LIMPOPO COAL COMPANY (PTY) LTD

VELE COLLIERY PROJECT

ENVIRONMENTAL MANAGEMENT PROGRAMME

MAY 2009

PROJECT DETAILS

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Reference Number	
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1.1 BACKGROUND

1.1.1 Location

Limpopo Coal Company (Pty) Ltd (Limpopo Coal) has applied for a mining right for coal on the farms Overvlakte 125 MS (Ptn 3,4,5,6,13, RE), Bergen op Zoom 124 MS, Semple 155 MS and Voorspoed 836 MS.

The extent of the mining right application area is 8663 hectares and is located on the northern border of South Africa in the Limpopo Province on the Limpopo River.

The nearest town is Musina, situated approximately 48km to the southeast. Mapungubwe National Park is situated approximately 7km (Most eastern boundary) to the west of the proposed mining area, whilst the Mapungubwe Hill is situated 35km to the west. Refer to Figure 1.1.

Table 1.1: Surface ownership associated with Vele Colliery Project

Farm	Ownership	Size (ha)	Title deed
Overvlakte 125 MS Ptn 3	EL Esterhuyse	342.6128	T81218/1994
Overvlakte 125 MS Ptn 4	EL Esterhuyse	842.2097	T81218/1994
Overvlakte 125 MS Ptn 5	Gedeelte 5 Over Vlakte 125 MS Boerdery (Pty) Ltd	842.2117	T2400/2000
Overvlakte 125 MS Ptn 6	Overvlakte No 6 (Pty) Ltd	219.0000	T74891/1990
Overvlakte 125 MS Ptn 13	Kelkiewyn Landgoed (Pty) Ltd	268.8496	T58674/2003
Overvlakte 125 MS Ptn 14	Limpopo Trust	416.3760	T42510/1994
Overvlakte 125 MS RE	Overvlakte Eiendom (Pty) Ltd	623.2108	T78260/1989
Semple 155 MS	Semple Eiendom (Pty) Ltd	942.9147	T89069/1996
Bergen op Zoom 124 MS	Isabel Barnard Trust	2078.1327	-
Voorspoed 836 MS	Factaprops128 (Pty) Ltd	2087.2216	T97196/1997
TOTAL		8662.7396	

1.1.2 Mineral Resource

The Vele Colliery Project is located in the Limpopo Coalfield in the Limpopo Province. The Limpopo Coalfield forms part of the greater Tuli Block Coalfield, and is represented in South Africa by a relatively narrow deposit of the Karoo Sequence rocks on the southern bank of the Limpopo River.

The mineral resource is estimated to contain 720.847 million (in-situ) tonnes of coal and can be defined as follows:

- Strata strike in a NE-SW direction
- General NW dip direction of 2^0
- Coal seam thickness varies between 7 and 9.5m
- Sulphur content 1.2%
- Ash content (raw) 34 Primary Product 12%
- Semi-soft/potentially hard coking coal with thermal coal fraction
- Primary yield of 25%, middlings yield of 35%
- Primary production 5 million tonnes per annum (mtpa)
- Secondary (middlings) production 6.5 mtpa

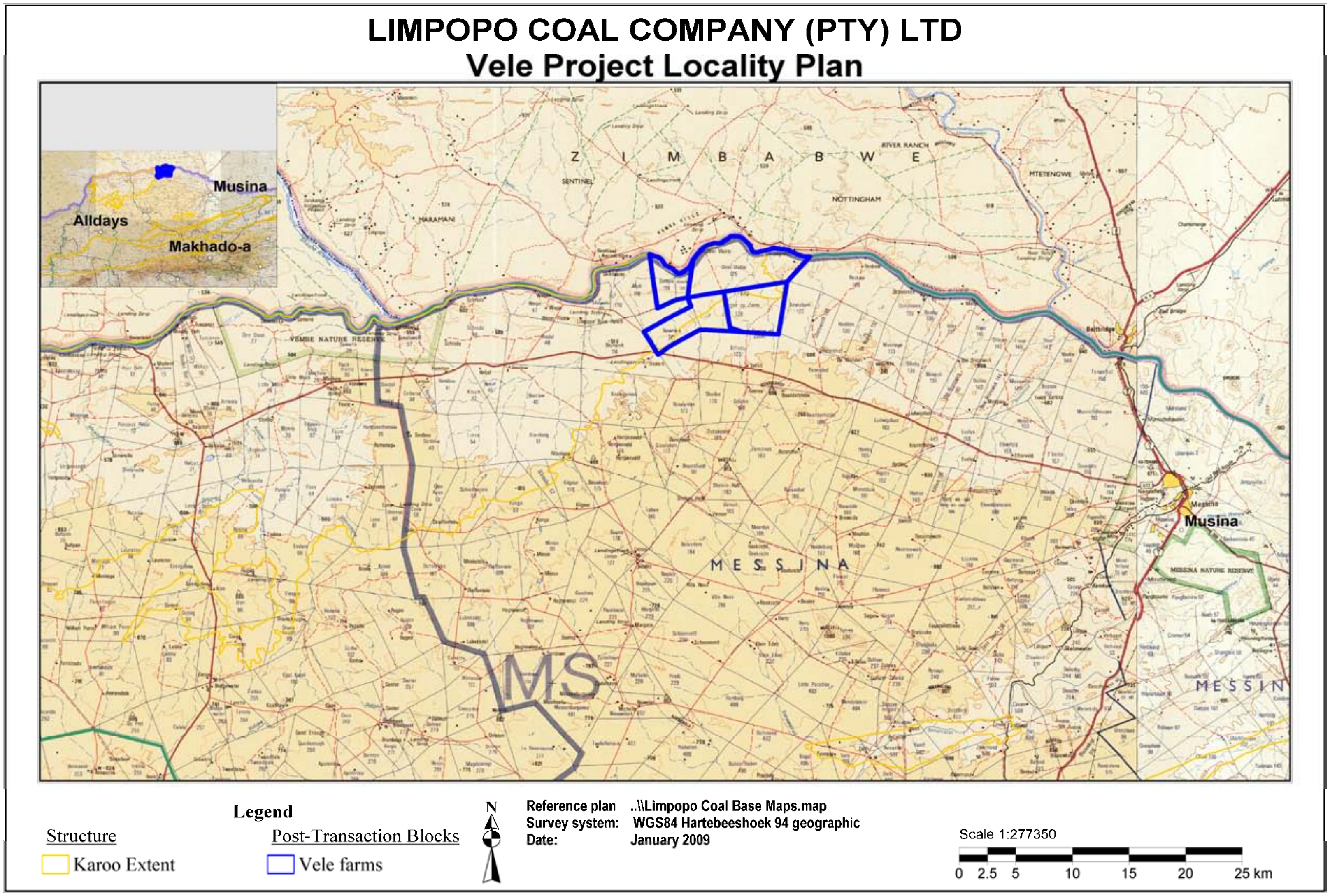


Figure 1.1: Vele Project Locality Plan

The intention is to mine the Vele resource by both opencast and underground methods starting in 2009 for a period of 29 years. Both the underground and opencast development will occur concurrently and last for the same number of years. Vele Colliery has been planned to produce 5 million tonnes sales of coal per year at full production. Mining rates are in the order of 14 million Run-of-Mine (ROM) tonnes per annum in order to achieve 5 mtpa.

Of the approximately 5 mtpa primary product (coking coal) that will be produced, 2.5 mtpa have been earmarked for Arcelor Mittal's domestic consumption. Limpopo Coal has engaged various marketing consultancies for the export sales generated from its projects.

Furthermore, Limpopo Coal has supported an application by an Independent Power Producer (IPP) to Eskom to qualify to tender for base load power supply into the South African grid. This will facilitate a market for the middlings product generated. This has a potential for 4.3 mtpa.

1.2 MOTIVATION FOR THE PROJECT

Production

The economically viable coal reserve to be mined by Vele Colliery is estimated at more than 441 million tonnes. The ROM coal produced by the colliery will be beneficiated on site and transported off-site to be sold on both the local and export markets. Of the 2.5 mtpa primary product approximately is planned for Arcelor Mittal's domestic use and the balance will be exported. Vele Colliery has a planned life of 29 years, with a potential for future expansion.

Expenditure

Construction phase – Mine development is expected to take approximately 3 years with a capital investment of R2.1 billion.

Operational phase – At full production, annual costs associated with the mining activity are estimated as to be in the order of R525 million, of which R103 million is direct labour costs. Of the total expenditure, approximately 15% is targeted to be spent on BEE / HDSA suppliers and contractors at full production.

Mine closure – Mine closure will inject money into the regional and local economy largely through use of contractors in dismantling surface infrastructure and finalising the rehabilitation process of any remaining spoil dumps and pits in the opencast mining areas.

Employment

Construction phase – During the 3-year construction period, contractor labour levels will peak at approximately 2,500, of which a large percentage will be targeted to be drawn from the local area and be employed for construction activities. The macro-economic model found that the indirect employment opportunities amount to 13,642.

Operational phase – The proposed new development will employ approximately 826 permanent employees with varying skills, implying an impact on the direct livelihood (direct workers and dependents) of approximately 1495 people. Indirect employment opportunities amount to 32,908 during the operational phase.

Mine closure – The mine closure operation will provide employment for between 250 and 826 people (declining) over the five-year period, following the end of mining activities.

Energy requirements

Coal is vital for economic development. It is important for electricity generation and a vital input into steel production. Over the past 30 years coal has been the indispensable driver of economic and social development. In China alone, 700 million people have been provided with access to electricity. Today around 40% of the world's electricity is produced using coal.

Coal will have a major role in meeting the future energy needs. Demand for coal and its vital role in the world's energy system is set to continue. Over the next 30 years it is estimated that global energy demand will increase by almost 60%. Two thirds of the increase will come from third world countries, and by 2030 they would account for almost half of the total energy demand.

Strong competitive forces are driving coal markets and coal prices. Many countries rely on coal for their energy needs. Therefore coal has an important role to play in maintaining the security of the global energy mix. Unless other forms of energy are developed, demand for coal will increase, exacerbated by the need for steel in the construction industry, car production and household appliances.

Income profile

According to the macro-economic study the total Gross Domestic Product (GDP) impact in South Africa of the construction phase will amount to R1.8 billion over the three year construction period. On the other hand, the Operational phase of the mine is expected to contribute R7.6 billion per annum to the GDP of South Africa. It is noteworthy that nearly two thirds i.e. R4.9 billion of this amount will be contributed to the GDP of Limpopo.

The impact of the construction phase on Capital formation is forecasted to amount to R4.8 billion in South Africa of which 46% is expected to be created in the Limpopo Province. In addition, the impact of the Operational phase on Capital formation is forecasted to amount to R14.5 billion per annum in South Africa with 51% of that amount in the Limpopo Province.

Broad-Based Black Economic Empowerment

Eyesizwe Coal (Pty) Ltd holds 20% of Limpopo Coal's shares, and Shangoni Management Services 6%. Coal of Africa Limited (CoAL) holds the remaining 74% and will act as Service Company for the day to day administration of activities at Vele Colliery on behalf of its subsidiary, Limpopo Coal Company.

CoAL is a company listed on the Australian ASX, AIM (London) and Johannesburg stock exchanges with all of its operations located in South Africa. The company is committed to empowerment and is proud to have a company associated with the Mvelaphanda Group as one of it biggest shareholders, holding more than 17% of CoAL's shares.

African Management Limited ("AML"), is a private equity initiative between Mvelapanda Holdings (Pty) Ltd and Och-Ziff Capital Management Group LLC (New York).

AML currently holds 71,310,5123 shares in CoAL, representing 17.33% of COAL's total issued capital. AML will also be issued with a total of 50,000,000 options in CoAL, which when exercised, will increase their holding to 121,310,512 shares, representing 26.29% of CoAL's issued capital. At project level the Vele Colliery Project and equity participation are 26% BEE owned. Together with the AML shareholding at Holding Company level, it increases the BEE involvement to well in excess of the 26% mark.

Motjoli Resources (Pty) Ltd, a South African 100% black – owned entity have a stake of 1.03% at Holding Company level.

Upon the exercise of options, CoAL's total BEE shareholding will be 27.32%

CoAL is committed to Broad Based Black Economic Empowerment and strives to procure goods and services from suppliers that are black-owned and managed. This policy has formed the focus of CoAL's procurement policies for the Vele Colliery Project. Prior to Mvelaphanda Holdings acquiring its shares in CoAL, the Company underwent an independent BEE audit by Emex Trust. CoAL was certified by Emex as being a Level 8 (more than 30% but less than 40%) contributor, a classification the company is confident it would have improved on during the period since the certification process was completed.

Environmental commitment

CoAL is committed to:

- Sustainable business models for all stakeholders, including shareholders, employees, communities and the environment
- Compliance with all applicable environmental legislation
- Environmental best practice
- Adherence to first world standards
- Restoring and rehabilitating affected areas
- Establishing appropriate and effective mitigation measures
- Progressive and innovative programmes to minimise environmental impacts

In line with the environmental commitment, the following potential biodiversity offset and rehabilitation programmes have been identified and will be investigated further and implemented if feasible during the life of mine:

- restoration of degraded riparian wetlands
- funding support for the Limpopo Valley Herb Project
- co-funding/improvement of the conservation contribution of land and/or land use activities within the TFCA
- establishment of a herbarium (Mapungubwe)
- support of other conservation initiatives, e.g. Ground Hornbill Research and Conservation Project

1.3 DETAIL PROJECT DESCRIPTION

The Vele Colliery Project will consist of opencast and underground mining operations, associated workshops and stores and a coal beneficiation plant. Other facilities at the mine site will include the following:

- Ventilation shafts
- Topsoil and overburden stockpiles
- ROM coal storage area
- ROM coal crushing plant (primary, secondary and tertiary crusher)
- Associated conveyors from the crusher to storage stockpiles and from the washing plant to the product storage stockpiles
- Product stockpile areas
- Temporary discard and slurry facility
- Rapid Load-out terminal
- Haul roads and service roads
- Change houses and offices
- Clean water management infrastructure, including:
  - Storm water canals
  - Flood protection berms
  - Surface water dam
  - Abstraction boreholes and reticulation system
- Dirty water management infrastructure, including:
  - Dirty water dams
  - Sewage treatment facility

During the Construction Phase, a temporary (2 years) construction camp will be erected on the farm Bergen op Zoom 124 MS.

The main mining activities of the final preferred mining operation are described in more detail in Sections 1.3.1 to 1.3.5. The alternative options that were evaluated to get to the final project boundaries are discussed in Section 1.3.6.

1.3.1 Mining Operations

The intention is to mine the Vele resource by both opencast and underground methods starting in 2009 for a period of 29 years. Both the underground and opencast development will occur concurrently and last for the same number of years. Refer to Figure 1.3.1 for the proposed mine layout and schedule. Vele Colliery has been planned to produce 5 million tonnes sales of coal per year at full production. Mining rates are in the order of 14 million ROM tonnes per annum in order to achieve 5 million saleable tonnes of coking coal per annum.

The coal seam reserves will be accessed via 2 box-cuts. The box-cut in the deeper reserves will be for underground access where adits will be mined into the lower coal seam. The box-cut for the opencast pit will start in the shallowest area and will initially consist of a mini-pit which will expand as the tonnages increase.

1.3.1.1 Opencast operations

There are two opencast pits which are designed to produce up to 10 Million ROM tons/annum. The first pit to be mined will be the East Pit and once this has been mined out the West Pit will be accessed. The opencast layout has been designed to produce an average of 800,000tpm, depending on the overburden thickness being mined and the number of working shifts per month. The overburden is planned to be moved by truck and shovel.

The operation is planned to operate on a 24/7 basis, utilizing 4 rotating teams working two 12hr shifts per day. Maintenance of equipment will be done based on industry norms.

To access the opencast reserves, topsoil must initially be stripped to a depth of 1m by a truck and shovel operation and stored for later rehabilitation. Initial topsoil stripping will be done by utilising contractors. Overburden stripping is then to be performed by truck and shovel. Interburden will be stripped by means of truck and shovel fleets. Separate coaling fleets will transport the coal from the pit to the ROM tip.

The planned opencast mining method is a typical strip mining method, employing conventional truck and shovel methods. Opencast strips and blocks were designed using the following design criteria:

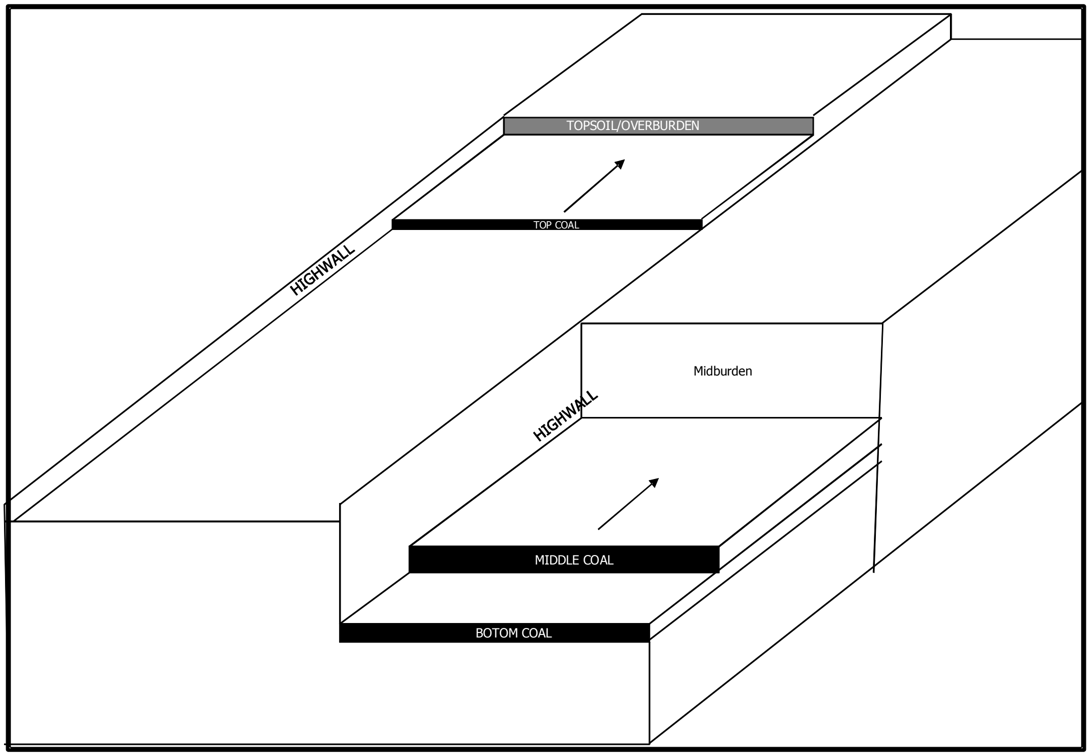
- Block lengths = 300m
- Block widths = 50m
- Strip lengths = Variable.

