applicant must make an effort to obtain water from the Vaal-Gamagara pipeline, especially since Kumba is injecting some of its decant into the system.
- The applicant accepts the principle of 'polluter pays'.

*****

# 15.9 AIR QUALITY

## General

Air quality issues in the Northern Cape Province are not considered a priority matter, due to perceived low emission rates in the Province which to some extent, is the result of the fact that very few industries have been developed and due to the fact that very little information is available on air quality, except for the larger centres and around some of the larger mine areas. Air quality around mine areas has improved to some extent as a substantial number of asbestos mines have been rehabilitated over the past decade. This form of air pollution was historically severe in certain areas. Since no co-ordinated air quality monitoring network exists in the Province, air quality monitoring is performed on a fragmented basis, hence no comprehensive assessment of air quality is therefore possible for the Northern Cape Province. It is anticipated that with the adoption of the Air Quality Monitoring Act, this situation will soon change.

Energy sources used in the Province are predominantly paraffin and wood, with rural areas relying more heavily on these fuels than urban areas. Electricity, where available, is mostly used for lighting only.

Pollution can either be of natural (dust generation through wind action, $Co_2$ production by veld fires) or anthropogenic (burning of fossil fuels) origin and will increase the atmospheric concentrations of carbon dioxide, sulphur dioxide and particulate matter. The grasslands of the Kalahari are fortunately not burnt due to its composition of sweet grasses, hence rural farm areas generally experience clean air except for around the large iron and manganese mines.

## Ambient sulphur dioxide concentration

Carbon dioxide is considered the most important greenhouse gas and according to the United Nations, South Africa is the third highest producer of carbon dioxide *per capita* in the world, hence activities generating carbon dioxide should be under scrutiny and any cumulative impact should be carefully considered. The ambient sulphur dioxide ($SO_2$) concentration will provide an indication of the level of air pollution from amongst other, industrial or domestic fuel use. The current annual guideline value of the WHO is

50 µg/m3 and the 24hr guideline 125 µg/m3. Due to the very sparse population in the immediate area of the farm Boskop, it is not anticipated that this value will be exceeded.

**Ambient nitrogen dioxide concentration**

Nitrogen oxides are mainly emitted from the burning of fossil fuels, fertilizer production and industrial processes and are generally emitted in the form of nitric oxide which is naturally oxidised to nitrogen dioxide, the main precursor of ozone and is thus a major component of oxidant air pollution. The hourly WHO guideline is 200 µg/m$^3$ and the SA annual value 94 µg/m$^3$. South Africa revealed a very low value of just above 13 µg/m$^3$ in 2000, which renders it clear that mining *per se* will not significantly affect this value. However, blasting will increase the ambient nitrogen levels significantly for a very short period, where after the impact will be eliminated through dilution.

## 15.9.1 SMOKE/EMISSIONS

**Immediate surrounds**

From an ambient nitrogen- and sulphur dioxide perspective the air quality of the immediate surroundings is very good due to its rural status. An increase in smoke generated by household fires of farm workers, burning of waste and veld fires will, however, occasionally decrease the air quality on an intermittent but limited basis. There are two mines similar to the Boskop Mine in the area, namely one to the north-northeast, approximately 7km away and one to the south-south-west, approximately 2km away, but the site visit revealed no visible smoke emissions in these areas. From a distance perspective, the mine to the north should not impact on the air quality of Boskop. The same would apply to the Sishen Mine that is located ±13 km to the north-north-west.

Since the area is still zoned agricultural it would cause tolerable ambient levels to be slightly higher than those of residential areas. It would, on the other hand, not exempt the applicant to implement the required measures to keep air pollution at acceptable levels within the immediate surrounds.

**Mine area**

One potential source of smoke could be cooking fires. This will not be permitted by the applicant since electricity is available on the farm. The workforce would not reside on the

property hence no camp will be established, therefore night-time fires will not be considered. No waste will be burned on site, but will be transported offsite to a waste facility. Waste receptacles need to be emptied and cleaned regularly to prevent odours developing.

Vehicular emissions on site will be low-moderate due to the use of extraction equipment, dumpers, haul trucks and genset for the crushing and screening plant. This operation will be similar to a small aggregate quarry where the low density of vehicles generally results in a limited impact. A cumulative impact will arise due to the traffic count on the R325 road, but due to the area's rural status and the fact that no residence is in close proximity to the concern, the air quality impact is rated very low.

No chemical processes will occur on site hence no chemical emissions will take place. The impact of smoke/emissions/odours on air quality is rated very low. Due to the low concentrations involved it will have a negligible impact on human health and aesthetics of the area.

## 15.9.2 DUST FALLOUT

**Ambient particulate matter concentration**

Airborne particulate matter is a complex mixture of pollutants released from many sources. It is normally found in a range of sizes for example particulates resulting from vehicle emissions, combustion processes and domestic burning practices are normally classified as fine particulate matter of aerodynamic diameter of less than 2.5 µm. Coarse particulates are mostly generated by industrial processes, inclusive of mining and are of aerodynamic diameter of between 10-25 µm. Pm 2,5 & Pm 10 particulate can penetrate the lungs and cause severe illnesses such as silicosis, asthma, etc. Total suspended particulate matter (TSP) refers to all airborne particulates, without particle size differentiation.

The SA & US-EPA 24hr guidelines for PM10 are 180 µg/m$^3$ and 150 µg/m$^3$ respectively. The annual guideline is 50 µg/m$^3$.

**Immediate surrounds**

The air quality of the immediate surroundings is very good due to its rural status. Although there are two smaller mines in the area, no extensive dust pollution were observed during the site visit, but the scenario might change when windy conditions prevail. The Sishen Mine to the north, as well as other mines closer to Kuruman generate a substantial amount of dust (soil & mineral dust) due to the magnitude of these mines and the landscape is covered by generated dust. Dust pollution around mines of similar magnitude was measured as high as 3000 $mg/m^2$ per day and exceeds the permissible limits. It is, however, doubtful if the larger mines in the area will affect the TSP of the Boskop Mine area.

**Mine area**

The amount of dust generated in a mining area is directly linked to the type of material that is extracted, mechanical processes involved, traffic volumes, wind speed and soil moisture content. The finer the material (more easily airborne) and the higher the clay and silt concentrations, the more severe the impact is. The dryer the soil becomes, the more dust it generates and therefore residue must be reinstated, seeded and covered with organic matter, if available, as soon as possible.
The setting of the mine in a dry, sandy area that experiences strong winds will occasionally require that the applicant implement definite measures to keep disturbed areas as small as possible. In addition, dust generation at the soil/residue stockpiles and crushing plant must be effectively curbed. This could be achieved through expedited removal of the residue from the plant area to phases 1 and 2 excavations and dust suppression techniques. Availability of adequate water supply at the crushing plant would render these objectives attainable.

Construction activities at the mine will be limited as explained under the construction phase and the dust impact would be negligible.

The sandy soils in the study area have a low clay and silt conten, but are poorly structured hence wind erosion will be a consideration at the mined out areas in phases 1 & 2 and at the crushing plant and extensive dust generation could be expected in these areas when strong winds prevail. Under normal conditions the impact would be low-moderate.

Irrespective of the extent of dust generation during adverse climatic conditions, the distance to receptor areas (Mr. Venter, 600m) to the north, will preclude that a significant impact is imposed.