The opencast mining activities are scheduled in accordance to their relative position to the surface infrastructure and associated primary ROM stockpile.

For general scheduling purposes, the opencast mining sequence adopts a four bench operation under steady state conditions. The first bench is a 50m wide strip and dedicated for a topsoil stripping operation. The assumed topsoil thickness is 1m. The second bench comprises a 50m wide strip dedicated to a subsoil stripping operation, having a variable thickness that is dependent on the line of weathering as modelled by the grid data. The third bench is a 50m wide strip dedicated to an overburden operation that requires drilling and blasting. For this purpose it is assumed that a 0% throw is achieved in blasting operations. It is also assumed than no pre-split drilling will be undertaken due to the shallow nature of the deposit. Similarly, it is assumed that vertical high walls can be maintained. The fourth bench comprises a 50m wide strip dedicated to the coal removal process, made up of a drilling and blasting operation and a coal loading and hauling operation.

Overburden access is provided by high wall ramps spaced at approximately 200m intervals and terminating in two end-wall ramps. The coaling bench is accessed via low-wall ramps spaced at approximately 200m intervals.

The proposed mining layout and design is schematically illustrated below



On completion of the initial box-cut, the steady state production sequence includes the following typical mining operations:

- Spoil pile levelling which runs concurrent with the primary mining activities, one bench in arrears.
- Spoils on the previous strip (arrears) are made up of predominately blasted overburden material.
- Subsoil stripped from any preceding bench is hauled and placed directly on the levelled overburden spoil and levelled.
- Topsoil stripped from any preceding bench is hauled and placed directly on the levelled subsoil area (arrears) and levelled.
- The levelled topsoil is fertilised and vegetated at the next available planting season (September/October).

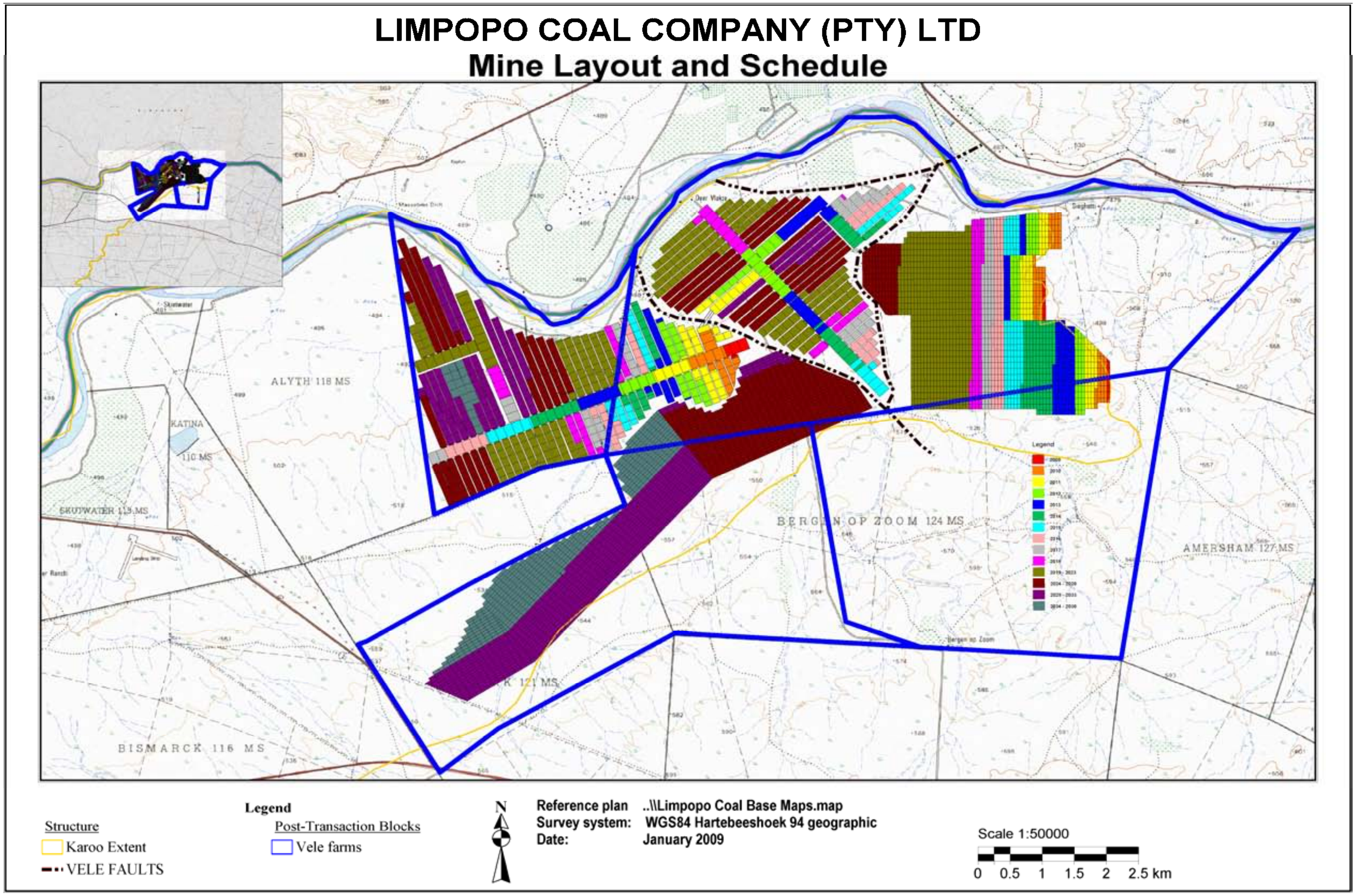


Figure 1.3.1: Vele Colliery mine layout and schedule

1.3.1.2 Underground operations

Five continuous miner sections will be required to mine the 4.5 million ROM tons required to achieve the required monthly saleable tonnage. Each section will be equipped with a high seam continuous miner, 4 coal haulers, 2 roofbolters, a feederbreaker and an LHD.

For underground access, a decline is to be sunk on the border with the opencast reserves. The underground development will continue in a northerly direction and have main developments mining East and West. The East Main will need to negotiate a downthrown fault to access the reserves in the central Graben area.

The method of bord-and-pillar mining with continuous miners was selected as the most suitable for optimal coal extraction (see schematic below for a typical layout of a bord-and-pillar mining layout with continuous miners). The main development section will mine a standard square pillar, bord-and-pillar mining layout which will have 5 intake roadways in the middle and two return airways either side. The secondary Continuous Miner and shuttle cars sections will consist of seven to nine roads with a central conveyor and a square pillar layout. Each section will have a barrier pillar separating it from the adjacent section.

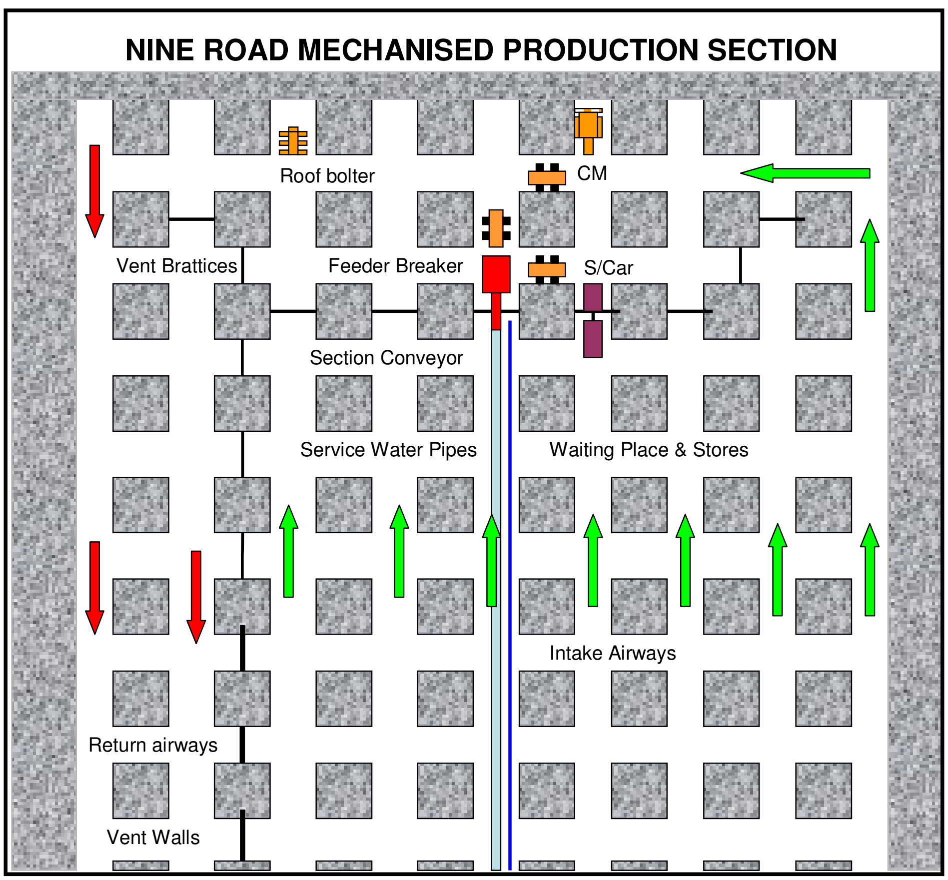
Pillars will be designed using the Salamon and Munro formula (1967). Safety factors that will be used for the protection of the workings will be as follows:

(i) Main Development - 2.2

(ii) Production panels - 1.6

No secondary extraction including pillar extraction has been designed for Vele Colliery due to the high likelihood of this resulting in surface subsidence.

Typical mechanized mining layout for a CM section



1.3.2 Coal Processing

Process routes are virtually identical for both the underground and opencast run of mine (ROM) coal except the latter product is subjected to rotary breaker beneficiation of the coarser coal fraction. Owing to the different washing characteristic of the underground and opencast coal, these coals will be treated separately, the respective products being combined.

The build-up of the production is governed by the capacity of the washing plants, and in order to produce saleable tons as early as possible a smaller modular plant will be set up to cater for the first 12 months of production after which the main plant will be commissioned.

The plant process flow is shown in Figure 1.3.2 overleaf.

1.3.2.1 Opencast coal process

ROM coal will be hauled to an opencast tip from where it will be fed to a vibrating grizzly screen by an apron feeder. Grizzly screen oversize at +450mm will feed a jaw crusher, which will reduce the oversize to 450mm. The combined grizzly undersize and crusher product will be conveyed to heavy duty sizing screens, sizing at 70mm, the +70mm fraction will be fed to a rotary breaker fitted with 95mm screen plates. The +70mm oversize from the breaker will be discharged as waste and will be conveyed to a waste bin from where it will be returned to the open cast pit by haulers. The –70mm breaker fraction will rejoin the sizing screen undersize and will be conveyed to a feed to plant (FTP) stockpile.

The –70mm FTP coal will be reclaimed from the FTP stockpile by vibrating feeders and a reclaim conveyor feeding three FTP coal bins each feeding an identical module. Feed to plant will be reclaimed from the silo by vibrating feeders and a reclaim conveyor, feeding two sizing screens sizing at 15mm. The 15mm oversize fraction will feed to a pre-wet screen the oversize being discharged into the primary dense medium (DM) cyclone mixing tank, where magnetite medium of a predetermined density is added. The pulp is then pumped to a DM cyclone where the separation of coal and discard is effected. The discard is drained and rinsed free of magnetite on drain and rinse (D&R) screens and discharged onto a common discard conveyor feeding a 1000 ton capacity discard silo from where it is returned to the pit by hauler. Product coal from the drum is also drained and rinsed free of magnetite on a D&R screens and discharged onto a common product conveyor feeding three double roll crushers, which reduce the feed to 15mm. The crushed cyclone product rejoins the –15mm sizing screen undersize on a common conveyor feeding three 1000 ton capacity silos.

Vibrating feeders and a reclaim conveyor belt, which feeds a desliming screen fitted with 1.8mm apertures panels, reclaims each silo. The 15x1.8mm fraction is discharged in a mixing tube, where magnetite medium of a predetermined density is added and the pulp pumped to the secondary dense medium cyclone thereby affecting the separation of coal and middlings. The cyclone product is drained and rinsed free of magnetite on a D&R screen and discharged onto a common product conveyor feeding the coking coal load out stockpile. The cyclone middlings underflow fraction is also drained and rinsed free of magnetite on a D&R screen and discharged onto a common middlings conveyor feeding the middlings coal load out stockpile.

Desliming screen underflow is pumped to a cluster of classifying cyclones for size classification. The coarser cyclone underflow will be fed to a bank of spirals where the coking coal, middlings and discard will be separated. The middlings and discard products will be dewatered by cyclones and dewatering screens before being discharged onto their respective conveyor belts. The coking coal will be dewatered by cyclones and centrifuge, the dewatered product being discharged onto the coking coal product conveyor.

Classification cyclone overflow will gravitate to a slurry sump from where it is pumped to a further cluster of classifying cyclones. The very fine cyclone overflow gravitates to a paste thickener, while the cyclone underflow gravitates to a further thickener. The thickened slurry will be pumped to a conditioner, conditioned and pumped to a bank of flotation cells. Flotation product will be thickened in a thickener and dewatered by filter presses before being discharged onto the coking coal product conveyor. Flotation tailings will be dewatered in filter presses before being discharged on the common discard conveyor.

In the dense medium processes magnetite will be reclaimed by low intensity wet drum magnetic separators for reuse in the plants. Clarified water from the thickeners and return water dams will be pumped back to the plant for reuse as process water.

The plant will operate on a four shift cycle 24 hours per day seven days per week. The plant will operate with 65 personnel.

1.3.2.2 Underground coal process

ROM coal will be conveyed to a surface stockpile. Coal from the ROM stockpile will be reclaimed by vibrating feeders and reclaim conveyor and fed to two sizing screens sizing at 80mm. Sizing screen oversize at +80mm will feed a primary double roll crusher, which will reduce the oversize to 80mm. The combined sizing screen undersize and crusher product will be conveyed to heavy duty secondary sizing screens, sizing at 50mm, the +50mm fraction will be fed to a secondary double roll crusher, which will reduce the oversize to 50mm. The 50mm crusher product will be returned to the secondary sizing screen in a closed circuit crushing operation. The -50mm secondary sizing screen undersize fraction will be conveyed to a feed to plant (FTP) stockpile.

The –50mm ftp coal will be reclaimed from the FTP stockpile by vibrating feeders and a reclaim conveyor, feeding one FTP coal bin. Feed to plant will be reclaimed from the silo by vibrating feeders and a reclaim conveyor, feeding two sizing screens sizing at 12mm. The 12mm oversize fraction will feed to a pre-wet screen the oversize being discharged into the primary dense medium (DM) cyclone mixing tank, where magnetite medium of a predetermined density is added. The pulp is then pumped to a DM cyclone where the separation of coal and discard is effected. The discard is drained and rinsed free of magnetite on a drain and rinse (D&R) screen and discharged onto a common discard conveyor feed a 1000 ton capacity discard silo from where it is returned to the open cast pit by hauler. Product coal from the drum is also drained and rinsed free of magnetite on a D&R screens and discharged onto a common product conveyor feeding a double roll crushers, which reduce the feed to 12mm. The crushed cyclone product rejoins the –12mm sizing screen undersize on a common conveyor feeding a 1000 ton capacity silo.

Vibrating feeders and a reclaim conveyor belt, which feeds a desliming screen fitted with 1.8mm apertures panels, reclaims the coal from the silo. The 12 x 1.8mm fraction is discharged into a mixing tube, where magnetite medium of a predetermined density is added and the pulp pumped to a rewash dense medium cyclone thereby affecting the separation of coal and middlings. The cyclone product is drained and rinsed free of magnetite on a D&R screen and discharged onto a common product conveyor feeding the coking coal load out stockpile. The cyclone middlings underflow fraction is also drained and rinsed free of magnetite on a D&R screen and discharged onto a common middlings conveyor feeding the middlings coal load out stockpile.

Desliming screen underflow is pumped to a cluster of classifying cyclones for size classification. The coarser cyclone underflow will be fed to a bank of spirals where the coking coal, middlings and discard will be separated. The middlings and discard products will be dewatered by cyclones and dewatering screens before being discharged onto their respective conveyor belts. The coking coal will be dewatered by cyclones and centrifuge, the dewatered product being discharged onto the coking coal product conveyor.

Classification cyclone overflow will gravitate to a slurry sump from where it is pumped to a further cluster of classifying cyclones. The very fine cyclone overflow gravitates to a paste thickener, while the cyclone underflow gravitates to a further thickener. The thickened slurry will be pumped to a conditioner, conditioned and pumped to a bank of flotation cells. Flotation product will be thickened in a thickener and dewatered by filter presses before being discharged onto the coking coal product conveyor. Flotation tailings will be dewatered in filter presses before being discharged on the common discard conveyor.