Regrettably, the sensitivity of the groundwater aquifer might preclude continuous dust suppression, but *ad hoc* dust suppression during periods of high winds would possibly reduce any significant impact. If circumstances dictate, the use of dust allaying agents will be considered. Once seeded, the dust impact from rehabilitated areas will abate significantly hence it is important that concurrent rehabilitation must be performed and that the minimum area must be exposed ahead of the production face. It would therefore be a serious error to leave rehabilitation for the end of mining activities in each block that is developed. Once phases 1 & 2 have been worked out, dust levels will significantly decrease and air quality would be acceptable.

In phases 3 & 4 dust generation will be extremely limited due to the mining of solid rock and dust will only be generated at the crushing plant. This impact is rated of low significance. Should the crusher and screens be relocated to phases 3 & 4 at a later stage, it must be positioned in the quarry voids, failing which an extensive dust plume will be generated above the plant due to the extent of exposure on the hill.

In terms of SABS and NEMA guidelines, dust fallout of 300 to 600mg/m/day is moderate and acceptable over the short term in residential areas, but experience has taught that any levels above 150mg/m/day will result in sporadic complaints. Considering the nature of mining operations onsite, the distance to receptor areas and the proposed mitigation measures that will be implemented, the dust count at any residence in the area will generally not exceed 100mg/$m^2$ per day and can be measured at the mine boundary. Should this assessment be proved incorrect, the mining area will be dampened down during adverse climatic conditions by means of installing a sprinkler system connected to an elevated water tank which will be filled from the boreholes to be registered.

Increased dust generated by the haul roads might represent the most prominent dust impact that would also be visible, since the road will be frequently used and wearing course material will be powdered. Dust counts along the road may increase by as much as 400mg/$m^2$/day if the incorrect wearing course is used, but will generally abate very quickly further away from the road. No residences are located along any of the internal

haul roads and the impact is rated low during normal climatic conditions and moderate during periods of adverse conditions. Due to the fact that hauling, extraction and crushing/screening will take place in close proximity to each other, a cumulative impact will be applicable and is rated moderate during normal climatic conditions and moderate to high during adverse conditions. With mitigation, this impact can be reduced to moderate under poor climatic conditions. To achieve this, roads will have to be watered down, the de-dusting systems on the crusher must be turned on and return of residue must be restricted to calm days. If possible, wearing courses of roads should preferably not contain excessive silt and clay content. Since dust generation is also determined by speed in conjunction with axle number, it is imperative that truck drivers reduce haul speed to approximately 30km/h.

Drilling activities associated with blasting would cause dust liberation around the drill, but would not reach any area outside the property boundary. Fitting dust bags to the drill rig will largely eliminate this impact, which is rated insignificant.

Blasting will cause an extensive dust cloud to hang in the air above the blasting area for approximately 3-5 minutes and wind conditions on the hill side will disperse it quickly. This impact will be induced once a month at the hard rock quarries and perhaps on a weekly basis when small pocket deposits are mined in phase 2, but the blasts would be small with a limited dust impact. Considering 1) the distance to receptors, 2) the fact that most fine dust settles within a 200-300m distance, 3) the short period that the impact will prevail and 4) the intermittent nature thereof, the impact on any abutting landowner is rated of very low significance, but could be experienced as a nuisance by residents and dust fallout may increase by 20-30mg/m$^2$/ for that particular day, which would be acceptable.

The natural product contains no silt or clay, but crushing and screening will result in low-moderate dust volumes under normal climatic conditions, but moderate dust volumes could be produced during adverse wind conditions.

Impact on Humans

Crushing manganese could release small particles (respirable dust - Pm 2,5-10) into the atmosphere that could travel longer distances and are rated as a harmful substance that could, with large and continuous dosages over extensive periods of time, result in

discomfort and respiratory related illnesses if no mitigation measures are put in place. Manganese is a very common compound that can be found everywhere on earth and is one out of three toxic essential trace elements, which means that it is not only necessary for humans to survive, but it is also toxic when too high concentrations are present in a human body. When people do not live up to the recommended daily allowances their health will decrease. But when the uptake is too high, health problems will also occur.

Manganese effects occur mainly in the respiratory tract and in the brain. Symptoms of manganese poisoning are hallucinations, forgetfulness and nerve damage. Manganese can also cause Parkinson, lung embolism and bronchitis. When men are exposed to manganese for a long period of time they may become impotent.
A syndrome that is caused by manganese has symptoms such as schizophrenia, dullness, weak muscles, headaches and insomnia.

Manganese compounds exist naturally in the environment as solids in the soils and small particles in the water. Manganese particles in air are present in dust particles. These usually settle to earth within a few days. Humans enhance manganese concentrations in the air by industrial activities and through burning fossil fuels. Manganese that derives from human sources can also enter surface water, groundwater and sewage water.
The Mexican mining company Autlán maintains that there is no evidence that manganese causes any harm to human health, but in the central state of Hidalgo, where the metal is mined, adults shake as if they suffer from Parkinson's disease and children's mental development lags behind normal. Sixty percent of the adults who live near some of these mines, present neurological problems and trembling similar to the effects of Parkinson's disease. In the case of the children near the mines, it was found that their intellectual and learning abilities are 20 percent lower than the comparable group that does not live near any mines. It therefore seems that constant exposure to manganese could cause some health problems. According to the World Health Organization excessive exposure causes illness known as manganism and the symptoms include: slower movement and lack of coordination, trembling similar to Parkinson's, muscular weakness and even schizophrenia, according to the World Health. It could not be established whether these illnesses have been recorded in South Africa.

Nevertheless, dust suppression at the crusher should be performed and the fact that rock will be washed prior to crushing will largely reduce dust generated through the crushing

process. It is also important that showers be made available for staff at the crusher in order to minimize continuous exposure. The fact that workers will be onsite for only five days a week should also assist in curbing any illnesses. Needless to say, the provision of dust masks to workers at the crusher is an absolute necessity. It would be pertinent that the thick layer of very fine dust that is normally deposited around the crusher be removed on a regular basis and sold off.

Considering the distance of at least 300-600m from any abutting residence, health impacts related to dust generation should be reduced extensively. In terms of the Mine Health and Safety Act, respiratory dust would be monitored regularly through gravimetric dust sampling and results would be made available for monitoring the situation and decision making. Under controlled circumstances respirable counts should be well below the threshold of 1.

The impact of manganese dust on plants and animals will be discussed briefly below, but considering the environmental status of the area, a limited impact is anticipated. The argument can be raised that manganese naturally occurs in the soil, but on the other hand it is not grinded to a fine dust that will facilitate and expedite the uptake process.

Impact on animals

For animals manganese is an essential component of over thirty-six enzymes that are used for the carbohydrate, protein and fat metabolism. With animals that eat too little manganese, interference of normal growth, bone formation and reproduction will occur. For some animals the lethal dose is quite low, which means they have little chance to survive even smaller doses of manganese when these exceed the essential dose. Manganese substances can cause lung, liver and vascular disturbances, declines in blood pressure, failure in development of animal foetuses and brain damage. When manganese uptake takes place through the skin it can cause tremors and coordination failures. Laboratory tests with test animals have shown that severe manganese poisoning should even be able to cause tumor development in animals.

Impact on plants

In plants manganese ions are transported to the leaves after uptake from soils. When too

little manganese is absorbed from the soil it causes disturbances in plant mechanisms. For instance disturbance of the division of water to hydrogen and oxygen, in which manganese plays an important part. Manganese can cause both toxicity and deficiency symptoms in plants. When the pH of the soil is low manganese deficiencies are more common, which should not be applicable at Boskop Mine.