In the dense medium processes magnetite will be reclaimed by low intensity wet drum magnetic separators for reuse in the plants. Clarified water from the thickeners and return water dams will be pumped back to the plant for reuse as process water.

The plant will operate on a four shift cycle 24 hours per day seven days per week. This plant will operate with a further 39 personnel.

VELE COLLIERY

PROPOSED METALLURGICAL FLOW

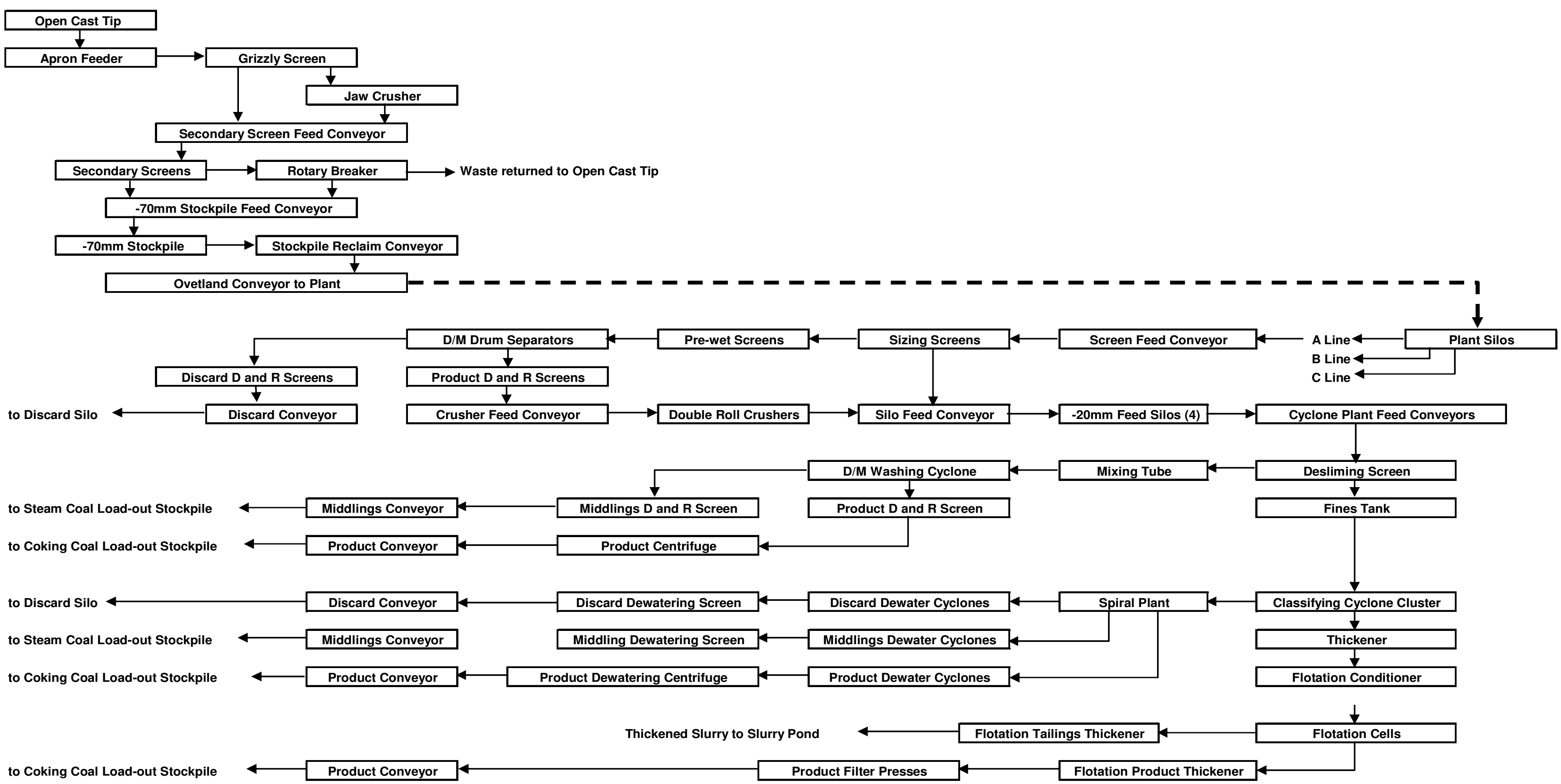


Figure 1.3.2: Vele Colliery process flow diagram

1.3.3 Surface Infrastructure

Other surface infrastructure include:

- Workshops and stores
- Change houses and offices
- Haul roads and service roads
- Conveyors
- Ventilation shafts
- Topsoil and overburden stockpile areas
- Coal stockpile areas
- Access road(s)
- Contractor camp – underground
- Contractor camp – opencast
- Borrow pits – still to be determined
- Railway loop: Provision is made on the plant layout plans for a railway loop, although the transport mode is still under investigation. If road haulage is selected, the plant area (designated a dirty water area) may be substantially reduced.

Refer to Figure 1.3.3 for the surface infrastructure layout plan.

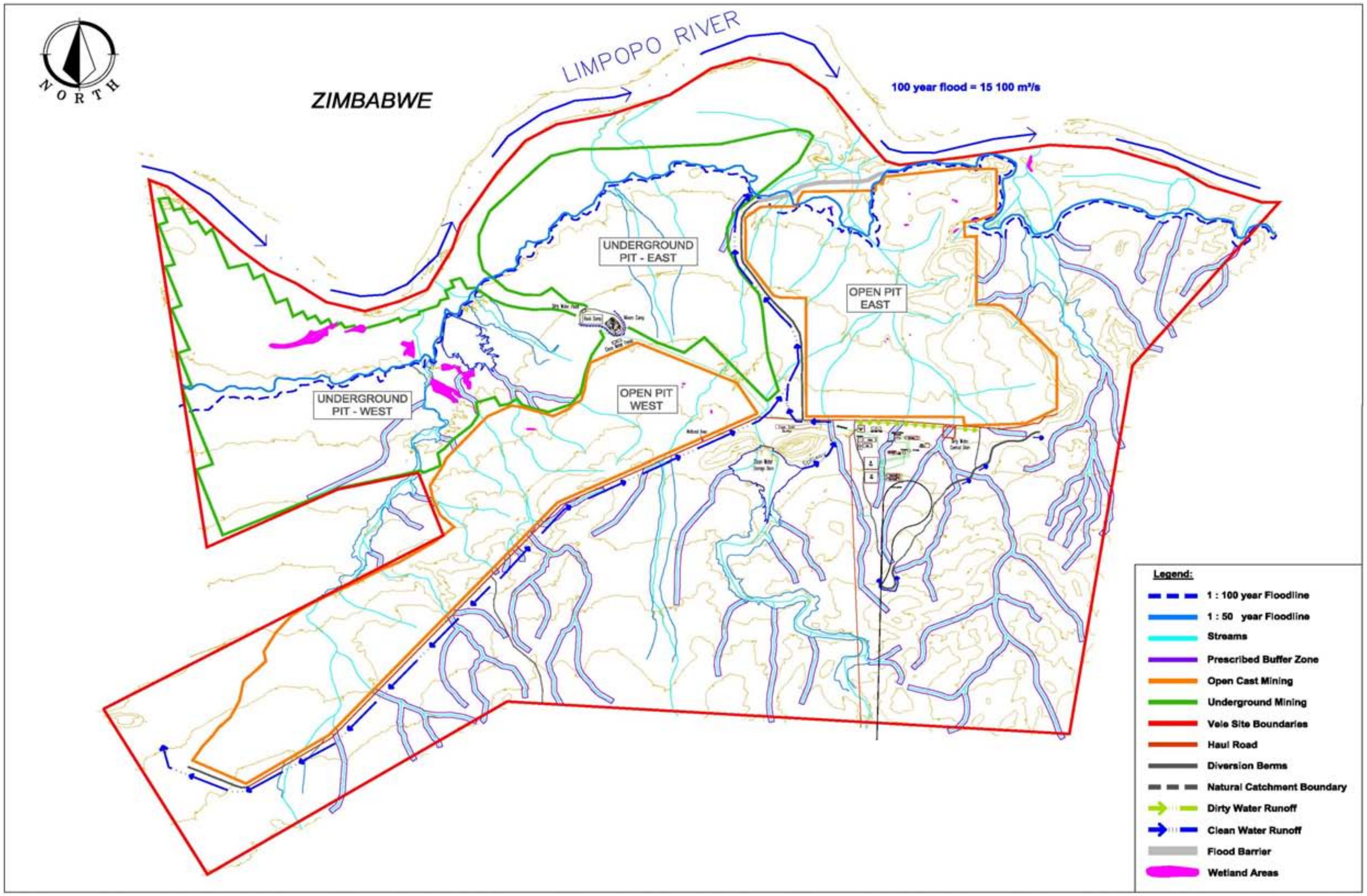


Figure 1.3.3: Surface infrastructure layout plan

1.3.4 Water Management Infrastructure

The water requirements for the proposed project will be abstracted from the Limpopo River during high flow periods, as well as from the primary aquifer by boreholes (existing or new) situated along the floodplain of the Limpopo River.

The clean water storage dam will be located between the two hills to the west of the plant area – refer to Figure 1.3.4(a). The required dam volume was estimated as 750,000 m^3 to cater for the mine's average make-up requirement of 2,500 m^3/day. To provide a safe operating margin, a dam volume of 1 million m^3 will be constructed.

1.3.4.1 Potable water

Based on a workforce of 826 people (including contractors), a volume of about 207 m^3/day of potable water will be required for domestic consumption, founded on a requirement of 250 liter per capita per day. Potable water will be sourced from the primary aquifer. A suitable plant to treat the water will be constructed depending on the quality of the water.

1.3.4.2 Sewage

For the proposed new development, two sewage treatment plants will be constructed and operated, one at the underground miners camp and one at the processing plant. Package plant systems will be used to treat water to DWAFs effluent quality standards. The effluent would be discharged into the dirty water dam(s) for re-use.

1.3.4.3 Processing water

It is estimated that the processing water requirement is approximately 4 Ml/day. The majority of this water would be provided by the dewatering of the mine workings, supplemented by water stored in the clean water dam. A closed system is being designed whereby all water is recycled for use in the process.

1.3.4.4 Storm water control measures

In general, the storm water control measures intend to secure the dirty areas (i.e. haul roads, dirty stockpile areas, open pit area and process plant area) and to divert clean upslope water past the mine. A number of small, non-perennial drainage lines traverse the proposed opencast mining area. These need to be diverted around the open pit in order to prevent flooding during the operational phase, as well as to ensure that the clean runoff water is diverted back to the natural environment.

Figure 1.3.4(b) shows the proposed storm water control measures around the east pit. On the southern side, the haul road acts as a cut-off and would divert clean storm water around the pit. The eastern edge of the pit is on the verge of a low escarp and only a nominal berm would be required to prevent water ingress to the workings.

Berms to control floods and divert a stream are required at the north-west boundary of the pit, as follows:

- A flood protection berm, to be 6m at its highest section, is required to prevent the 1:100-year flood water from entering the workings.
- A stream diversion berm and concomitant earth canal are required to divert a stream flowing across the north western corner of the proposed pit into an adjacent stream. The receiving stream flows parallel and fairly close to the stream which is to be diverted.