Highly toxic concentrations of manganese in soils can cause swelling of cell walls, withering of leaves and brown spots on leaves. Deficiencies can also cause these effects. Between toxic concentrations and concentrations that cause deficiencies, a small area of concentrations for optimal plant growth can be detected.

The overall impact of emissions and dust on air quality is rated as low-moderate during reasonably calm days, but moderate to high during adverse climatic conditions during the period that phases 1 & 2 are developed. Development of phases 3 & 4 will result in a significant reduction in dust generation and the worst impact would be of moderate significance. Should mitigation measures be implemented, the impacts would be reduced by at least one to two increments. At closure, the disturbed area will be rehabilitated and will cause air quality to revert back to more or less original levels.

**Impact on air quality**

| | OPERATIONAL (no mitigation) | WEIGHT | OPERATIONAL (with mitigation) | WEIGHT | CLOSURE | WEIGHT |
|---|---|---|---|---|---|---|
| **Extent** | Local | 2 | Local | 2 | Site Specific | 1 |
| **Duration** | Long Term | 3 | Long Term | 3 | Short Term | 1 |
| **Intensity** | Medium - High | 5 | Medium | 4 | Low | 2 |
| **Probability** | Definite | 4 | Likely | 3 | Probable | 2 |
| **Status** | Negative | | Negative | | Negative | |
| **Confidence** | Medium | | High | | High | |
| **Significance** | **Moderate to High** | **40** | **Low - Moderate** | **27** | Very Low | 8 |

## Management plan

- Vehicles to be maintained properly, fitted with standard exhaust systems, will not be left idling unnecessarily and trips must be restricted to what is essential.
- No burning of waste will be allowed on the property.

- No cooking fires will be permitted.
- Bio-degradable waste will be contained in receptacles with proper lids and be removed from the process area on a weekly basis. No odours will be tolerated in the mine and plant area.
- No chemicals that could generate odours will be stored or disposed of on site.
- Wearing course of applicable roads and process area will be upgraded when necessary to reduce dust generation.
- Gravel haul roads will be dampened down during periods of high extraction rates or extreme climatic conditions if dust generation exceeds acceptable levels, provided that water is available for this purpose. If water availability is a limitation, dust allaying agents such as Dust-Tex, Dust-A-Side or Everbond shall be used, with the latter especially effective on roads.
- An irrigation system will be installed in the crusher area and mine area (phase 1) and equipment for this purpose must be in place before crushing activities commence.
- The crusher and screens will be fitted with atomizers with specific reference to material transfer points or transfer points should be enclosed. If necessary, rubber shutes will be installed at final transfer points.
- Crushing will cease if dust counts exceed acceptable levels in the plant area or at the property boundaries.
- No crushing operations should generally be conducted over a weekend.
- Blasting will be restricted to calm days and blasting design (appropriate burden, spacing and stemming) will be adapted to generate as little dust as possible. If the impact of blasting requires, the blasting area will be dampened down prior to blasting.
- Drilling rigs will be fitted with dust bags.
- The mine will be developed in phases to reduce the extent of exposed areas and the minimum area for optimal mining will be denuded ahead of the production face.
- Disturbed mine areas will be re-vegetated as soon as possible as per the re-vegetation plan.
- Residue stockpiles will be limited to the minimum height to reduce exposure to wind action. During periods of high winds, the return of residue will be delayed to calm days.
- If dust generation reaches unacceptable levels, fine mesh shade cloth will be used to cover any stockpile that generates excessive dust.
- Detrital excavation would as far as practically possible be avoided during periods of high wind action. Should irrigation be ineffective during such adverse climatic conditions, it should be considered to cease quarry operations. The management

system will allow for monitoring the situation over weekends. Mining activities shall not impose dust counts of more than 100 mg/m$^2$/per day at any residence.

- If required by the DMR, dust counts will be conducted on a monthly basis for the first three months and repeated on a six monthly basis. The terms of reference for the dust counts must be determined in conjunction with the officials from the DMR.
- Any complaints will be recorded in a register and if necessary, a liaison forum with abutting residents will be established to provide for enhanced dust monitoring and mitigation of the impact.
- Workers will be provided with dust masks, hand wash basins and showers at the mine to reduce possible impact on respiratory system and inadvertent intake.
- This impact should be addressed in an environmental awareness programme.

### 15.9.3 NOISE

The impact of noise levels generated by development activities is determined by the time of day, the consistency thereof, distance to people, whether it is a low or high-pitched noise and whether cumulative noises are generated within the area wherein the development is taking place. Noise levels are more intense in the morning and evening than during the rest of the day, since sound waves are bent towards the earth during these periods and are more irritating if it is high pitched. The more continuous the noise is, the higher the impact. In terms of SABS standards noise levels for rural areas are 40dB during the day, 35dB in the early evening and 30dB at night. At the farm Boskop these levels will increase by 2-3dB due to traffic impact.

Noise impact is generally rated against the following: 1) The average person will be able to just detect a noise increase of 2dB, 2) An increase in noise levels between 2-5dB will result in no or sporadic complaints from communities/residents, whilst an increase between 5-10dB will result in widespread complaints, 3) An intruding noise is defined by National Noise Regulations as disturbing if it causes the ambient noise levels at the border of the property from which it emanates to increase with 7dB, 4) An average person will perceive such an increase in the ambient noise levels as a doubling of noise levels and very strong response will be expected from communities/residents. Noise impact will further be evaluated against a general accepted principle that noise levels on average abate with 5dB over 100m where no to limited natural screens are in place.

The impacts caused by the mining operation will be evaluated against the following average noise levels (at source) associated with mining activities: Operating bulldozer (80-90dB – low pitched); Operating loaders (65-75dB – low pitched); Haul trucks (60-70dB – low pitched); Blasting (110-140dB), Crushing system (75-90dB – low pitched); Reverse sirens (60-80dB – high pitched). The rural setting of the area will cause the ambient noise levels to be around 40-45dB and increases in noise levels would therefore be observed instantly. Traffic on the R325 and possible *ad hoc* activities on abutting properties will intermittently increase noise levels to approximately 55-90dB.

Maintenance of equipment where steel on steel action is taking place will generate above average noise levels and should generally be avoided early morning or at dawn since it will tend to amplify such noises, but considering the absence of any residence in close proximity to the site, it would in this case not make any difference. Mining or crushing at night-time will impose extensive noise levels that will be audible on abutting properties and should generally not be contemplated. If operations fall behind schedule and require additional operational time, the impact of such operations will firstly be determined and the outcome submitted to the Department of Mineral Resources for consideration.

Seeing that no campsite will be established onsite, no noise would be generated at night that could become a nuisance. Working hours will on average be from 7am to 5pm on weekdays, which would coincide with the daily activities of the inhabitants of the area. As a rule no mining will take place over the weekend, but should demand dictate work on Saturdays, operations will be ceased at 13pm on Saturdays. No operations will take place on a Sunday or public holidays.

Reverse sirens fitted to all construction vehicles produce a high pitched, irritating noise especially where a number of vehicles will operate simultaneously. It will produce noise levels up to 75dB and might still cause some irritation to nearest residences during the early morning and evening. Since the fitting of the sirens is a requirement of the Mine Health & Safety Act, as well as OHS Act, there is no mitigation possible, except for preventing operations very early in the morning or late at night. However, due to the remote locality of the farm, it is not anticipated to impose any impact during the development of phases 1 & 2 since the distance of 600m to Mr. Venter's house will abate the level to approximately 45dB without taking into consideration the screenings effect of the hill to the north. Mining of phases 3 & 4 will bring the operations 300m closer to his

residence and even though he himself is employed at a mine and is accustomed to these noises, operations on a Saturday and Sunday should, where possible, be prevented.

Trucks on the R325 will cause noise disturbances of approximately 55-65dB within 30m from the road, but would be similar to the existing impact experienced along the road. It should be emphasized that this impact already exits since all material imported to and exported from mines in the area is carted along the Postmasburg – Kuruman Road. This impact is therefore rated of low significance.

Impacts related to the use of the bulldozer for bush and overburden clearing will be an *ad hoc* impact and will generate noise levels of approximately 90dB, which will result in noise levels of around 65-75dB within a range of 300m. This impact will at most prevail for one week per month, but only when phases 2, 3 & 4 are developed and would be acceptable based on the intermittent level. Drilling rigs will produce noise levels up to 90dB also for one week per month which will similarly result in same noise levels at Mr. Venter's residence as mentioned above. This high pitched noise might be found a bit more irritating than other noises.

Blasting will cause a severe impact once a month when phases 3 & 4 are developed and noise levels around 120dB would be applicable, which would result in levels of 105dB at Mr. Venter's residence. It will be a startling but instantaneous noise which might annoy local residents. However, due to the much higher elevation level of the quarries in relation to residences, noise waves might be projected upward and over the residences, which could reduce the impact significantly. However, on cooler and specifically cloudy days, noise waves would be bent downwards and together with down draft could increase levels to around 110dB, which will cause some complaints. Blasting must therefore rather be restricted to sunny and warm days when upward draft and projection will be experienced. Blasting at phase 2 will be less significant as it would generally be smaller and the hill will effectively screen noise levels to the north. Intrusive noise levels will therefore only be experienced approximately 12-15 years from granting of the right.

Adverse conditions such as low cloud cover or strong northerly winds could potentially increase noise levels between 3 & 7dB at residential areas, which will increase levels considerably to the north when phases 3 & 4 are developed, but would be much less effective if operations take place at phases 1 & 2. Noise generated at the plant, phase 1

and southern section of phase 4 would not impose any impact on any abutting property, since it is located at the lowest point on the farm.

Management of noise levels must be achieved via an environmental awareness programme informing operators of machinery, truck drivers, drilling operators and blaster of the remedial measures to be implemented.

**Noise Impact**

| | OPERATIONAL (no mitigation) | WEIGHT | OPERATIONAL (with mitigation) | WEIGHT | CLOSURE | WEIGHT |
|---|---|---|---|---|---|---|
| **Extent** | Local | 2 | Local | 2 | N/A | 0 |
| **Duration** | Long Term | 3 | Short Term | 1 | N/A | 0 |
| **Intensity** | Low-Medium | 3 | Very Low | 1 | N/A | 0 |
| **Probability** | Definite | 4 | Possible | 2 | N/A | 0 |
| **Status** | Negative | | Negative | | N/A | |
| **Confidence** | High | | High | | N/A | |
| **Significance** | Moderate | 32 | Very Low | 8 | N/A | 0 |

## Management plan

- All vehicles will be fitted with standard exhaust systems and be regularly serviced.
- Unnecessary hooting, shouting, flapping of tailgates and use of exhaust brakes will be discouraged where necessary.
- Unnecessary idling of vehicles will be discouraged.
- Travelling speed on internal haul roads, especially on the hill, will be reduced to 30km/h.
- Moving parts of vehicles/screen/crusher will be regularly lubricated, replaced and serviced.
- Repair work that involves using grinders and hammers on steel or any other steel on steel activity should preferably not be done early morning or early evening.
- Normal working hours will apply for week days (7am - 5pm in summer and 7.30am – 4.30pm in winter) and Saturdays (8am-1pm) if necessary– No work on holidays or Sundays.

- Workforce and contractors will be properly managed in terms of noise generation and be sensitized on dignified human behaviour.
- Protective hearing devices will be provided to all operators of machinery/vehicles generating noise above 55dB at source.
- No campsite will be established at the quarry area.
- To curb the impact of blasting, the following mitigation measures can be considered:
    1. Blasting will be done at noon when over air pressure impact will be the minimum.
    2. Correctly calculating the charge size to keep air blast and ground vibration levels below predetermined acceptable values.
    3. Designing the blast regime and timing to optimise rock fragmentation and movement and minimize air blast effects and explosive use.
    4. Correct stemming of blast holes, i.e. the filling of a suitable length of blast hole above the explosive charge with material of the correct type to minimize air blast, to prevent the formation of flyrock and maximize the rock fragmentation.
    5. Monitoring blast, ground vibration and human response to ensure noise levels are in fact acceptable and to modify the blasting regime when appropriate to do so.
    6. Pre-notification of affected persons of the intention to blast and the time of blast, preferably at the same time of day and day of the week to remove the element of surprise.
    7. Rather consider more frequent blasts than large blasts.
    8. Blasting must not be done during periods when high southerly winds prevail.
- In the event of complaints being received, baseline noise readings will be obtained at the property boundary and nearest residence followed by noise counts during operations to determine the true impact of the operation. If readings are border line, the survey will be repeated annually and if necessary, the required rectifying steps will be taken. The terms of reference for the noise counts must be determined in conjunction with the officials from the DMR.
- This impact should be addressed in an environmental awareness programme.

****

## 15.10 WASTE GENERATION AND MANAGEMENT

**Building Rubble**

The only construction that will take place will be the construction of conservancy tanks for toilets, the weighbridge and the establishment of the batching plant area, which is related to the establishment of service area and bund walls. This will generate very little cement and brick residue. Mixing of cement could generate waste water that could affect soils in the area and needs to be addressed. No other rubble will be generated at the quarry. No other construction activities will take place therefore no additional amount of cement residue, brick residue, corrugated plate off-cuts, ceramic waste or PVC residue would be generated. There will be a mobile office and workshop area and allocated crushing equipment on the mine area.

At closure all foundations and demolished brick buildings/bund walls, etc. will be removed to the quarry void or be deposited at the local waste facility.

Negligible impacts on soil, water, vegetation, air quality and humans are anticipated.

**Industrial waste**

Very little industrial waste will be generated and will be restricted to the odd tire casing and pieces of dysfunctional equipment, which will be stored at the allocated area and removed from the property on a monthly basis, as long term storage might affect soils and humans through producing chemical leakage.

However, no impacts on soils, water vegetation, air quality and humans are anticipated.

**Domestic waste**

The waste stream will mainly consist of limited domestic waste (food, bottles, plastic bags, paper, clothing, rags, etc) and deposited in the containers provided for this purpose. Refuse bins will be clearly marked and placed at the entrance to the property to encourage workers to use them. Poor control over domestic waste handling could lead to littering the site and abutting properties and must be avoided since it could lead to livestock mortality

and foul odours. It could also lead to reduced visuals. Due to the relatively limited amount of people anticipated on site (about 50), the waste stream will have little impact on soils, water vegetation, air quality and humans.

**Mine Residue**

The geology of the area restricts the type of residue to potential oversize boulders and mining operation- and crusher dust. The boulders will be returned to the excavation for profiling the sides of the quarry and be covered with overburden on a monthly basis. Crusher dust is a by-product of crushing and normally causes a dust and associated visual impact and potential health impacts. Dust is most severe during windy conditions. However, dust control measures will be implemented as previously discussed.