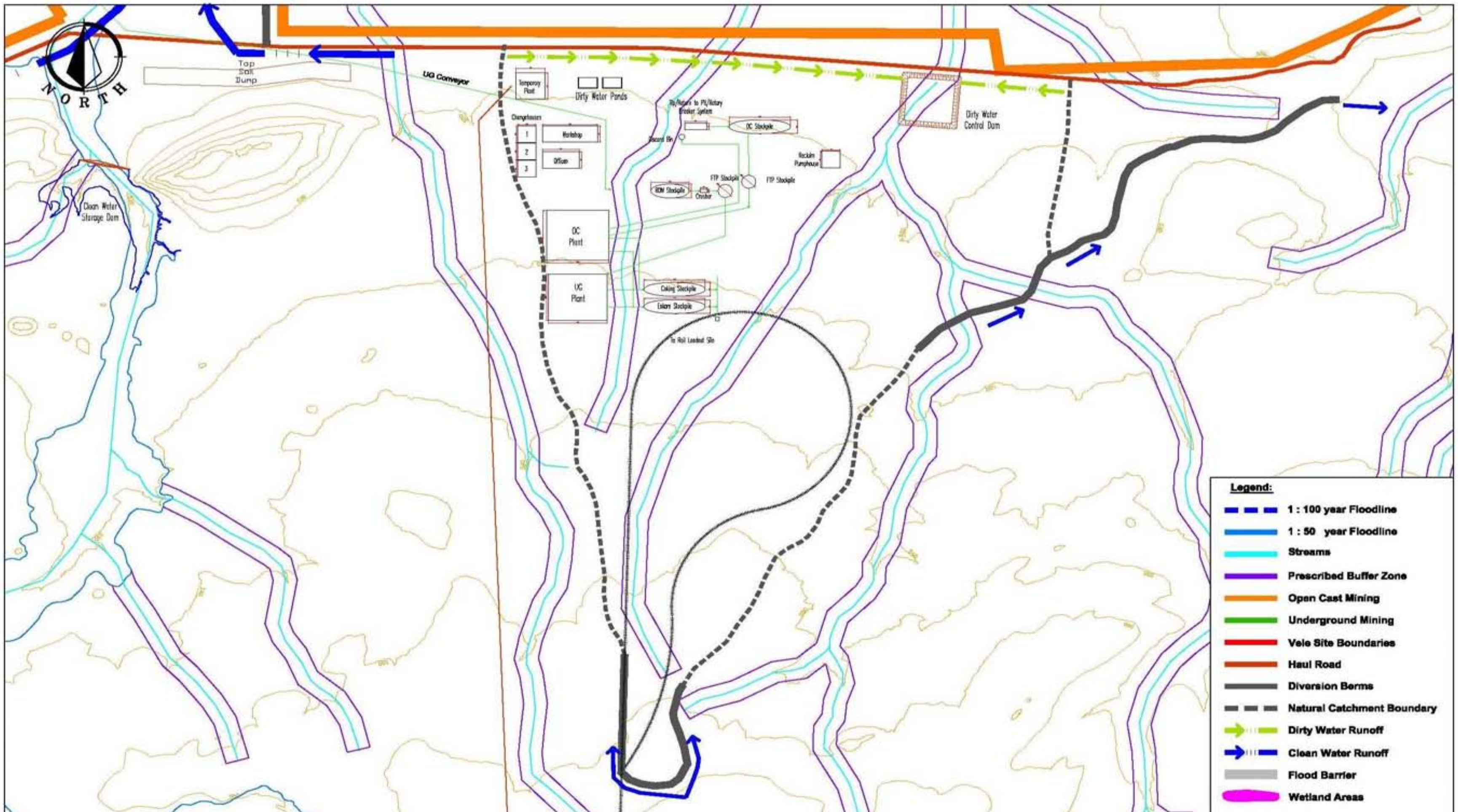


Figure 1.3.3(a): Clean and dirty water management around plant area

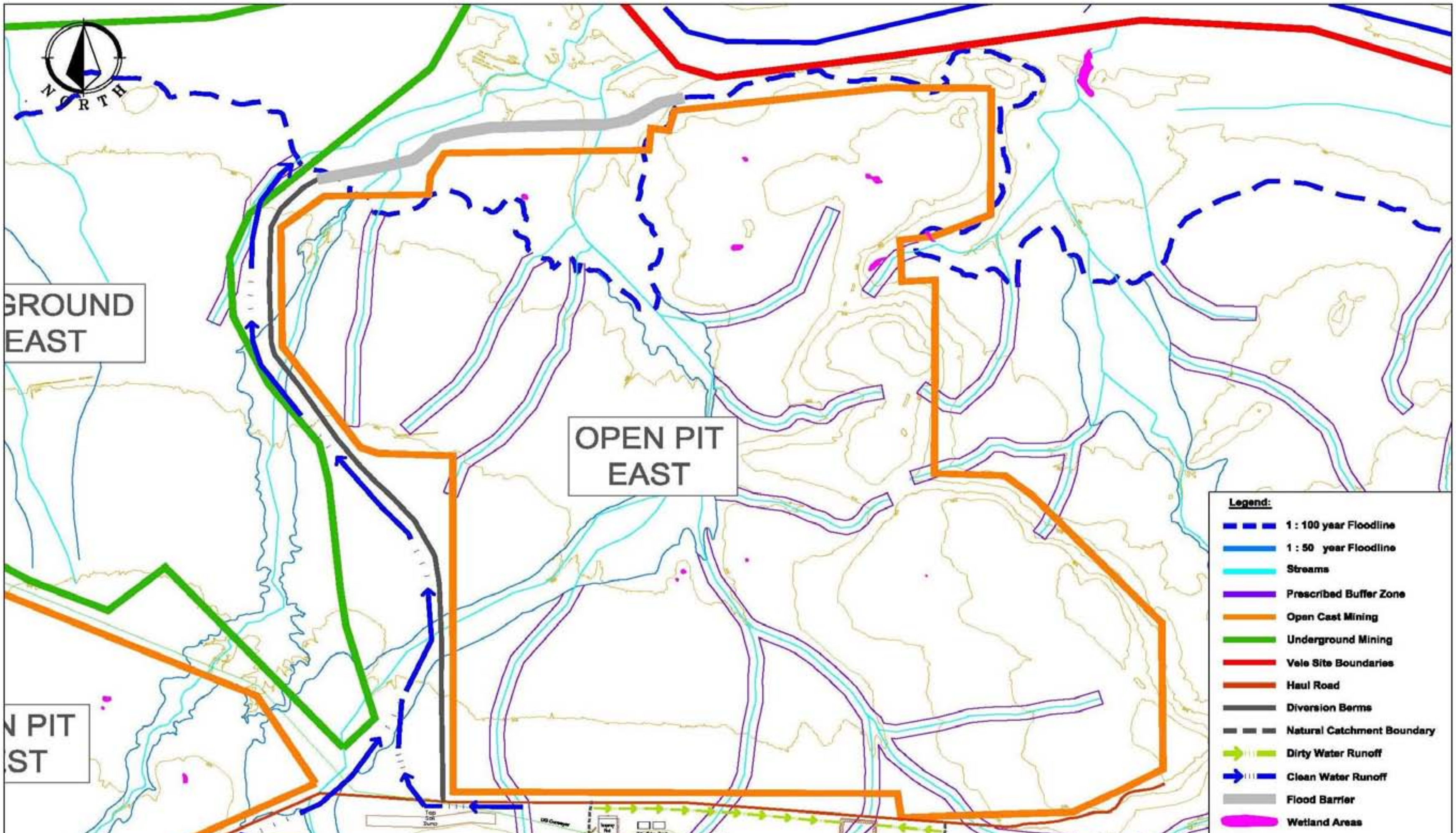


Figure 1.3.4(b): Clean and dirty water management around the East Pit

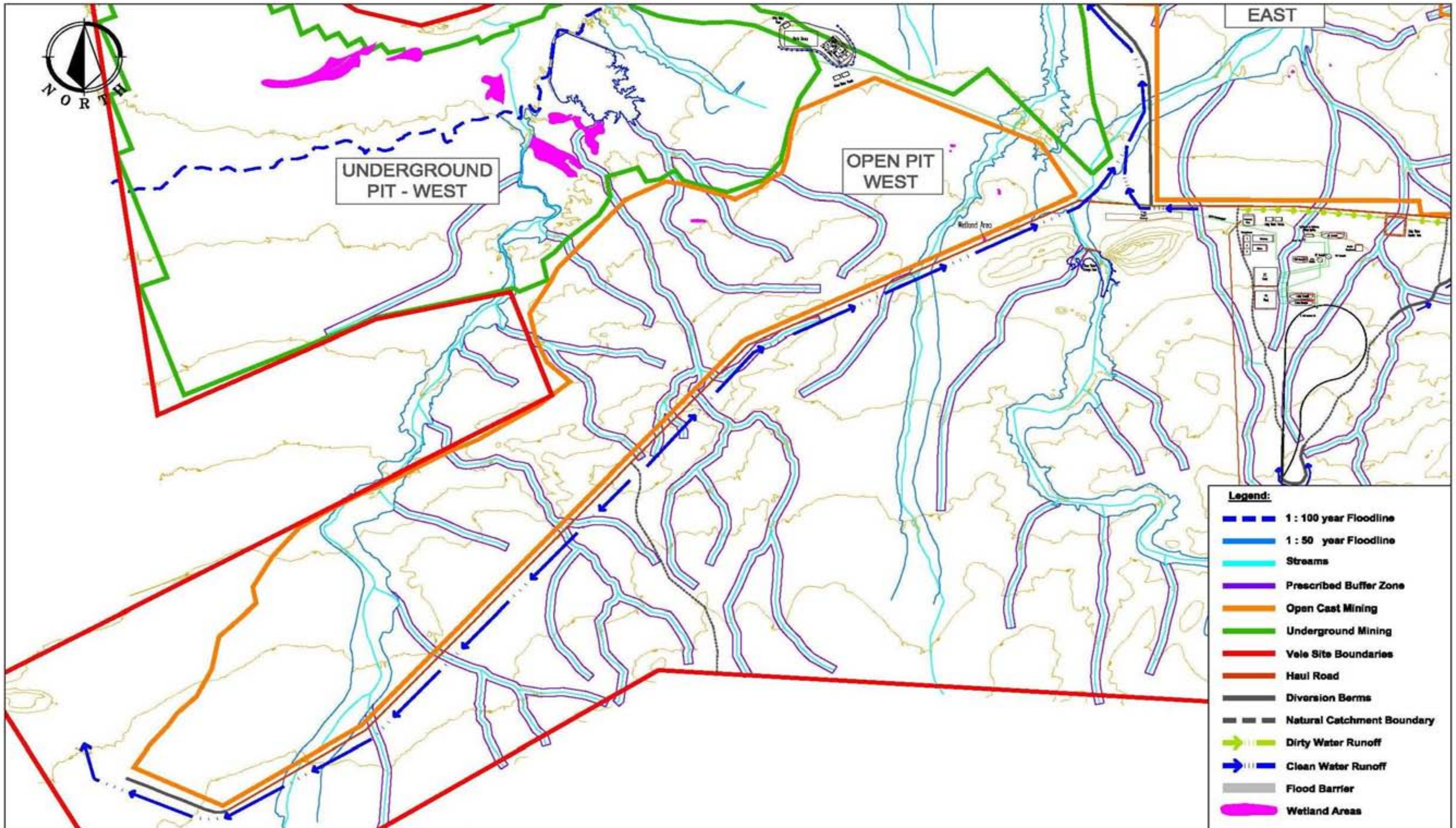


Figure 1.3.4(c): Clean and dirty water management around the West Pit

Figure 1.3.4(c) shows the proposed surface water mitigation measures at the west pit where work is scheduled to start only by 2024. The pit would be developed from east to the west and diversion of the northward flowing streams is required from 2024, to the east and west around the pit as shown. The haul road would again be constructed as the diversion berm.

1.3.4.5 Dirty water management system

Plant area

The proposed measures are shown in Figure 1.3.4(a) and it involves the diversion around the 'dirty' plant area, including the proposed railway loop. As indicated, the natural catchment area boundary is utilised as far as possible as the boundary of the area to reduce the need for man-made berms, thereby reducing the impact on vegetation, soils and visual quality. If a railway is not constructed, the deemed dirty water area will be substantially reduced.

At the upstream, southern end of the area, low diversion berms are required to direct some of the surface flow, in the form of unconcentrated sheetflow, away from the area. Being close to the natural top end of the watershed, the quantity of water to be diverted is small.

Further downstream on the western side of the area, the railway line is used as the stream diversion, thereby obviating the need for an additional berm, since railway lines are normally elevated above natural ground level. No cross drainage culverts are to be installed over this length of the line. On the lower eastern side, a berm is required to reroute a small drainage line towards the east to tie in with the drainage system around the East Pit.

The northern boundary of the dirty water area is formed by the haul road, which will be constructed above natural ground level. Upstream of the haul road, dirty water will be conveyed in drains towards the dirty water dam. The dirty water dam is constructed in the stream which naturally drains the dirty water area.

The dirty water dam will be lined and must contain the 1:50-year flood volume. It should have a spillway to discharge floods larger than the 50-year flood with a minimum freeboard of 800 mm above the full supply level, as prescribed in GN 704. A minimum dry freeboard, i.e. the freeboard above the design flood level, should be 300 mm. The 1:50-year flood volume has been estimated as 50 000 m^3 and the design flood peak is 16 m^3/s. Provisionally a dam of 130x130m with 3 m water depth is proposed. The relative shallow depth and concomitant large surface area would aid high water losses by evaporation. The final design would depend on the excavatable depth and availability of suitable material for construction of the dam wall. Apart from the spillway, dam outlets should be provided in order for water to be abstracted for re-use. After major flood events the re-use of water from this dam should be first priority so as to keep the water levels as low as possible.

Other smaller, deep lined ponds are to be provided close to the plant which would receive water pumped from the workings and from the dirty water dam for use in the plant. At least two days' plant water demand should be stored here as back-up in the event of pump failures, i.e. at least 10,000 m^3. Excess water received in the ponds would spill (through pipes) to the dirty water dam.

Miners camp

This area is regarded as a dirty water area to be provided with upstream diversion berms and downstream collection berms to feed water to a dirty water pond. This dirty water pond can also be used to receive water from the underground mine and would be sized to tie in with the dewatering storage requirements. The conceptual layout is shown in Figure 1.3.4(c).

The approaching upstream clean water flow is in the form of sheet flow and special measures are required at the outlet of the diversion drains to spread out the flow to achieve natural sheet flow conditions, thereby preventing scour.

Haul road

The haul road to serve the open pits is to be constructed on the southern upstream side of the pits. On the upslope side a drain will be provided to convey storm water around the pits, or in the case of the plant area, dirty water will be channelled to the dirty water dam. The cross fall of the road would be to the northern, downstream side, except along the plant area, so that contaminated water can be collected in dirty water drains. The drains would convey the water into the pits itself where it will be contained and pumped out as part of the dewatering system.

1.3.5 Transport and road infrastructure

At first, haul trucks will transport the coal to the nearest rail siding in Musina, but once the feasibility study has been conclusive, a rail link or overland conveyor belt will be built to transport the coal. In the interim, the trucks will make use of the R572 to reach Musina.

The following table shows the number of trucks which will travel on the road per day for 336 days/year (28 days per month) for the build-up period until full production. From this it would appear that the 60 ton payload truck would be best, requiring 31 of these vehicles at 8 loads per day to deliver the 5mt required.

Table 1.3.5(a): Estimated traffic numbers – trucks

Year	2009	2010	2011	2012	2013
Tons	61,000	1,501,150	4,326,863	4,546,740	5,010,000
Trucks / day 34 tons	5	131	379	398	439
Trucks / day 60 tons	3	74	215	226	249
Trucks / day 90 tons	2	50	150	150	166

Additional travelling between the project site and Musina will take place when workers living in town travel to the mine on a daily basis. Any product and service deliveries to support domestic as well as industrial activities on the mine site will also require service providers to travel from town to the project site.

Table 1.3.5(b): Estimated traffic numbers – other vehicles

Transport types	2009	2010	2011	2012	2013
Staff Busses	5	36	36	15	15
Staff personal transport	90	120	120	120	120
Suppliers (heavy duty)	20	20	20	5	5

For the interim period whilst coal will be transported to Musina siding by road transport, road infrastructure construction and upgrades will be required. This includes a bypass in Musina and a mine access road from R572. The existing Pont Drift and Venetia Roads will not be upgraded. An agreement will be entered into with the Roads Agency Limpopo to maintain the existing surfacing and drainage structures.

The ***Vele mine access road*** is a single road 8000m long which must be newly built. Initially the road will be gravel and upgraded to tar once the mine is in full production.

The bypass roads to the MAC siding will be along the following route:

1. From the mine trucks will turn right onto the existing All Days/Venetia Road
2. After 1.4 km the trucks will turn left onto the new Venetia - Harper Link Road that passes to the west of the old sport stadium.

3. After 2.1 km the trucks will turn left onto the existing Harper Road
4. After 2.3 km the trucks will turn right into the new MAC siding access road

The works on the above roads will be as follow:

1. The new Venetia - Harper Link Road will be constructed to the following standard:
   a. Road length = 2100m.
   b. Road width = 10.6m.
   c. Surfaced width = 10.0m (1.3m shoulder + 3.7m traffic lane + 3.7m traffic lane + 1.3m shoulder). We have seen from experience that this surface width works well when Minibus Taxi's also have to be accommodated.
   d. The pavement structure will be designed for a 4 year design period. The pavement will be able to carry 6.5 Million Equivalent Standard Axles (MESA).
   e. Storm water drainage will be provided in the form of 600mm diameter concrete pipe culverts and will be tied in to suit the municipal storm water drainage system.
   f. The intersections with Venetia and Harper Roads will be designed to safely handle coal truck turning circles.
   g. During construction the road will be closed for traffic.
   h. Road signage and road markings will be installed in accordance with the South African Road Traffic Signs Manual (SARTSM).
2. The existing Harper Road will by upgraded to the same standard as the Venetia - Harper Link Road:
   a. Road length = 2300m; Road width = 10.6m.
   b. Surfaced width = 10.0m (1.3m shoulder + 3.7m traffic lane + 3.7m traffic lane + 1.3m shoulder). We have seen from experience that this surface width works well when Minibus Taxi's also have to be accommodated.
   c. The existing pavement will be recycled to form part of the new pavement structure that will be designed for a 4 year design period. The pavement will be able to carry 6.5 Million Equivalent Standard Axles (MESA).
   d. The existing storm water drainage will be upgraded using 600mm diameter concrete pipe culverts.
   e. The intersection with the MAC siding access road will be designed to safely handle coal truck turning circles.
   f. During construction the road will be closed for traffic.
   g. Road signage and road markings will be installed in accordance with the South African Road Traffic Signs Manual (SARTSM).
3. The new MAC siding access road will be constructed to the following standard:
   a. Road length = 700m; Road width = 8.6m.
   b. Surfaced width = 8.0m (0.3m shoulder + 3.7m traffic lane + 3.7m traffic lane + 0.3m shoulder). No Minibus Taxi's need to be accommodated on this road.
   c. The pavement structure will be designed for a 4 year design period. The pavement will be able to carry 6.5 Million Equivalent Standard Axles (MESA).
   d. Storm water drainage will be provided in the form of 600mm diameter concrete pipe culverts and will be tied in to suit the municipal storm water drainage system.
   e. During construction the road will be closed for traffic.
   f. Road signage and road markings will be installed in accordance with the South African Road Traffic Signs Manual (SARTSM).

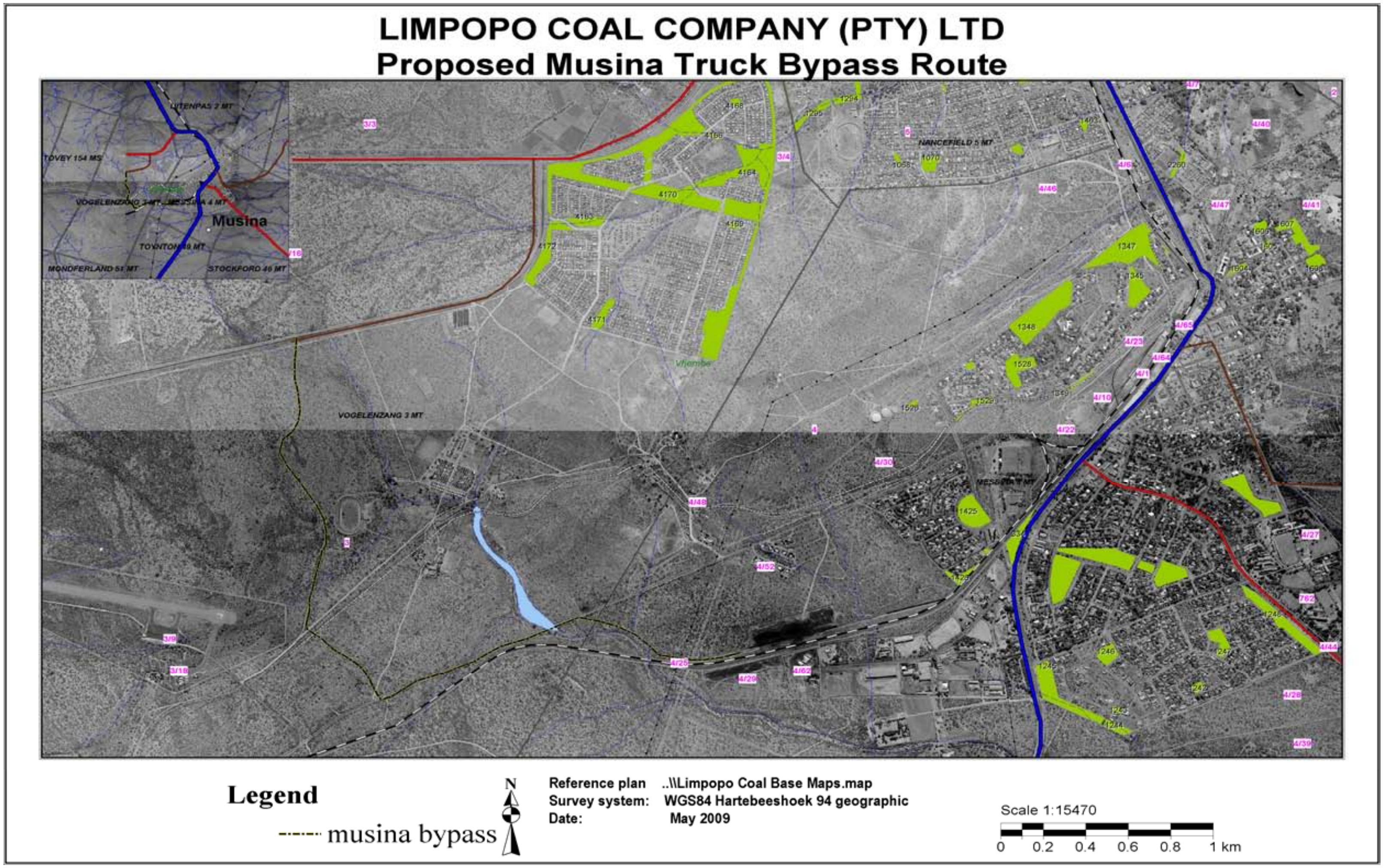


Figure 1.3.5: Proposed Musina Bypass Route for coal transport to Musina Siding

1.3.6 Alternative Options Investigated

A number of alternative options have been evaluated during the mine design. A high-level qualitative risk assessment was performed to determine the most preferred option from an environmental perspective. These are listed in Table 1.3.6 overleaf, and briefly discussed below.