Since no chemical processes or mineral processing is required, no chemical/mineral waste will be generated. A water reticulation system will be established at the crushing plant, which will be used for dust suppression and washing of crushed material and it will work on a recycling basis, which will not result in any waste production or any other significant environmental impact. If blasting, stockpiles and dust are handled correctly, it will impose very limited impact.

The cumulative impact on soils, water quality, stream flow, vegetation, and aesthetics is rated of low significance.

**Sewage system**

The sewage system will consist of either chemical toilets or the establishment of conservancy tanks. One toilet will be provided for every 10 employees. The conservancy tanks will dispose of adequate capacity as regulated by the local authorities to prevent ground water pollution and will be emptied on a regular basis. The same applies for the use of chemical toilets.

The effluent stream will be limited to approximately 2.5- 5$m^3$ per week and minimal impact on soils, groundwater, surface water, air and humans are anticipated.

**Hydrocarbons**

The mine area would not produce any waste whilst the servicing of equipment and vehicles would generate a substantial amount of hydrocarbon waste such as used oil, lubricants and hydrocarbon-contaminated filters. The latter and other dysfunctional parts must be placed in receptacles in the workshop from where it will be periodically removed to a registered hazardous waste site.

Servicing of equipment and vehicles would take place at the workshop where hydrocarbons will be drained with funnels into steel containers and constitute an excellent manner to deal with hydrocarbons. From this storage point, the containers are either moved off site to a recycling company, or stored onsite in a designated area. Storage method of used oils on the property could result in limited spills and must be addressed.

Emergency repairs will be done over appropriate drip trays and hydrocarbons will be drained with funnels into appropriate containers. In this process minor spills may occur which will affect soil properties to a limited depth, but will be remedied naturally or with application of fertilizers and the impact is rated of low significance. Since filled receptacles could be destabilized and capsize, more significant spills could occur hence it needs to be stored within a bunded area. All receptacles will dispose of proper lids to ensure that rain events do not result in overflow. The potential impact on surface or groundwater is insignificant due to the distance to open water and depth of groundwater.

Fuel will also be stored as previously described and any fuel spills during refueling will be contained. The impact is rated low.

**Salvage yard & scrap metal**

The site will host a crushing plant and hence the spare parts will generate scrap metal which will be stored at an allocated salvage yard within the mining area. It will be kept neatly and if needed, fenced off. All unusable equipment will be disposed of at an appropriate recycling facility on a monthly basis. The impact on soil, water quality and aesthetics is rated low.

At closure, any scrap metal and dysfunctional equipment that might be positioned onsite, will be sold to a commercial scrap yard. No post closure impact is anticipated.

**Impact of waste on the environment**

| | OPERATIONAL (no mitigation) | WEIGHT | OPERATIONAL (with mitigation) | WEIGHT | CLOSURE | WEIGHT |
|---|---|---|---|---|---|---|
| **Extent** | Local | 2 | Site Specific | 1 | Site Specific | 1 |
| **Duration** | Long Term | 3 | Long Term | 3 | Short Term | 1 |
| **Intensity** | **Medium** | **4** | **Low-Medium** | **3** | Low | 2 |
| **Probability** | Definite | 4 | Likely | 3 | Unlikely | 1 |
| **Status** | Negative | | Negative | | Negative | |
| **Confidence** | High | | High | | High | |
| **Significance** | **Moderate** | **36** | **Low** | **21** | **Insignificant** | **4** |

## Management plan

- All oversize boulders will be returned to the excavations for profiling of the sides or alternatively be reduced in size for crushing.
- The odd tyre casings and dysfunctional equipment that could be generated, will be disposed of immediately at the nearest registered waste facility.
- All machinery, constructed facilities and waste, if any, will be demolished and removed at closure.
- At closure, all waste will be removed from site.
- Vehicles may not leak any fuel, oil or lubricants and will be maintained to an acceptable standard.
- Any fuel spills will be cleaned up immediately and the soil from spill areas must be removed to the waste disposal site.
- Used hydrocarbon fluids will be stored within selected receptacles and stored within a bunded area demarcated for this purpose for disposal to recycling facilities.
- A steel diesel tank with a capacity of no less than 50 000L and petrol tank with capacity of no more than 2 000L will be established. These tanks will be positioned within a bunded area disposing of a concrete floor and release valve to drain the bund after extreme precipitation. The walls of the bund will be at least 25cm thick, plastered and with a capacity of no less than 56 000L. The tank will be provided with an apron and sump to capture any fuel spills during refuelling processes.
- The conservancy tanks for the toilets will dispose of adequate capacity as regulated by the local authorities and will be emptied on a regular basis.
- An elevated water tank will be established for flush toilets.

- One toilet facility will be provided for every 10 (ten) employees.
- Alternatively - no less than 5 chemical toilets will be placed at the quarry which will be regularly serviced and emptied at an approved waste site.
- Relocation of the plant will result in emptying the conservancy tank and demolishing it.
- The sewage system will be maintained according to municipal regulations.
- Strict controls will be enforced to ensure that the surrounds are not used as ablutions and this aspect would be included in the environmental awareness programme.
- Water will be recycled at the water reticulation system and no waste water will be drained into the mining area.
- All building waste will be returned to one of the pit excavations, compacted and covered with soil for rehabilitation.
- Domestic waste generated ancillary to the mining process will be deposited in containers with scavenger proof lids placed at the quarry. It will be removed from the site to the nearest waste site on a weekly basis and will not be dumped in the veld. Containers will be clearly marked to ensure that they are used for the right purpose. Management will provide clear management guidelines and this aspect will be included in the environmental awareness programme, if needed.
- One or more skips will be positioned in the mining area and will be covered with a small mesh net to prevent wind dispersal of waste. The skip will be regularly emptied at an approved waste facility.
- The waste facility will be fenced to prevent wind dispersal of some waste components.
- Waste will not be burnt or buried on site.
- Staff will be equipped to distinguish between domestic waste and industrial waste.
- Small day to day repairs or servicing of vehicles or equipment will take place on site, but major maintenance work will be done off-site at facilities at the nearest town.
- All hydrocarbon-contaminated material, including soil will be disposed at a hazardous waste facility and the affected area will be bio-remedied by a specialist in case of any large spills.
- No washing of vehicles will take place on the property.
- Facilities will be maintained and kept neat on a continuous basis.

- Any unusable scrap metal or dysfunctional machinery on the property will be collected and removed on a monthly basis and the allocated storage space will be fenced off and be earmarked for this purpose.
- At closure all remaining stockpiles will be flattened and reintroduced to disturbed quarry areas and all waste will be removed off site and disposed off in an appropriate manner.
- A general clean up of the property will be done on a weekly basis and before every year end closure all personnel will be involved to establish a sense of pride in achieving a clean environment.

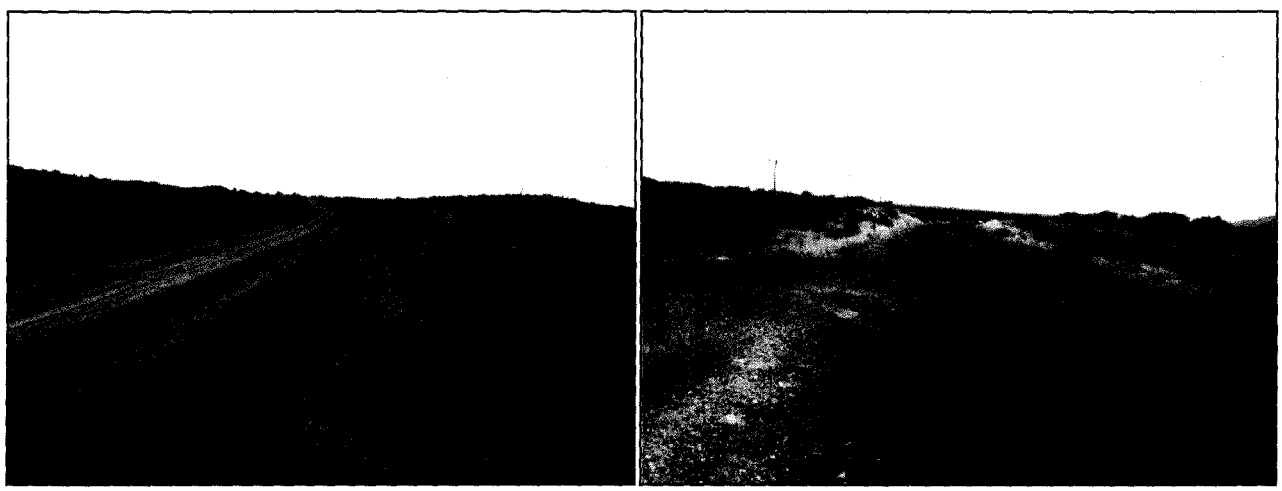
****

## 15.11 TRANSPORT IMPACT

The existing farm access roads will be used to gain access to the mining site. No additional roads will be established, except for within the mined out areas, which will not pose any environmental impact. The farm infrastructure is reasonably stable due to the underlying rock and might not require major upgrading but could become corrugated with time, thus construction material to upgrade these roads will be obtained from a registered source and placement of a 30cm thick wearing course will be contemplated through grading and compaction.

The access roads from the proposed site will lead to the R325 and access to the markets will be via the R325 road, which is a public tar road leading between Postmasburg and Kuruman. The R325 is currently under heavy vehicle strain mostly due to other mining companies' traffic volumes and this mining concern will further increase traffic volume with about 7-8 heavy vehicles per day. Currently, the majority of impact will be mainly between Postmasburg and Kathu or from the mining site to Postmasburg. The R325 is not in the desired maintenance state although it is designed for use by all types of vehicles. The surface of the road is poor and some potholes and edges breaking away were noted. In addition, the line of sight from the access road into the R325 is reduced on both sides. In addition the R325 is elevated from the farm access roads; thus heavy vehicles would not be able to enter the R325 unless the incline is reduced.

**Line of sight to the north and south with turns (phase 1 & 2)**



**Improved line of sight to the south and north near crest of hill (phases 3 & 4)**

Therefore, in order to safely use the access to the R325, calming lanes have to be constructed on both sides of the road and will be done in conjunction with the District Roads Engineer (DRE). The incline to the R325 also needs to be filled in and material for this purpose should be obtained from residue dumps at the local mines or appropriate aggregate will be imported for this purpose and a Bell-mouth entrance must be constructed at all accesses to the R325.

The DRE must be consulted, since it is proposed that the existing roads on both ridges be used for access but the legal status of the accesses to the R325 needs to be clarified.

The necessary heavy vehicle signage must be erected on both sides of the access as per the specifications of the DRE. During periods of high hauling rates, a flagman should secure the access. Once mining is terminated, the farm access roads will be retained for future use.

With any mining concern that is established, the potential safety risks for motorists would increase. Cyclists and pedestrians will experience a similar risk and truck drivers will be sensitized on the matter and provided with the necessary transport training and as previously indicated, the necessary road upgrading and construction must take place before mining commences. Road safety for motorists is important and truck drivers will be informed accordingly and be sensitized towards displaying proper road etiquette.

Material will only be carted from the property as from 08h00 to 17h00 during the week, but may result in the need to cart on Saturday mornings as well. No carting of material will be

permitted on Sundays. Should a need arise to conduct any mining/mining related activities on Sundays, the permission from the Principal Inspector of Mines will be obtained first and after the required impact assessment has been done in this regard.

The impact on the public R325 road is rated moderate-high considering the condition of the road and the contribution to the overall freight that is hauled on this road. It would therefore be essential that adequate liaison between the applicant and the DRE be established in terms of the repair of any section of the road that could pose a threat to the public. If all the mitigation measures are implemented, the impact can be reduced to low-moderate.

**Traffic Impact**

| | OPERATIONAL (no mitigation) | WEIGHT | OPERATIONAL (with mitigation) | WEIGHT | CLOSURE | WEIGHT |
|---|---|---|---|---|---|---|
| **Extent** | Sub Regional | 3 | Sub Regional | 3 | Site Specific | 1 |
| **Duration** | Long Term | 3 | Long Term | 3 | Short Term | 1 |
| **Intensity** | **Medium-High** | **5** | **Medium** | **4** | Low | 2 |
| **Probability** | Definite | 4 | Likely | 3 | Unlikely | 1 |
| **Status** | Negative | | Negative | | Negative | |
| **Confidence** | High | | High | | High | |
| **Significance** | **Moderate-High** | **44** | **Low-Moderate** | **30** | **Insignificant** | **4** |

## Management plan

- All vehicles will be properly maintained in accordance with The South African National Roads Agency Limited and National Roads Act (Act No. 7 of 1998).
- All drivers will display the necessary road etiquette and dispose over applicable drivers licenses and this aspect will be included in the environmental awareness programme.
- No unnecessary hooting would be permitted.
- Vehicles entering the R325 road or any other public road will come to a complete stop before entering the road and any transgressions in this regard will be heavily penalized. All contractors will sign a letter of agreement to this effect.
- All vehicles visiting the quarry shall be road worthy and will be included in the agreement with contractors.

- Overloading will not be permitted. Speeding will be prohibited and drivers will be penalized should it be proved that this requirement is contravened.
- Hauling of material will mostly commence at 08h00 and cease at 17h00. No vehicles may park along the road outside the mine area before or after the said times.
- The appropriate signage (W107 & W108 –1,2m size) will be erected on both sides of the quarry entrance and access to R325 road will be maintained in collaboration with the District Roads Engineer.
- The District Roads Engineer will be consulted on the maintenance of the road to be used before mining commences.
- If poor visibility or slow access of vehicles onto the R325 road could result in any accidents, a flagman will be used at the access.
- During periods of high haulage a flagman will secure the access.
- Internal haul road will be maintained to an acceptable standard to prevent erosion and maintain safety standards.
- Calming lanes must be constructed on both sides of the road and will be done in conjunction with the District Roads Engineer (DRE), before mining commences.
- The incline to the R325 must be filled in and material for this purpose should be obtained from residue dumps at the local mines, or appropriate aggregate will be imported for this purpose before mining commences.
- A Bell-mouth entrance must be constructed at all accesses to the R325 in conjunction and as per stipulation from the DRE.
- The DRE must be consulted prior to mining with regards to the use of access to the R325 on both ridges and if not approved, an application in this regard needs to be directed to the DRE.

******

## 15.12 VISUAL IMPACT AND AESTHETIC ACCEPTABILITY

**Overview**

Impacts on landscape reflects changes to a number of parameters such as character, fabric and quality of landscape and changes to available views of a particular landscape and the social impact that it impose. The visual impact of the proposed quarry will therefore be assessed in terms of the sensitivity of the landscape and the magnitude of change in the present conditions

Setting

The quarry setting is located in a rural area with no other immediate industrial activities on the butting properties. There is a similar mine located 2km to the south. The site is located east of the R325 and west of the Sishen-Saldanha rail line. The access to the farm house dissect the property and leads to the farm residence immediately north-east of phase 1 & 2. A number of roads traverse the properties in all directions. The vegetation cover is substantially affected and appears as a brownish-grey homogeneous cover due the leave-less *Acacia mellifera* plants in winter but it will turn to green in summer. The small excavations in the mine area cannot be seen from a distance.