1.3.6.1 Mining methodology

Apart from the No-Go Option, three alternatives were evaluated in respect of the mining methodology, namely:

- Opencast only
- Combination opencast & underground
- Underground only

From an environmental perspective, underground mining would be the most suitable as this would limit the surface disturbance and impact on the biodiversity of the area. However, a large portion of the resource will be lost due to the safety risks associated with mining of shallow resources. A combined mining plan including both opencast and underground mining was thus opted for in order to optimize the mineral resource utilization. Apart from the obvious reduction in surface disturbance (compared to opencast mining only), this option further allows for co-existence with agriculture as the majority of cultivated areas will be mined underground. This further allows for in-pit disposal of the mine residue (discard and slurry) which is positive in terms of groundwater quality management, visual impact (no surface dumps) and the general biodiversity of the area. Refer to 1.3.6.3 below.

1.3.6.2 Conveying methodology

Three conveying systems have been evaluated to transport the product to Musina, from where it will be distributed to inland and export clients via rail. These include:

- Road transport
- Conveyor system
- Railway line

The impact of road transport on the roads and the safety of the road users in the vicinity would be huge and is thus not seen as a sustainable option. A conveyor system is the best financial and environmental solution; however the length of haulage distance (> 20km) makes this option less attractive for operation and maintenance. With the high volumes of product that needs to be conveyed during the operational phase of the proposed mine, a railway line to Musina becomes the most cost efficient with the lowest impact on the environment.

Further assessments need to be performed to determine the impact associated with a railway line, and for the interim (first 5 years of mining), road transport will be used to haul the product to Musina.

1.3.6.3 Mine residue management

Three options were evaluated for the management of the mine residue (discard and slurry) associated with the proposed project. Two surface facilities were looked at, namely surface discard dumps and slurry facilities and a co-disposal facility catering for both. The third option that was evaluated is in-pit disposal of mine residue during rehabilitation of the opencast pits.

From a groundwater perspective, the in-pit disposal is the option that would (potentially) cause the least impact owing to the fact that the residue could be placed at the bottom of the pit, allowing the residue to be inundated with water. This would reduce the potential for oxidation and the formation of acid-mine drainage.

In-pit disposal would also facilitate a free-draining final profile which from a visual and end-land use perspective is the preferred option. Surface residue facilities would have a huge visual impact as well as long-term maintenance issues.

1.3.6.4 Mining equipment

Opencast

Initially a combination of truck and shovel and draglines were proposed for the opencast operations. However, due to the large visual impact associated with draglines, this option was disregarded and only truck and shovel operations will be performed at Vele Colliery.

Underground

Three options were evaluated for the underground operations, namely:

- Continuous miners
- Blasting
- Enhanced extraction

Due to the potential impact on the primary aquifers in the area, blasting and enhanced extraction were disregarded for underground mining due to the potential for the creation of fractures to surface which could potentially drain the primary aquifers into the underground workings.

1.3.6.5 Process effluent

Two options were evaluated:

- Slurry ponds
- Inclusion of filter press within the system

The inclusion of a filter press within the process would facilitate increased recycling of water, reduce the risk of spillages and acid-mine drainage and limit the impact on air quality as the residue will be consolidated. Thus, even though this would mean a higher capital cost input, from an environmental perspective this is the preferred option.

Table.

1.3.6.6 Housing of permanent employees

Three options were evaluated, namely building housing facilities on site (within mining licence boundaries) or off site on adjacent land, or to encourage permanent employees to live in Musina by providing housing allowances as part of the remuneration package. The latter would not only contribute to the LED programmes in Musina, but would also be more beneficial to the employees over the longer term.

During construction a temporary camp will be erected on the farm Bergen op Zoom 124 MS.

1.3.6.7 Processing plant position

In order to finalise the position of the plant site a number of environmental aspects were taken into consideration. Firstly viewshed analyses were performed to determine the position that will have the least impact on surrounding properties, in specific the Mapungubwe National Park. Subsequent to the viewshed analyses, the plant layout was changed and the infrastructure placed in such positions that optimum screening effect of the topography could be achieved.

In addition to this, the environmental features that require protection, remediation, management or avoidance was plotted. These include the heritage sites, the protected species such as Baobab trees and the drainage lines with associated springs and floodline areas. Again the plant position was adjusted to minimise the impact as far as possible, whilst still having a feasible layout.

The final plant position and layout is shown in Figure 1.3.6.

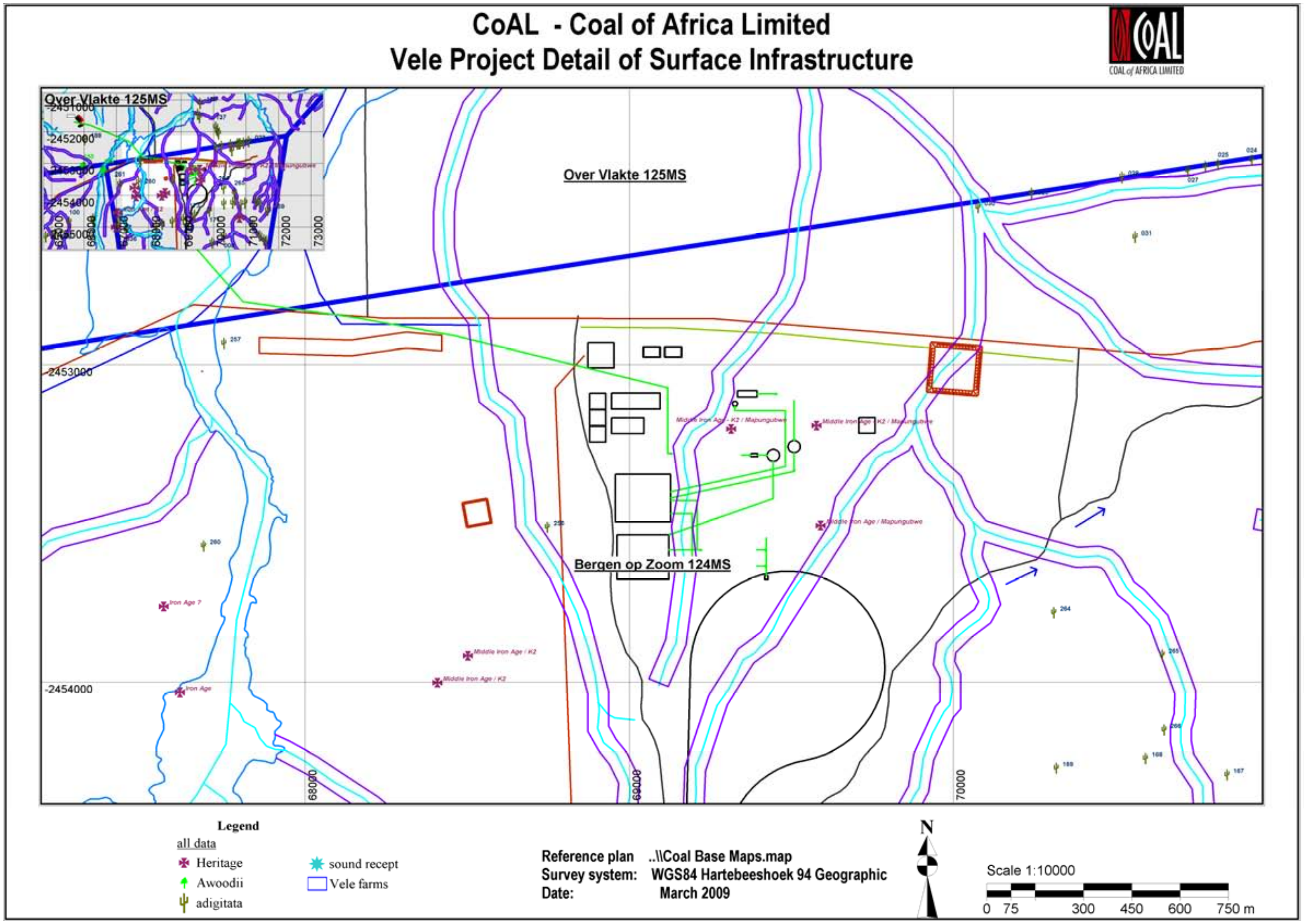


Figure 1.3.6: Final plant position and layout

1.4 PROJECT SCHEDULE

The Vele Colliery Project will follow four phases of development, i.e. Construction & Commissioning, Build-Up Period, Operational, Decommissioning & Closure, as detailed in Table 1.4.

Table 1.4: Project Life-Cycle of Vele Colliery

STAGE 1 CONSTRUCTION & COMMISSIONING	STAGE 2 BUILD-UP	STAGE 3 OPERATIONAL	STAGE 4 DECOMMISSIONING & CLOSURE
2009 - 2011 (3 years)	2012 – 2013 (2 years)	2014 – 2036 (24 years)	2036 - 2038 (3 years)
No. of estimated workforce: 50 – 100 Contractor based 2000 - 2500	No. of estimated workforce: 100 – 826	No. of employees: 826	No. of employees: 826 – 0
Mining right obtained Construct and establish infrastructure and service areas Commence mining of coal from box-cuts	Build production levels up to optimum level of approx 5 million primary sales tons per annum	Maintain approx 5 million primary sales tons per annum Continuous improvement monitoring, and evaluation	Start to develop portable skills Scaling down of operations Rehabilitation Retrenchments

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

This report was prepared in terms of legislation applicable to a project of this nature, i.e.:

- No. 28 of 2002: Mineral and Petroleum Resources Development Act (MPRDA)
- No. 36 of 1998: National Water Act (NWA)
- No. 107 of 1998: National Environmental Management Act (NEMA)
- No. 39 of 2004: NEMA: Air Quality Act (AQA)
- No. 45 of 1965: Atmospheric Pollution Prevention Act (APPA)
- No. 10 of 2004: NEMA: Biodiversity Act
- No. ?? of 2003: NEMA: Protected Areas Act
- No. 84 of 1998: National Forest Act
- No. 25 of 1999: National Heritage Resources Act
- No. 49 of 1999: World Heritage Convention Act
- SANS 1929 of 2005: South African National Standards, Ambient air quality – Limits for common pollutants, 2005
- GN No. R.527 of 23 April 2004: Mineral and Petroleum Resources Development Regulations
- GN No. 704 of 4 June 1999: Regulation on use of water for mining and related activities aimed at the protection of water resources

A large number of specialists were appointed to perform the Environmental Impact Assessment (EIA) and assist with the development of the Environmental Management Programme (EMP) for Vele Colliery, as put forward in this document. These are:

Surface Water & Groundwater	WSM Leshika Consulting (Pty) Ltd
Soils, land use & land capability	Red Earth cc
Biodiversity	Dubel Integrated Environmental Services
Air quality	Bohlweki SSI Environmental (Pty) Ltd
Environmental noise	Jongens Keet Associates
Visual / aesthetic	Metro GIS
Heritage resources	Frans Roodt
Palaeontological	Dr JF Durand
Blasting	AJ Rorke
Socio-Economic	Naledi Development Restructured (Pty) Ltd
Macro-Economic	Conningarth Economists

The specialist reports are attached as annexures to this EMP document. For the purpose of this report, the specialist findings and recommendations have been integrated into a sustainable management plan for the mine to take forward into operation. Thus, the specialist reports have not been duplicated, only summarized, and the relevant specialist sections should be read in conjunction with the specialist reports attached.

2.1 SECTION 39 (3) (A)

2.1.1 Baseline Information

2.1.1.1 Geology (WSM Leshika, 2009 – Annexure E)

Stratigraphy

The stratigraphy of the study area consists of 3 major geological entities. From oldest to youngest these are:

i) The Limpopo Mobile Belt basement (3.4 – 2.0 Billion years)

ii) The Karoo Sequence (240 to 160 million years)

iii) Quaternary deposits (< 10 million years)

The Limpopo Mobile Belt basement is exposed in the south eastern two thirds of the study area. The Limpopo Mobile Belt (LMB) is a zone of intense deformation and metamorphism caused by the collision of the Kaapvaal craton with the Zimbabwean Craton. The LMB consists of three distinct zones which are separated by major continental scale shear zones, i.e.: a northern marginal zone, a central zone and a southern marginal zone. The study area is situated in the centre of the central zone. See Figure 2.1.1.1(a).

The central zone is comprised of a complex assortment of meta-sediments interlayered with quartzo-feldspathic gneisses and mafic rocks, metamorphosed to a high grade. The meta-sediments and gneisses are collectively known as the Beit Bridge Complex.

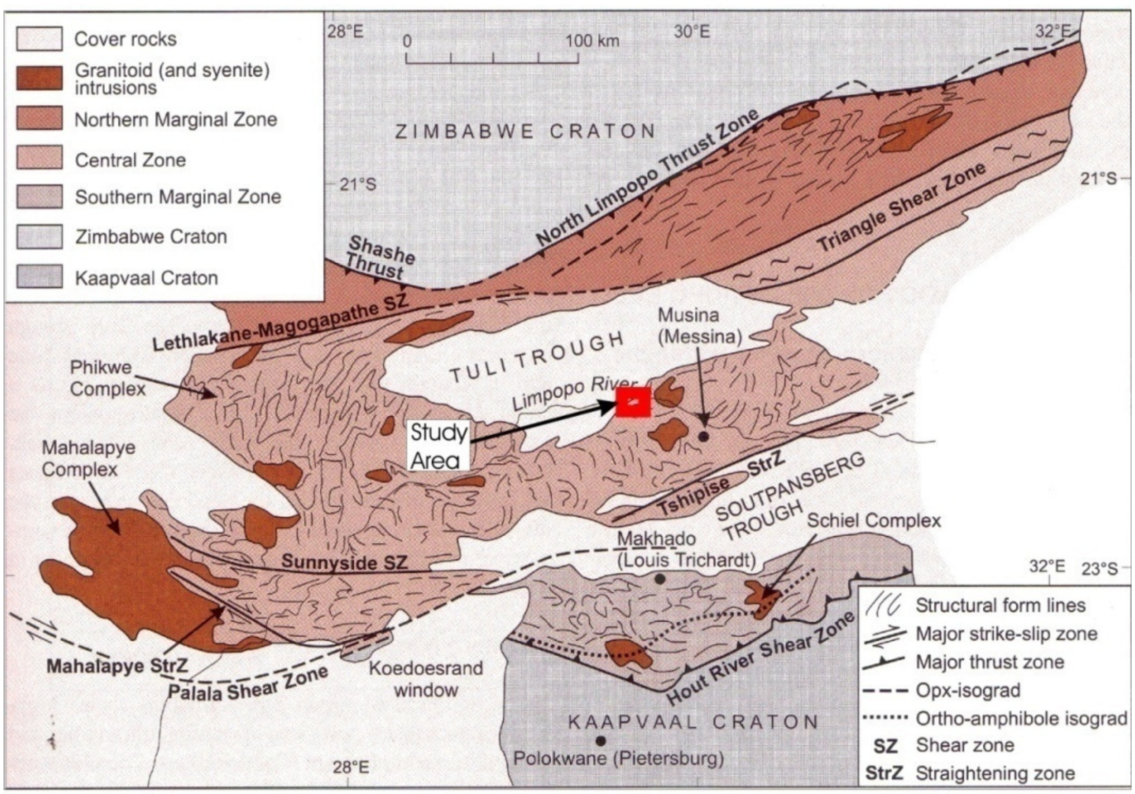


Figure 2.1.1.1(a): Generalised map of the LMB showing Central Zone setting of the Vele Colliery Prospect (after Boshoff, 2004, Geology of SA, 2006)

The Karoo Sequence strata was deposited in a fault bounded trough known as the Tuli Basin. Sedimentation into the basin was fault controlled. Karoo Sequence strata overlies a third of the study area to the NW and is represented by the following formations:

(i) The Tshidzi Formation; is a 10m thick basal conglomerate/diamictite and can be correlated to glacial Dwyka tillite in the main Karoo basin. Tillite was intersected in several core boreholes drilled through to basement.

(ii) The Madzaringwe Formation consists of a lower grit layer with conglomerate lenses and can be up to 6m thick in places. These in turn are overlain by a thick shale succession with a distinctive coal bearing zone in the middle of up to 20m in thickness. The coal seams are of economic potential. A coarse, micaceous sandstone represents the top of this formation. Lower Karoo strata were deposited on an uneven floor and are therefore not always present.

(iii) The Mikambeni Formation overlying the above comprises 15m of grey or yellowish shales and siltstones with occasional coal seamlets. The Madzaringwe and Mikambani Formations can be correlated with the Ecca Group of the main Karoo basin.

(iv) The Fripp Sandstone Formation consists of siltstones and very fine sandstones with subordinate grey mudstones and attains a maximum thickness of 25m.

(v) The Solitude Formation is a 110m thick inter-layered grey and purple shale with minor sandstone and grit intercalations.

(vi) The Bosbokpoort Formation consists of up to 60m red to purplish mudstones with subordinate white siltstone layers. Calcareous nodules and concretions are often present.

(vii) The overlying 200m thick Clarens Formation can be further sub-divided into a lower Red Rocks Member (60m thick) comprising fluviatile, very fine, pink argillaceous sandstones and an upper Tshipise Member consisting of (5 - 140 m) fine, yellow aeolian sand.

(viii) Letaba Formation dolerite sills and dykes often coincide with the final basalt lava stage of Karoo Sequence deposition. No basalt is preserved in the study area. The dolerite dykes in the study area have a predominant EW trend and secondary trends in NE, ENE and N-westerly directions.

Quaternary Deposits in the study area comprise the following:

(i) Mature alluvium consisting of alluvial sand pebbles and mud lenses within the flood plain attaining thicknesses in excess of 25m.

(ii) Immature alluvial gravels, sheet wash on the upper slopes of the Limpopo catchment area and between the hills.

Typical borehole logs are listed in Appendix I of the groundwater specialist report (Annexure E).

Mineralization

Three coal horizons have been delineated namely the Top, Middle and Bottom Coal Horizons. All three coal horizons are interbedded coal and clastic units with varying coal percentages. In terms of the SANS10320:2004 definition this deposit can be classified as a multiple seam deposit as within the coal horizons the coal thicknesses are generally greater than the clastic partings, and the interburden thickness are significantly greater than the thickness of the individual coal horizons. The Bottom Coal seam is consistently of the highest grade (coking coal). It is 3-4m thick and will be mined in both o/c and u/g workings. The Middle Coal seam will be mined only in the open cast operation.