A portion of the mine is located on the crest of a hill series in the western corner of the mine area. The immediate area can therefore be described as generally poor due to moderate scale land degradation. The site is not located near any conservation area or area of extreme beauty and can be categorized as large transformed area within amidst an open space system reflecting improved vegetation in most directions and therefore, a very ordinary quality landscape.

The proposed extension will not drastically change the appearance of an important regional or national scenic resource nor would it block any important views or create significant contrasts with the scale and line of the existing setting. It will however temporarily affect the form and colour of the landscape setting, but can be properly mitigated through profiling and re-vegetation strategies as discuses in earlier chapters.

Of importance is how the development would fit or being absorbed into the landscape. Visual landscape absorption capacity is determined by a number of factors and can be described as the capacity of a landscape to absorb alterations to it and still maintain its integrity. This capacity is determined by a number of parameters such as slope, aspect, surface variation and vegetation components. The slope in phases 1, 2 and the southern portion of phase 4 is relatively flat hence the area would be less visible and would be generally well absorbed in the landscape. Should the steeper interface leading to the crest of phase 3 be mined, it would be very visible since the hill constitutes a vocal point in the landscape. Developing of phases 3 & 4 on the crest of the hill will generally not be visible since the rim of the crest does not dispose of manganese ore. These 'valleys' would generally be well absorbed in the landscape. However, any alterations to the rim and upper slopes will generally not be well absorbed and would be very visible and would make screening difficult.

Aspect

In terms of aspect, phases 1 & 4(s) is located at the lowest elevation whilst phase 2 is located at the foot of the hill, but on the eastern slope which will receive poorer quality light than northern and west facing slopes and will present a duller landscape with less vivid colour and texture visible and would make these excavations slightly less visible. The excavation on the crest of the hill will receive good light exposure throughout the day and changes in colour and texture would be more vivid. With this perspective the absorption capacity will be slightly reduced.

Surface variation

In terms of surface variation the larger mine area reveals moderate undulation with the presence of the hill to the west, but the interface seems generally even. The crest of the hill is also relatively even with gentle slope, which will decrease the absorption capacity of the area.

Vegetation variety

In terms of vegetation variety all the development phases host a total homogenous vegetation cover of *Acacia mellifera* with a brownish-greyish colour in winter and light

green colour in summer and reveal therefore uniform textures and colour. This will result in a reduced visual absorption capacity. The mining areas will therefore not fit in comfortably into the landscape and will tend to stand out. This negative impact can be effective addressed over time with the proposed re-vegetation approach previously discussed. The absorption capacity of the land concerned is therefore generally low and will increase the visual impact and will be the most noticeable in summer. The impact is rated moderate.

Visibility – direct line of sight

Being situated at lower levels than the R325 phase 1 and southern section of phase 4 will be very visible from the road, especially because of the phase's close proximity to the road, when nearing the property from the Postmasburg side. Due to the flat topography of the land to the south, the site will however only become visible when very close to the mining areas and view shed would be for a limited time only, which will reduce the impact to some extent. The impact is rated low-moderate. Phase 2 is located on slightly higher elevation level and would become more visible from the south, but due to the distance from the road, the impact should be less than what was experienced with phase 1 and the significance is rated low. When nearing the site from Kathu, phases 1 & 2 would not be visible since line of sight would be interrupted by the hill but when passing over the crest, mining would be very visible and people will look down on the mining areas and the impact is rated of moderate significance. Phase two would be less visible due to its angle towards the road.

Development of phase 3 would generally not be visible from the south or north, considering that a valley will be created in the crest and all plant and equipment will be screened by production faces. The only time that it would be visible from the south or north is firstly when excessive dust is generated in the quarry and on the haul roads, which would be only on rare occasions since there is no soil or topsoil in this area. The second instance where it would become very visible is when the rim and upper slope is affected and should be avoided at all cost. According to the project geologist, manganese is not found in the rim area or down slope hence this impact would not develop. It is therefore important that earthmoving equipment do not work on the side of the hill and development should commence from the east towards the west at phase 3 and from the west to the east at phase 4.

In the event that phase 3 is mined from the 1270m contour straight through to the 1300m contour, the non-mitigated visual impact would be extremely high and should be avoided. According to geological information the slope represents a syncline filled with waste material hence this development strategy would not readily materialised. In the event that it does, substantial amounts of overburden and topsoil would have to be imported to rehabilitate the very visible benches and profiling should be done exceptionally well. The impact would still be moderate to high.

When travellers pass over the crest of the hill, phases 3 & 4 would become briefly visible and the larger the quarries get, the more extensive the visual impact would be since one would be able to look down into both excavations. It is therefore again important that development of these phases start away from the road and that a buffer zone of at least a 100m must be retained between the road and the excavation to facilitate some screening by the rising slope. This approach would reduce the significance of the impact from high to moderate.

Dust generated at the mining area, haul road and plant will tend to increase the visual interference and this impact will be increased during periods of high winds. Mitigation of dust generation would thus be beneficial to curb visual impact, but should not be contemplated at the expense of the groundwater regime in the area and alternative matters of dust suppression should be investigated.

Due to topographical interferences and the fact that there is no residence in close proximity to the site, visual impact would be restricted to road users. Mr. Venter's residence is at much lower altitude on the northern side and the mine would receive complete topographical screening. To the east the land is generally flat and the line of site is obscured by the vegetation in the area and would reduce the impact. Since extensive backfilling will take place at phases 1 and 2, visual impact would be significantly reduced. Also, since phases 1 & 2 can be rehabilitated to a decent standard; will reduce the impact to almost zero at closure. In addition, as phase 1 development retracts from the road, the impact would also reduce significantly.

The study area and immediate surrounds do not constitute a major tourist destination and public vantage point and the development of the mine would therefore not affect tourist expenditure in any way. However, tourist does use the R325 and in terms of the Siyanda

IDP program, rehabilitation of mines along this route has become a priority and DVD will have to work towards this objective

The road on the hillside currently poses a very limited visual impact. Although it needs widening it must only allow for single lane traffic and not widened more than what is required in this regard. Vegetation along the road must not be cleared since it will largely continue to screen the road from the R325 vantage points.

No permanent infrastructure will be erected in the mining area. The plant will be established away from the road and will pose a low visual impact, but the extent of the stockpile and operational area and the stockpiles *per se* would in turn tend to increase the impact. Once the plant has reached its second position; it would not be readily visible from the road, which is a positive factor. Stockpile areas will also be positioned in the quarry and will also not impose visual impact, another positive factor. Since mining areas would be denuded, it will become more visible and would require that a concurrent and expedited rehabilitation plan be adopted.

No additional haul roads will be constructed that could possibly increase the visual impacts. However, during periods of high extraction rates, a limited dust plumes may develop above the road that will impact on the visibility of the activity and the aesthetics of the area in general, especially during adverse weather conditions. This impact can be significantly reduced by wetting the road. The extraction operation *per se* will liberate insignificant dust volumes at phases 3 & 4, but will be significant at phase 1 and possibly 2, but could be mitigated as discussed previously. Blasting will cause a highly visible plume over a large area. This impact would, however be short-lived as wind movement will disperse it quickly and will only occur at most once a month.