Structure

The Central Zone of the LMB has been subjected to several episodes of deformation resulting in tight isoclinal folding and refolding of lithologies of variable orientation. Layering is generally vertical indicative of deformation caused by lateral compression. The general trend of lithologies in the study area is NE-SW but can vary across the full rotational spectrum in the vicinity of fold hinges.

The Karoo strata strike in a NE-SW direction with a very gentle dip to the NW of ± 2^0. Exploration drilling has delineated a down faulted triangular block (central graben) of approximately 760 ha and a throw of 80m in the east central portion of the deposit. See figure 2.1.1.1(b). This feature has a significant influence on the design of the mine necessitating the division of planned mining operations into 2 u/g and 2 o/c blocks. The bounding faults of the central graben block have the potential to transmit groundwater and river water into the workings.

South of the mining area are two major ENE trending faults, bisecting Erfrust and clipping the SE corner of Bergen op Zoom. See Figure 2.1.1.1(b). The two faults run semi-parallel and are probably associated with the major shear zones which delineate the Central Zone of the LMB. They may have played a role in the basin formation and preservation of the Karoo deposits. The water level data indicates shallow water levels and a steep gradient south of the fault and flatter gradients and deeper water levels north of the fault, indicative of deeper weathering and preservation of material north of the faults. These structures are water bearing and a number of high yielding boreholes have been developed by resident farmers.

Two interconnected faults of lesser strike length, striking NE and EW in the Karoo through to basement occur on the farm Overvlakte. See figure 2.1.1.1(b). The NE shear zone is water bearing as evidenced by a high yielding borehole drilled on Overvlakte Ptn 3 although the main strike is within the gneisses below the Karoo.

The study area exhibits two additional structural trends i.e. a NW-SE and a West-Easterly trend, the latter corresponding with dolerite dyke intrusions. See figure 2.1.1.1(b).

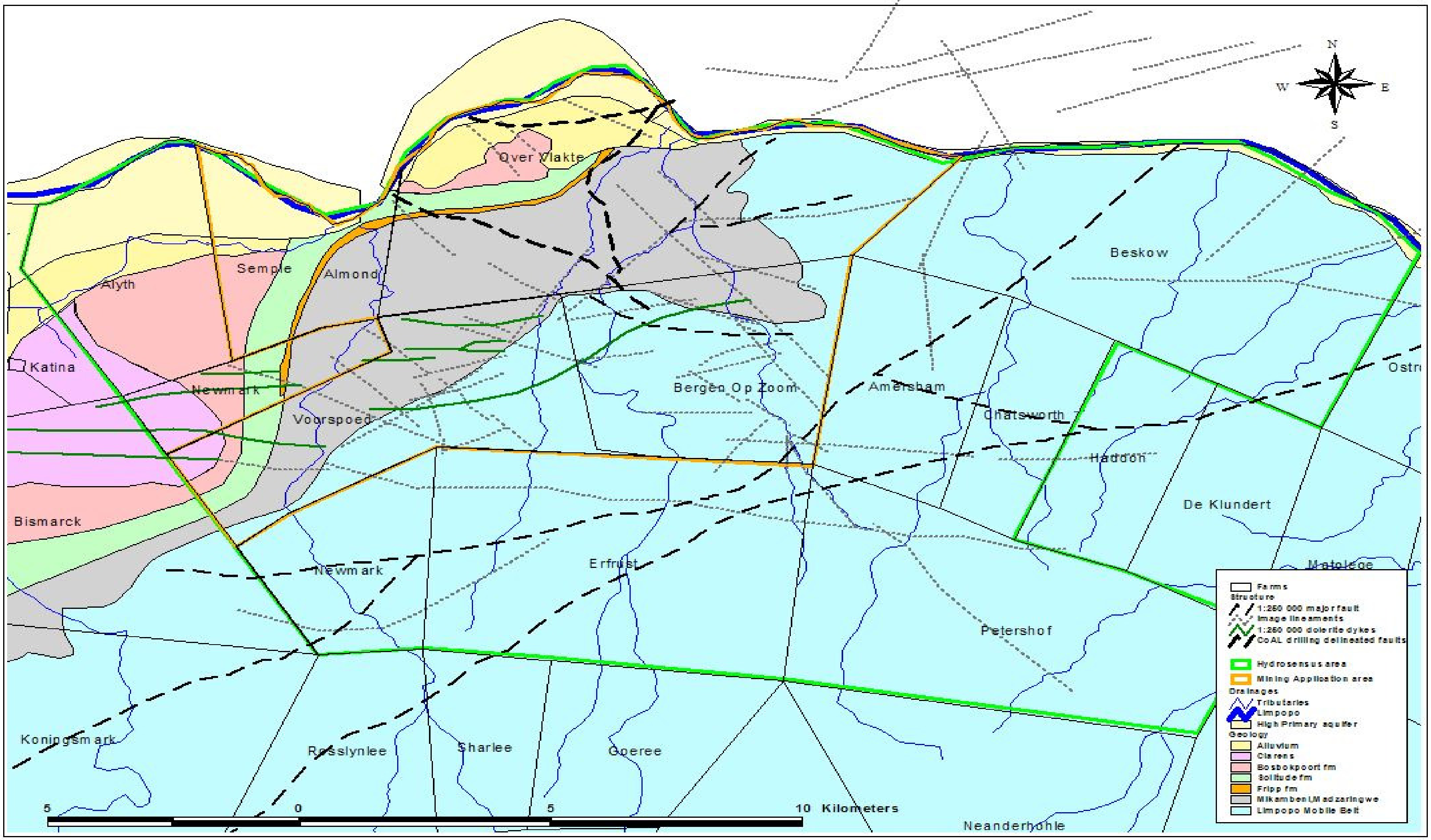


Figure 2.1.1.1(b): Geology of the study area

2.1.1.2 Climate

The climate of the Limpopo Basin varies spatially from being arid in the west through semi-arid and temperate areas in central zones to semi-arid in the east, with a few sub-humid pockets in the centre. Three wind systems have a strong influence on the basin's climate. These are the tropical cyclones from the Indian Ocean, the south-easterly wind systems that bring rainfalls from the Indian Ocean and the Inter-Tropical Convergence Zone (ITCZ), which in some years moves sufficiently far southwards to influence rainfall in the northern parts of the basin.

Air temperatures across the basin show a marked seasonal cycle, with highest temperatures recorded during the early summer months and lowest temperatures during the cool, dry winter months. Rainfall is also highly seasonal, falling predominantly as intense convective thunderstorms during the warmer summer months.

The severe droughts observed during the early 1990s and the exceptional floods during 2000 in the Limpopo valley illustrate the extreme variability of rainfall and runoff in the basin. This variation has significant effects on aquifer recharge.

The climate of the study area is semi-arid with a mean annual rainfall ranging from 285 and 440 mm (Figure 2.1.1.2(a)). Rainfall is highly variable and usually falls during the summer months. Extended periods of below average rainfall occur. There is on average 10 rainy days per year. Temperatures sometimes rise to 45℃ in summer. The winters are mild and frost occurs very seldom.

The mean annual rainfall of the study area is approximately 348 mm per annum. The mean annual rainfall for the Goeree (Dongolakop) weather station (0809/285 : 22° 15' S; 29° 40' E; 614 m amsl : 30 years) is 278 mm with a potential minimum of 154 mm during dry years and a potential maximum of 451 mm per annum during wet years.

The rainy season is predominantly from November to March when about 83% of the total annual rainfall occurs. The driest months are from May to September, when less than 7 mm of rain per month is recorded.

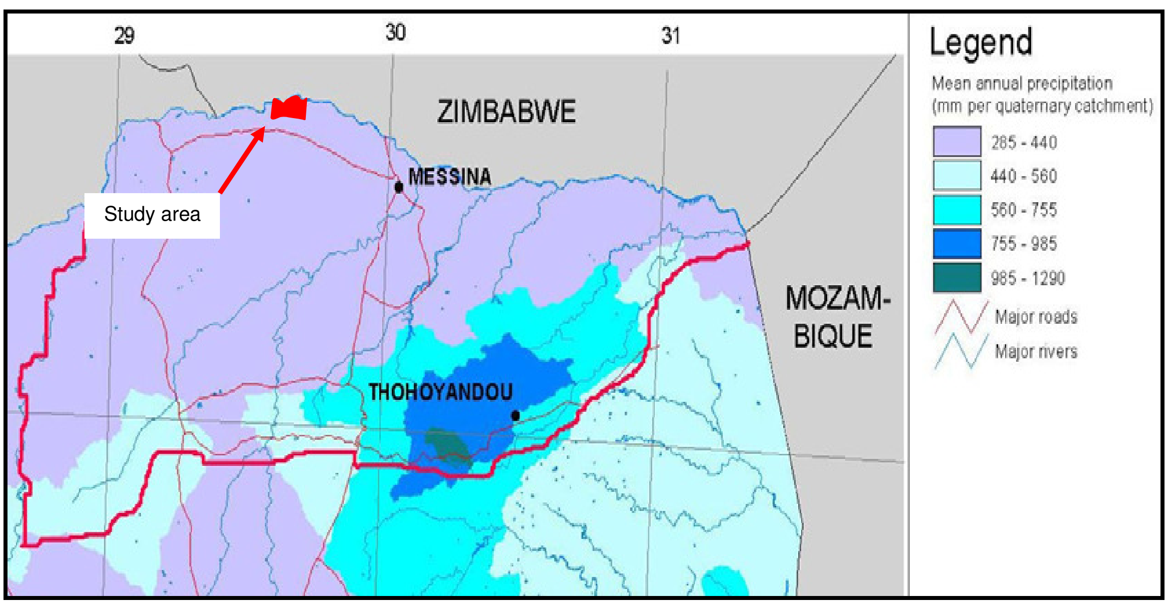


Figure 2.1.1.2(a): Mean annual precipitation in the study area

The minimum monthly mean temperature does not dip below 6℃, while the maximum mean temperature reaches a high of 33.4℃ in January. Note that even in the winter months, the mean daily maximum temperature is well above 20℃.

Meteorological data for the period January 2006 to June 2008 were obtained from the Unified Model data run by the South African Weather Service.

A period wind rose for the Vele site is presented in Figure 2.1.1.2(b). Wind roses comprise of 16 spokes which represent the directions from which winds blew during the period. The colours reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories.

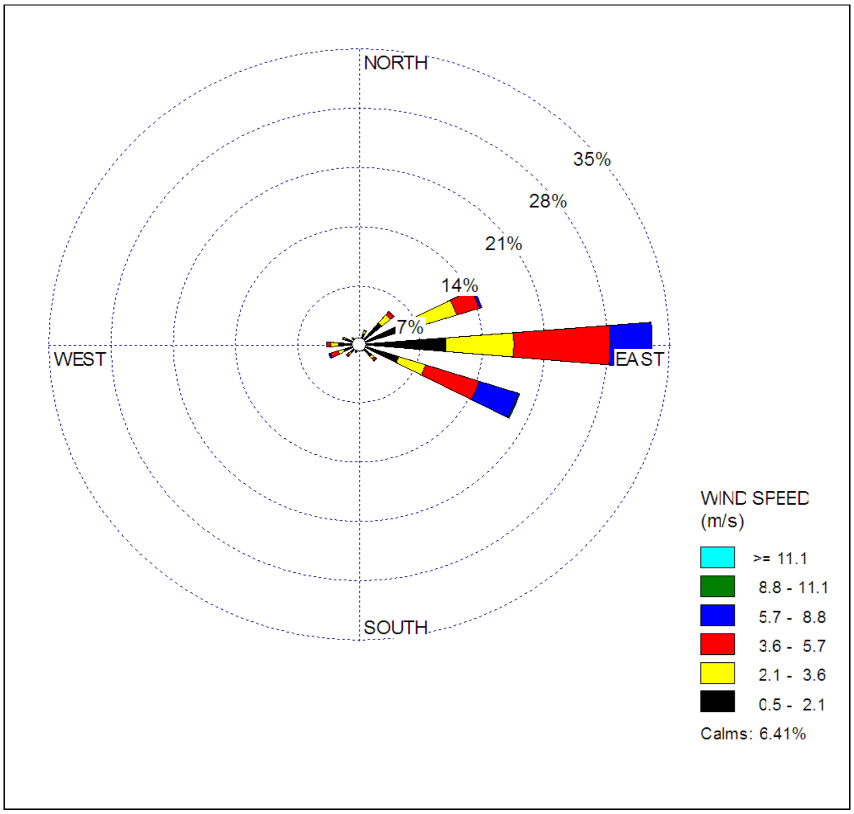


Figure 2.1.1.2(b): Period wind rose for the Vele site for the period 2006 to 2008

Looking at Figure 2.1.1.2(b) and Figure 2.1.1.2(c) (overleaf) respectively, it can be seen that Vele is not an area of high wind speeds on average. At the Vele site, 6.4% of the time, calm conditions existed over the area. The highest frequency of wind speeds lie between 0.5 to 2.1 m/s which occurred for 41.3% of the time. The second highest wind class (3.6 – 5.7 m/s) occurs 22.5% of the time. Figure 2.1.1.2(b) shows that the prevailing winds are from an easterly direction with a second weaker wind field from the south-east. This wind pattern is consistent with the wind fields following the major landforms in the area, in this case the Limpopo River Valley.

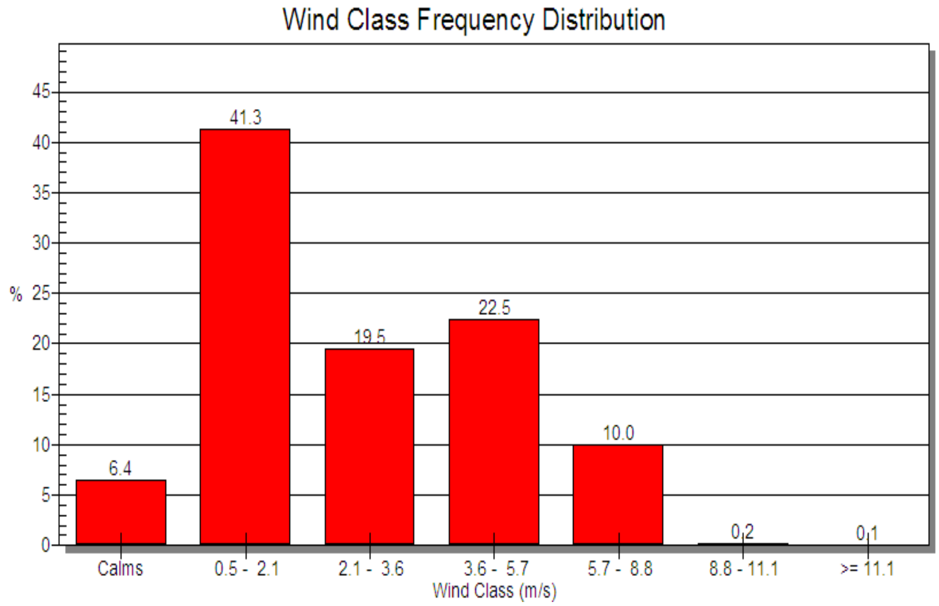


Figure 2.1.1.2(c): Wind class frequency distribution for period 2006 to 2008

Atmospheric stability is commonly categorised into six stability classes. These are briefly described in the table below. The atmospheric boundary layer is usually unstable during the day due to turbulence caused by the sun's heating effect on the earth's surface. The depth of this mixing layer depends mainly on the amount of solar radiation, increasing in size gradually from sunrise to reach a maximum at about 5-6 hours after sunrise. The degree of thermal turbulence is increased on clear warm days with light winds. During the night-time a stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral. From Figure 2.1.1.2(d) it can be seen that the site experiences very stable atmospheric conditions for the majority of the time with a 33% frequency of occurrence. This thus indicates an area with a poor dispersion potential.

ATMOSPHERIC STABILITY CLASSES		
A	Very unstable	calm wind, clear skies, hot daytime conditions
B	Moderately unstable	clear skies, daytime conditions
C	Unstable	moderate wind, slightly overcast daytime conditions
D	Neutral	high winds or cloudy days and nights
E	Stable	moderate wind, slightly overcast night-time conditions
F	Very stable	low winds, clear skies, cold night-time conditions

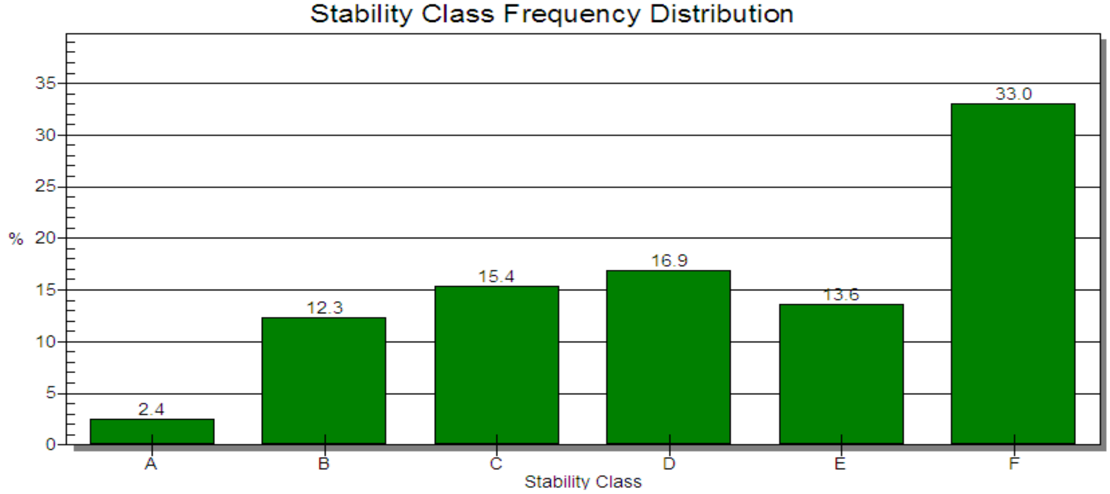


Figure 2.1.1.2(d): Stability Classes for the Vele Site

2.1.1.3 Topography

The Limpopo River valley area consists mostly of extremely irregular plains (Figure 2.1.1.3). The altitude of the study area range from 484 m amsl at the Limpopo River to 598 m amsl on the undulating terrain in the south-eastern areas of the farm Bergen op Zoom, an increase of 114m over a distance of almost 7 kilometres. The topography of the study area is fairly flat in the northern, western and central areas but undulating hills and rocky outcrops is typical of the north-eastern, eastern and south-eastern areas. The highest point in the area is Dongolakop in the south-western corner of the farm Petershof (to the southwest of the study area), measuring 896 m amsl.