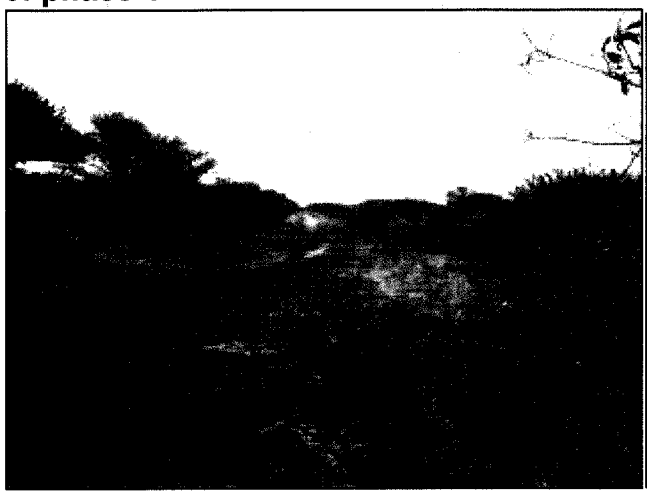
Visibility from the air would be moderate to high due to the irregular landforms that will be developed, especially in the crest of the hill. Since the site is not located near any commercial airport or airstrip related to the tourism industry, the impact is reduced to very low.

Based on the above assessment, but more especially the low population density in the area, the visual impact during mining is rated of moderate significance if the prescribed mitigation measures are implemented. In the absence of mitigation measures the impact

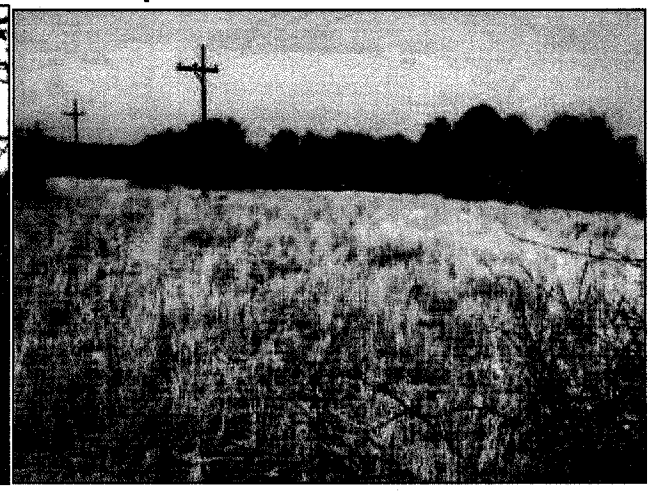
 

will increase to high, especially during the first few years, adverse weather conditions and high extraction periods. Post closure impact (5 years after closure) is rated of low significance.

**Visuals to the south over western part of phase 1**



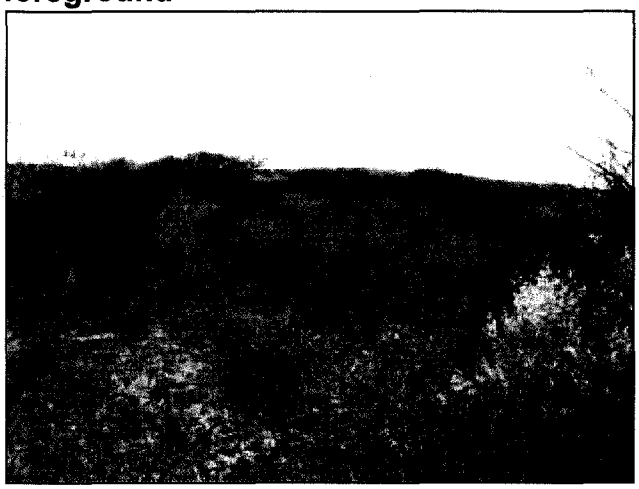
**Visuals to the south beyond phase 1 – note improved surface cover**



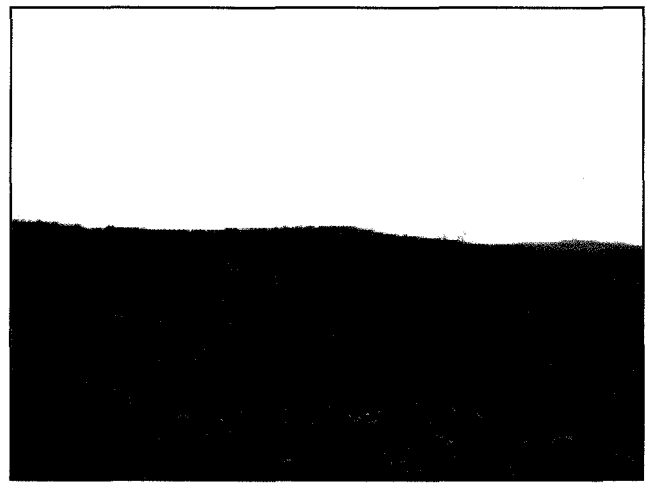
**Visuals to the south with centre of Phase 1 in foreground**

**Visuals to the south-east over eastern section of mine**

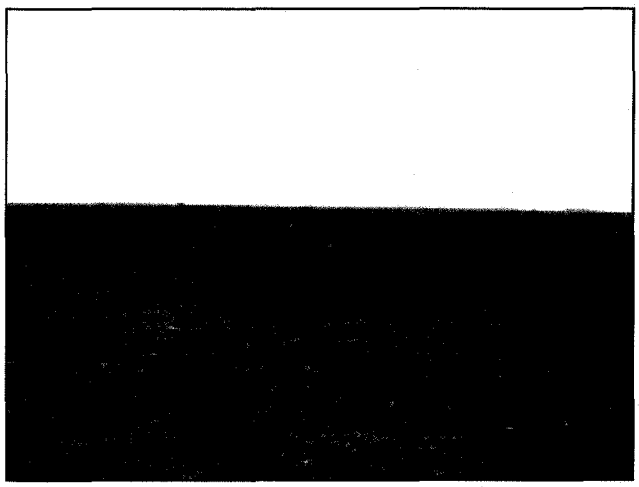
**Visuals to the north over phase 1 in foreground**



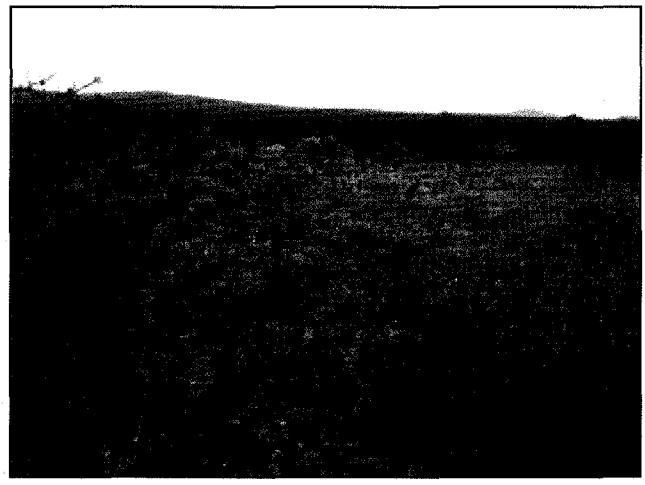
**View to west of phase 1**



**View to south of phase 1**



**View to the east of phase 2**



**Visuals to the east** of phase 3

**View to the south from phase 3**