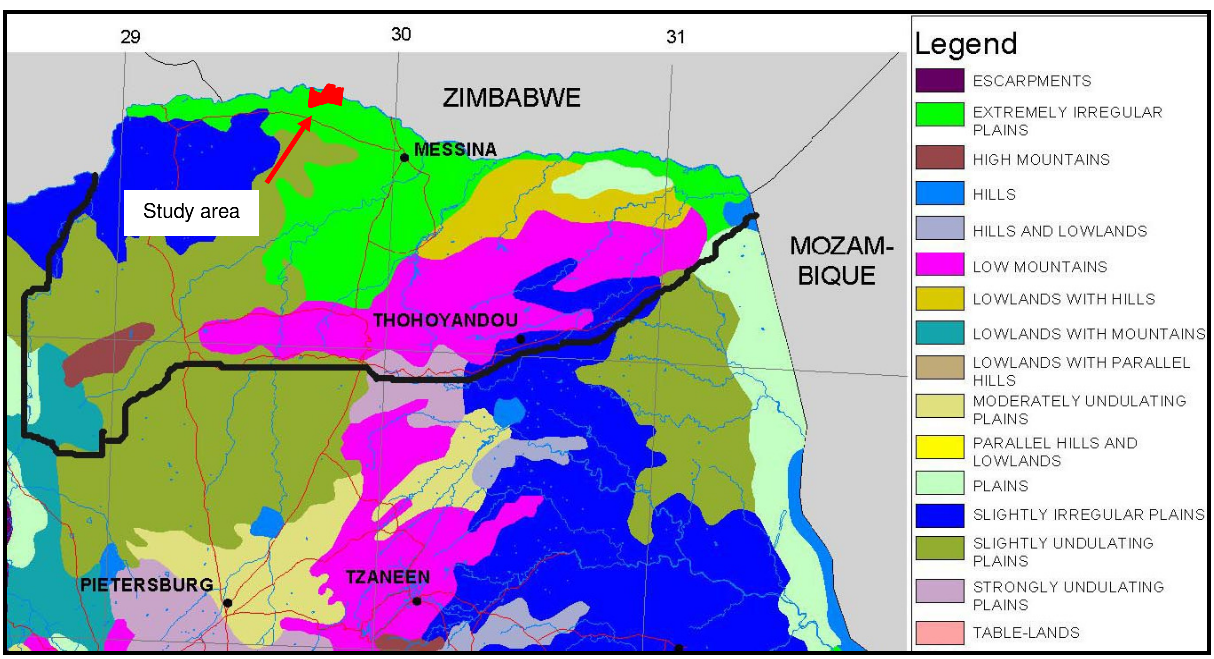


Figure 2.1.1.3: Topography of the study area

Five (5) broad landscape units can be identified in the study area:

- Soft undulating landscape with plains and isolated koppies towards the western, central and northern parts.
- Limpopo River valley and associated floodplains and larger drainage lines.
- Extremely irregular undulating rocky areas with koppies and hills with fairly steep slopes to the south-eastern parts.
- The sandveld plato and steep sandstone scarp to the east.
- The eroded valley bottom on the eastern border.

Deeper sandy soils are associated with the flat topography whilst shallow rocky soils are associated with the undulating hills and rocky outcrops. Existing agricultural activities are limited to the flat areas adjacent to the Limpopo River. Some of these areas are also associated with floodplains alongside the Limpopo River. Because of the irregular undulating rocky areas, fairly steep rocky slopes, shallow rocky nature of soils and intensity of rainfall (thunderstorms), the study area is very susceptible to water erosion, especially on roads and areas denuded of vegetation or with a poor herbaceous basal cover.

2.1.1.4 Soil (Red Earth, 2009 – Annexure B)

A soil survey (fieldwork) of the proposed Vele Colliery was carried out in three phases from 17 to 31 July, 21 August to 20 September, and 7 to 31 October 2008, by Mr BB McLeroth of Red Earth cc.

The objectives of this survey were to:

- Describe the soils (distribution, types, depth, surface features, wetness hazard and cultivation factors per horizon, suitability for agriculture and ‘topsoil’, physical and chemical characteristics, fertility, erodibility, dryland production potential and irrigation potential).
- Determine the pre-mining land capability.
- Determine the present land use.
- Identify the location of sensitive landscapes, to classify and delineate the wetlands into the permanent/semi-permanent, seasonal and temporary classes, as well as to identify riparian areas.

Parent material (geology or lithology) types encountered in the study area include (descending order of frequency):

- meta-sandstone and sandstone (highly dominant) which display occasional grit and pebble phases;
- carbonate (these hardpan carbonate and soft carbonate horizons are either associated with base rich parent material, or alternatively occur in slope positions of accumulation of bases);
- alluvium (recent);
- colluvium (or ancient weathered alluvial silt and clay deposits);
- gneiss;
- mudstone/shale;
- ferricrete; and
- dolerite (rare).

Soil structure ranges from apedal (rarely single grain) to weak blocky for the majority of topsoils and subsoils. However, the structured broad soil group displays moderate to strong blocky structure in the pedocutanic subsoils, while the vertic and prismacutanic broad soil groups display strong blocky structure in the topsoils and subsoils respectively.

All of the soils have a high base status (calcareous = extremely poorly leached; or eutrophic = very poorly leached), given the interaction of the low mean annual precipitation (approximately 348 mm), the high mean annual temperature, and the low to high base reserve of the parent materials in the area.

The pH of the majority of the soil forms (and thus broad soil groups) which occur in the survey area is problematic due to being too high (7.4-7.8: mildly alkaline; 7.9-8.4: moderately alkaline - majority; or 8.5-9.0: strongly alkaline). However, a limited number of broad soil groups (particularly red apedal/red structured, and yellow-brown apedal) display a pH which is ideal (6.6-7.3: neutral) to slightly acid (6.1-6.5: slightly acid – rarely).

SOIL FORM				TOTALS					
BROAD SOIL GROUP	MAP NOTATION	FORM	HORIZONS	GRID SURVEY		RECONNAISSANCE NORTH		RECONNAISSANCE SOUTH	
				ha	%	ha	%	ha	%
RED APEDAL / RED STRUCTURED	Hu	Hutton	orthic A/red apedal B	402.93	14.73	97.58	3.62	-	-
	Bv	Bainsvlei	orthic A/red apedal B/soft plinthic B	2.33	0.09	-	-		
	Li	Lichtenburg	orthic A/red apedal B/hard plinthic B	17.54	0.64	-	-		
	Sd	Shortlands	orthic A/red stuctured B	61.64	2.25	-	-		
YELLOW-BROWN APEDAL	Cv	Clovelly	orthic A/yellow-brown apedal B	27.82	1.02	1.41	0.05	-	-
STRUCTURED	Sw (Non-Alluvial)	Swartland	orthic A/pedocutanic B/saprolite	92.20	3.37	10.33	0.38	-	-
	Se (Alluvial)	Sepane	orthic A/pedocutanic B/unconsolidated wet	36.11	1.32	112.43	4.18		
	Va (Non-Alluvial)	Valsrivier	orthic A/pedocutanic B/unconsolidated non-wet	11.32	0.41	179.97	6.69		
NEOCUTANIC	Oa (Non-Alluvial / Alluvial)	Oakleaf	orthic A/neocutanic B	18.06	0.66	13.73	0.51	-	-
	Tu (Non-Alluvial / Alluvial)	Tukulu	orthic A/neocutanic B/unspecified wet	1.67	0.06	-	-		
CARBONATE (including all soils with neocarbonate, hardpan carbonate or soft carbonate horizons)	Ag (Non-Alluvial / Alluvial)	Augrabies	orthic A/neocarbonate B	371.58	13.58	1212.74	45.05	-	-
	Pr (Non-Alluvial / Alluvial)	Prieska	orthic A/neocarbonate B/hardpan carbonate horizon	210.35	7.69	302.54	11.24		
	Ad	Addo	orthic A/neocarbonate B/soft carbonate horizon	158.20	5.78	2.00	0.07		
	Py	Plooysburg	orthic A/red apedal B/hardpan carbonate horizon	108.19	3.95	0.95	0.04		
	Ky	Kimberley	orthic A/red apedal B/ soft carbonate horizon	54.27	1.98	1.01	0.04		
	Mu (Non-Alluvial / Alluvial)	Montagu	orthic A/neocarbonate B/unspecified wet	64.54	2.36	73.46	2.73		
	Br	Brandvlei	orthic A/soft carbonate horizon	135.75	4.96	7.02	0.26		
	Cg	Coega	orthic A/hardpan carbonate horizon	28.42	1.04	6.18	0.23		
SHALLOW	Ms	Mispah	orthic A/hard rock	681.98	24.92	367.19	13.64	-	-
	Gs	Glenrosa	orthic A/lithocutanic B	98.14	3.59	250.39	9.30		
ALLUVIAL	Du	Dundee	orthic A/stratified alluvium	60.28	2.20	27.39	1.02	-	-
	Fw	Fernwood	orthic A/ E horizon	1.70	0.06	-	-		
HYDROMORPHIC	We	Westleigh	orthic A/soft plinthic B	9.50	0.35	3.87	0.14	-	-
	Kd	Kroonstad	orthic A/ E horizon/ G horizon	2.21	0.08	-	-		
	Ka	Katspruit	orthic A/ G horizon	0.16	0.01	0.06	0.00		
DUPLEX	Ss	Sterkspruit	orthic A/prismacutanic B	1.33	0.05	-	-	-	-
VERTIC	Ar	Arcadia	vertic A/ unspecified	0.67	0.02	-	-	-	-
	Rg	Rensburg	vertic A/G horizon	5.21	0.19	-	-		
UNDIFFERENTIATED (various Broad Soil Groups and Soil Forms)				-	-	-	-	2997.06	98.79
River	River			24.96	0.91	6.78	0.25	23.65	0.78
Stream	Stream			9.00	0.33	1.05	0.04	6.05	0.20
Drain				2.17	0.08	-	-	-	-
Dam				30.54	1.12	4.61	0.17	2.18	0.07
Depression				0.87	0.03	-	-	-	-
Pond				0.04	0.00	3.54	0.13	-	-
Wall				1.69	0.06	2.62	0.10	0.15	0.00
Bank				0.29	0.01	-	-	-	-
X2 and X3 (Excavations)				1.24	0.05	1.05	0.04	-	-
Dirt Road				1.39	0.05	1.97	0.07	4.67	0.15
			TOTALS	2736.29ha	100%	2691.87ha	100%	3033.76ha	100%

2.1.1.5 Pre-mining land capability (Red Earth, 2009 – Annexure B)

Land capability classes were determined using the guidelines outlined in The Chamber of Mines Handbook of Guidelines for Environmental Protection (Volume 3, 1981), a summary of which is given below.

PRE-MINING LAND CAPABILITY REQUIREMENTS

Criteria for Wetland

- Land with organic soils or
- A horizon that is gleyed throughout more than 50 % of its volume and is significantly thick, occurring within 750mm of the surface.

{*Note: The DWAF definition (DWAF. Edition 1, September 2005) has now superceded this definition, and instead considers a wetland to occur if the soil wetness indicator occurs within 500mm of the surface. Exceptions are the Champagne, Rensburg, Katspruit and Willowbrook forms which may be of any depth. The topsoils of the former two forms are frequently deeper than 500mm*}

Criteria for Arable Land

- Land, which does not qualify as a wetland
- The soil is readily permeable to the roots of common cultivated plants to a depth of 750mm
- The soil has a pH value of between 4.0 and 8.4
- The soil has a low salinity and SAR
- The soil has a permeability of at least 1.5mm per hour in the upper 500 mm of soil
- The soil has less than 10 % (by volume) rocks or pedocrete fragments larger than 100mm in diameter in the upper 750mm
- Has a slope (in %) and erodibility factor (K) such that their product is <2.0
- Occurs under a climatic regime, which facilitates crop yields that are at least equal to the current national average for these crops, or is currently being irrigated successfully

Criteria for Grazing Land

- Land, which does not qualify as wetland or arable land
- Has soil, or soil-like material, permeable to roots of native plants, that is more than 250mm thick and contains less than 50 % by volume of rocks or pedocrete fragments larger than 100mm
- Supports, or is capable of supporting, a stand of native or introduced grass species, or other forage plants, utilizable by domesticated livestock or game animals on a commercial basis

Criteria for Wilderness Land

- Land, which does not qualify as wetland, arable land or grazing land.

The pre-mining land capability of the proposed mining areas is shown on Map 4 of the specialist report (Annexure B) and can be summarised as follows (Red Earth, 2009):

MAP NOTATION	CAPABILITY CLASS	TOTALS					
		GRID SURVEY		RECONNAISSANCE NORTH		RECONNAISSANCE SOUTH	
		ha	%	ha	%	ha	%
Wp	WETLAND (Permanent) (soil form: Rg, Ka) : I	5.37	0.20	0.06	0.00	-	-
Ws	WETLAND (Seasonal) (soil form: We, Kd, Depression) : I	12.58	0.46	3.87	0.14	-	-
Riparian	RIPARIAN (rivers and streams) These areas may also be classified as permanent wetlands.	33.96	1.24	7.83	0.29	29.70	0.98
Riparian 2	RIPARIAN (soil form: Du, Fw) Alluvial soils on the edge of the rivers and streams.	60.26	2.20	23.19	0.86	-	-
Riparian G	RIPARIAN (soil form: Ag, Oa) Not suitable for cultivation.	47.87	1.75	80.86	3.00	-	-
Riparian G-A2	RIPARIAN (soil form: Ag) Suitable for cultivation. Alluvial soils in the original riverine bush area, which has frequently been removed for cultivation.	17.10	0.62	293.25	10.89	-	-
A1	ARABLE 1 (pH <8.4) : II	396.07	14.47	69.64	2.59	-	-
A1-G	ARABLE 1 (pH <8.4) : II	47.79	1.75	-	-	-	-
A1/G	ARABLE 1 (pH <8.4) : II	1.88	0.07	-	-	-	-
G-A2	GRAZING - ARABLE 2 (pH >8.4): III Intensive management is required for cultivation purposes due to the pH (> 8.4 for approximately half of these areas). Also applies to Riparian G-A2.	551.88	20.17	1247.71	46.35	-	-
G-A1	GRAZING : III	17.28	0.63	14.70	0.55	-	-
G	GRAZING : III	435.83	15.93	110.73	4.11	-	-
G/L	GRAZING : III	10.15	0.37	138.63	5.15	-	-
G-L	GRAZING : III	110.75	4.05	149.80	5.56	-	-
L-G	WILDERNESS (Natural) : IV	6.08	0.22	-	-	-	-
L	WILDERNESS (Natural) : IV	944.08	34.50	537.81	19.98	-	-
Drain	WILDERNESS (Man-made) : IV	2.17	0.08	-	-	-	-
Dam	WILDERNESS (Man-made) : IV	30.54	1.12	4.61	0.17	2.18	0.07
Pond	WILDERNESS (Man-made) : IV	0.04	0.00	3.54	0.13	-	-
Wall	WILDERNESS (Man-made) : IV	1.69	0.06	2.62	0.10	0.15	0.00
Bank	WILDERNESS (Man-made) : IV	0.29	0.01	-	-	-	-
Excavations	WILDERNESS (Man-made) : IV	1.24	0.05	1.05	0.04	-	-
Dirt Road	WILDERNESS (Man-made) : IV	1.39	0.05	1.97	0.07	4.67	0.15
Not Differentiated		-	-	-	-	2997.06	98.79
TOTALS		2736.29ha	100%	2691.87ha	100%	3033.76ha	100%

2.1.1.6 *Existing land use (Red Earth, 2009 – Annexure B)*

The existing land uses in the area are:

- Residential: There are numerous farmhouses and farm labourer houses scattered throughout the study area.
- Educational:
  - Farm school on the farm Overvlakte 125 MS.
  - Conference facilities at Dongola Ranch (on the farm Erfrus).
- Mining: There is an open cast coal mine in Zimbabwe just north of the farm Overvlakte 125MS.
- Tourism:
  - Dongola Ranch.
  - Mapungubwe National Park and World Heritage Site is situated approximately 5.4km to the west of the proposed mining area (most eastern boundary).
  - There are several game lodges in the area.
  - Much of the area westwards of the colliery development area, together with areas in Botswana and Zimbabwe is part of the proposed Limpopo/Shashe Transfrontier Conservation Area (TFCA).
  - The Limpopo Valley Game Reserve is just to the south of Route R572.
  - Two farms in Zimbabwe immediately to the north of the development site are also likely to be part of the proposed Limpopo/Shashe Transfrontier Conservation Area.
- Farming:
  - Most of the farms fronting onto the Limpopo River are being actively farmed (agriculture). This is on the South African as well as on the Zimbabwean sides of the river.
  - There are several game farms in the area.

The majority of the survey area is comprised of Mopani veld (Acocks veld type 15). However, limited areas (majority cleared) of riverine forest occur on the levee close to the Limpopo River. On Bergen Op Zoom and Voorspoed, the Mopani veld areas are presently utilized for game farming. Although game farming was previously practiced in the remaining Mopani veld areas (Overvlakte and Semple), the game which currently inhabit these areas are for the farmers own use. However, cattle ranching were previously practiced in these areas in the past (till the late 1970's).

Dryland production is not suitable (crop failure and low yields) in the area, due to the following factors: low mean annual precipitation (approximately 348 mm); high A-pan evaporation rate; high mean annual temperature; long dry season; occasionally moderately saline subsoils (highly calcareous mudstone derived variants of the structured and carbonate broad soil groups only); and occasionally marginally non-sodic subsoils (previously mentioned soils only).

Commercial agricultural enterprises have been established on the majority of the 'very gently sloping zone' on Overvlakte and Semple. These areas are irrigated with water derived from screened sand points (i.e. boreholes) which are located in the Limpopo River bed, this water being stored in dams and ponds. A high level of farming/irrigation planning and management has been required in order to successfully cultivate the soils in the area, this being due to both the moderate to high salinity levels of the soils which naturally occur in the area, as well as the generally moderate to poor quality (relative salinity level of the Limpopo River is determined by the time of the year) [for irrigation purposes] water which is available.

Agricultural produce includes citrus (predominantly oranges, but also grapefruit), wheat, cotton, maize (occasionally), seed maize (occasionally), onions, butternut, tomatoes and spanspek. Furthermore, a wide variety of fresh produce is grown for Woolworths on portion 13 of Overvlakte. Four previously cultivated areas are present on Bergen Op Zoom.

Evidence of misuse

The riparian capability class units are comprised of deep fine sandy-loam textured carbonate broad soil groups of alluvial origin. These units occupy the original riparian vegetation zone (mostly felled for cultivation) on the floodplain of the Limpopo River. The natural vegetation which once occurred in the limited areas of hydromorphic and vertic soils (wetland capability class areas) has unfortunately been largely transformed by man.

The majority of the Mopani veld areas are heavily overgrazed, and particularly so on Overvlakte and Semple. Sheet, rill and gully erosion is evident in many of these areas, the worst erosion occurring on the highly calcareous variants of the carbonate, structured, duplex and shallow broad soil groups. Nevertheless, soil erosion is present on the majority of the broad soil groups, and particularly so when slopes of approximately 4 degrees are exceeded. Grass cover was completely absent in many areas at the time of the soil survey. In the region, a reasonable grass basal cover is vital at the end of the dry season. This is necessary in order to protect the soils from raindrop action, since intense thunderstorms occur in the rainy season.

Salinization (as a result of agricultural practices) has occurred in three separate areas in footslope positions. All of these soils have an alluvial origin. The affected patches occur in the following property portions: Overvlakte portion 13 (Montagu soil form to the east of the dry river bed); Overvlakte portion 4 (Augrabies and Montagu forms to the south-west, south and south-east of the farmyard); and Semple (Westleigh, Kroonstad and Katspruit soil forms in the drainage line area to the west of the workshop). Drains have been excavated on the latter two property portions in an attempt to remedy the situation.

MAP NOTATION		TOTALS					
		GRID SURVEY		RECONNAISSANCE NORTH		RECONNAISSANCE SOUTH	
		ha	%	ha	%	ha	%
C	Cultivated (last season)	218.00	7.97	137.27	5.10	-	-
Cp	Cultivated (previously)	22.28	0.81	458.09	17.02	50.83	1.68
	Cultivation Roads	57.83	2.11	82.32	3.06	-	-
	Vegetables	-	-	159.55	5.93	-	-
	Citrus	295.97	10.82	363.68	9.80	-	-
	Mangos	-	-	0.97	0.04	-	-
	Palms	-	-	9.67	0.36	-	-
	Foilage	-	-	0.90	0.03	-	-
Gp	Pasture	2.01	0.07	0.19	0.01	-	-
	Field	1.77	0.06	4.66	0.17	-	-
	Open	3.34	0.12	31.31	1.16	-	-
Tb	Trees (bamboo)	0.11	0.00	0.11	0.00	-	-
Tw	Trees (windbreak)	3.22	0.12	0.72	0.03	-	-
B/G	Indigenous Bush / Grassland mix (mostly Mopani)	1969.43	71.97	1246.25	46.30	2945.33	97.09
Br	Indigenous Bush (riverine)	16.95	0.62	124.91	4.64	-	-
Bd	Indigenous Bush (degraded)	26.25	0.96	118.92	4.42	-	-
	Homestead	2.67	0.10	7.57	0.28	0.79	0.03
	Farmyard	3.50	0.13	2.96	0.11	-	-
	Compound (labour housing)	7.22	0.26	11.60	0.43	-	-
B	Buildings (not indicated in homesteads/compounds)	1.25	0.05	1.25	0.05	0.04	0.00
	Airstrip	-	-	5.43	0.20	-	-
W	Wetlands (without a man-made landuse)	3.41	0.12	1.77	0.07	-	-
	Dam (new - including excavated site and wall)	28.99	1.06	-	-	-	-
	Reservior	0.00	0.00	0.06	0.00	0.05	0.00
	River	24.96	0.91	6.78	0.25	23.65	0.78
	Stream	9.00	0.33	1.05	0.04	6.05	0.20
	Drain	2.17	0.08	-	-	-	-
	Dam	30.54	1.12	4.61	0.17	2.18	0.07
	Depression	0.87	0.03	-	-	-	-
	Pond	0.04	0.00	3.54	0.13	-	-
	Wall	1.69	0.06	2.62	0.10	0.15	0.00
	Bank	0.29	0.01	-	-	-	-
	Excavtion (X2 and X3)	1.24	0.05	1.05	0.04	-	-
	Dirt Road	1.39	0.05	1.97	0.07	4.67	0.15
TOTALS		2736.29ha	100%	2691.87ha	100%	3033.76ha	100%

2.1.1.7 Natural vegetation / plant life (Dubel, 2009 – Annexure C)

Biome

A biome is a broad ecological unit that represents a major life zone extending over a large natural area (Rutherford & Westfall 1994). It is the largest land community unit recognised at a continental or subcontinental level and mappable at a scale no larger than about 1:10 million (Rutherford & Westfall 1994).

The vegetation of the study area belongs to the broad vegetation group the Savannah Biome (*Low and Rebelo 1996)*. The Savannah Biome is the largest Biome in Southern Africa, occupying 46% of its area, and over one-third the area of South Africa. It is well developed over the Lowveld and Kalahari region of South Africa and is also the dominant vegetation in Botswana, Namibia and Zimbabwe. A grassy ground layer and a distinct upper layer of woody plants (trees and shrubs) is characteristic of the Savannah Biome. Where this upper layer is near the ground (low growing) the vegetation may be referred to as Shrubveld, where it is tall and dense, as Woodland, and the intermediate stages are locally known as Bushveld.

The environmental factors delimiting the biome are complex and include (*Low and Rebelo 1996)*:

- altitude ranges from sea level to 2 000 m;
- rainfall varies from 235 to 1 000 mm per year;
- frost may occur from 0 to 120 days per year; and
- almost every major geological and soil type occurs within the biome.

A major factor delimiting the biome is the lack of sufficient rainfall, which prevents the upper (tree and shrub) layer from dominating, coupled with fires and grazing, which keep the grass layer dominant. Summer rainfall is essential for the grass dominance, which, with its fine material, fuels near-annual fires. In fact, almost all species are adapted to survive fires, usually with less than 10% of plants, both in the grass and tree layer, killed by fire. Even with severe burning, most species can resprout from the stem bases (*Low and Rebelo 1996)*.

The shrub-tree layer may vary from 1 to 20m in height, but in Bushveld typically varies from 3 to 7m. Soil depth is one of the critical factors that determine tree high in the biome. The shrub-tree element may come to dominate the vegetation through bush encroachment in areas that are being overgrazed (Low and Rebelo 1996).

Most of the savannah vegetation types are used for grazing, mainly by cattle or game. In the southernmost savannah types, goats are the major stock. In some types crops and subtropical fruit are cultivated. These mainly include the Clay Thorn Bushveld (14), parts of Mixed Bushveld (18), and Sweet Lowveld Bushveld (21). Urbanization is not a problem, perhaps because the hot, relatively moist climate and diseases (sleeping sickness, malaria) hindered urban development in the past.

Representation of the savannah biome in conservation areas in South Africa is good in principle, mainly due to the presence of the Kruger- and Kalahari Gemsbok National Parks within the biome. However, the large areas conserved in South Africa, belies the fact that half of savannah vegetation types are inadequately conserved, in having less than 5% of their area in reserves. However, much of the area is used for game farming and can thus be considered effectively preserved, provided that sustainable stocking rates and sound environmental practises are maintained. The importance of tourism and big game hunting in the conservation of the area must also not be underestimated.

Veld types / Vegetation types

According to Acocks=s (1988) classification of the vegetation of South Africa, the study area falls within one recognised veld types, namely Veld Type 15 - Mopane Veld. According to the classification of Low and Rebelo (1996), there is also only one veld type present, namely Veld Type 10 – Mopane Bushveld. According to Mucina & Rutherford (2006), the study area is situated in the Musina Mopane Veld, the Limpopo Ridge Bushveld and the Subtropical Alluvial Vegetation alongside the Limpopo River. The latter vegetation type is severely modified and degraded because of agricultural practices and the security fence alongside the Limpopo River. The rocky outcrops and koppies occurring throughout the study area also fall in the Limpopo Ridge Bushveld. All of these veld types are described below.

The bulk of the proposed mining site forms part of a much broader landscape (Savanna Biome, Veldtypes Musina Mopane Bushveld and Limpopo Ridge Bushveld (Mucina and Rutherford, 2005)), and fringes along the Subtropical Alluvial Vegetation (riverine) of the Limpopo. Much of the riverine landscape, both within the proposed mining area and elsewhere, has been destroyed or altered, particularly through the establishment of crop farming – any remaining pristine habitat assumes a new and increased significance (Braack 2009). The frequent, high volume use of pesticides in these areas is also significant. Similarly, inherent abiotic factors (thus survival factors) within the mopane and ridge Bushveld (such as soil temperature and moisture properties) have been significantly altered in many parts of these veldtypes through veld-mismanagement and overgrazing (Braack 2009).

Mopane Bushveld (Low and Rebelo 1996)

Man has transformed approximately 8% of the veld type, opposed to the 38.29% that has been conserved. In South Africa, it is fairly well conserved in the Kruger National Park and Mapungubwe National Park, and many Provincial Nature Reserves such as Messina, Nwanedi, Makuya, Letaba Ranch and Hans Merensky, as well as private conservation areas and game farms. Effectiveness of conservation of veld in the private conservation areas is however determined by the level of ecologically sound management that is applied. This is questionable in many of the above mentioned conservation areas, and the amount of conservation areas mentioned by authors creates a false picture of an area well conserved, while the real conservation status is most probably much lower.

The Mopane Bushveld can mostly be found on sandy, loamy to rocky soils derived mostly from gneiss. The altitude ranges from 300-700m above sea level. The annual rainfall is low and erratic varying between 250-500 mm. Very high summer temperatures occur and temperatures range from 1.5-42.5^{0}C, with an average of 22^{0}C. Therefore evaporation rates are very high. Frost occurs very seldom and is, for all practical considerations, regarded as absent with no influence on the vegetation.

The tree layer is characterized by dense growth of *Colophospermum mopane* (Mopane), and mixtures of mopane and *Combretum apiculatum* (Red Bushwillow), *Acacia nigrescens* (Knobthorn), *Adansonia digitata* (Baobab), *Commiphora* spp. (Corkwood spp.), *Boscia albitrunca* (Shepherd's Tree), *Kirkia acuminata* (White Seringa), *Grewia* spp (Raisin bush spp.) and *Acacia tortilis* (Umbrella Thorn).

The shrub layer is moderately developed and individuals of *Grewia* spp., *Ochna inermis* (Stunted Plane), *Sterculia rogersii* (Common Star-Chestnut) and *Dichrostachys cinerea* (Sickle Bush).

The grass layer is poorly developed, with grasses such as *Enneapogon cenchroides* (Nine-awned Grass), *Cenchrus ciliaris* (Blue Buffalo Grass), *Stipagrostis uniplumis* (Silky Bushman Grass), *Aristida congesta* (Tassel Three-awn) and *Schmidtia pappophoroides* (Sand Quick). *A. congesta, E. cenchroides* and herbs are common in overgrazed and degraded areas.

Rainfall and especially grazing have always been important driving forces in this vegetation type, and certain changes in the vegetation composition and structure can be expected if these driving forces change.

The position in the landscape (crest, scarp, mid slope, valley floor) generally strongly influences the qualities of the soil and therefore the characteristics of the vegetation as well as the species composition thereof.

Currently the most common economic uses for this veld type are game and cattle farming, and ecotourism. In the study site, especially along the Limpopo River, agriculture (citrus, cotton etc.) is the most important land use.

Musina Mopane Veld (Mucina and Rutherford, 2006)

The Musina Mopane Veld is characterized by undulating to very irregular plains with some hills, at an altitude of around 600m. On areas with deep sandy soils, the white seringa (*Kirkia acuminata)* is one of the dominant tree species along with *C. mopane* (Mopane), *C. apiculatum* (Red Bushwillow) and *Grewia* spp. (Raisin bushes). The herbaceous layer is poorly developed, especially where mopane occurs in dense stands. This vegetation type is classified as "Least threatened" with 2% statutorily conserved in the Mapungubwe National Park, as well as the Nwanedi, Musina and Honnet Nature Reserves to the east. About 3% is transformed, mainly by cultivation, and soil erosion is moderate to high.

The geology consists mainly of gneisses and meta-sediments of the Beit Bridge Complex, with variable soils from deep red/brown clays to deep, freely drained sandy soils, to shallower types including skeletal Glenrosa and Mispah soil forms. The mean annual precipitation varies between 300 – 400 mm and the area is generally frost-free.

Important taxa include trees such as *C. mopane* (Mopane*), A. digitata* (Baobab*), A. nigrescens* (Knobthorn)*, C. apiculatum* (Red Bushwillow)*, A. senegal* var. *leiorhachis* (Slender Three-hook Thorn) and *Commiphora mollis* (Velvet Corkwood). Conspicuous small trees and shrubs include *G. bicolor* (White Raisin*)*, *G. flava* (Velvet Raisin)*, B. foetida* subsp. *rehmanniana* (Stink Shepherd's tree) and *T. prunioides* (Lowveld Cluster-leaf). The grass layer is characterized by *Aristida* spp. (Three-awn grasses), *S. uniplumis* (Silky Bushman grass)*, S. pappophoroides* (Sand Quick), *B. deflexa* (False Signal grass), *E. cenchroides* (Nine-awned grass) and *U. mosambicensis* (Bushveld Signal grass).

Limpopo Ridge Bushveld (Mucina and Rutherford, 2006)

This vegetation type covers the irregular hills and ridges of much of the area in the vicinity of the Limpopo River. The altitude varies from 300 m to 700 m in the east, with some hills reaching 1 000 m in the west. The vegetation structure is moderately open savannah with a poorly developed ground layer. *K. acuminata* (White Seringa) is prominent on many of the ridges along with *A. digitata* (Baobab). On shallow calcareous gravel and calc-silicate soils, the shrub *Catophractes alexandri* is dominant. Areas of sandstone of the Clarens Formation are prominent in places such as Mapungubwe National Park. Although not as prominent as at Mapungubwe National Park, sandstone ridges also occur in the study area.

The mean annual precipitation varies from 300 – 400 mm and the area is generally frost-free. Important plant species include the *A. digitata* (Baobab), *S. birrea* (Marula), *C. mopane* (Mopane), *C. glandulosa* (Tall Common Corkwood), *T. prunioides* (Lowveld Cluster-leaf), *B. albitrunca* (Shepherd's tree) and various figs, e.g. *F. tettensis*.

This vegetation type is classified as "Least Threatened", with some 18% statutorily conserved in the Kruger and Mapungubwe National Parks. Only about 1% is transformed, mainly by cultivation and mining.

Limpopo Riverine and floodplain vegetation (Subtropical Alluvial Vegetation)

From an ecosystem and conservation point of view, the riparian fringe and associated floodplains of the Limpopo River is of critical importance. It is normally a dense vegetation community with a closed canopy that occurs in the rich alluvial deposits along the river.

The most prominent trees in this community are *A. xanthophloea* (Fever tree), *F. albida* (Ana tree), *C. imberbe* (Leadwood), *X. zambesiaca* (Nyala tree), *F. sycomorus* (Common Cluster fig), *P. violacea* (Apple-leaf = *L. capassa*) and *C. megalobothrys* (Large Fever-berry). The Limpopo floodplain has allowed some trees to grow to massive sizes such as Nyala and Ana trees in particular.

Floodplains alongside the Limpopo River area are characterised by *Salvadora australis* bush clumps (Narrow-leaved Mustard tree), *A. tortillis* (Umbrella Thorn), *A. xanthophloea* (Fever tree), *Hyphaene coriacea* (Ilala Palm), *Balanites pedicillaris* (Small Green Thorn), *A. stuhlmannii* (Vlei Thorn), *Phaeoptilum spinosum* (Brittle-Thorn), *A. nebrownii* (Water Thorn) and *Acacia borleae* (Sticky Thorn).

The Limpopo River riparian forest and associated plant communities have been under severe pressure since 1978 (De Beer, 2006). Extensive patches of this vegetation have been cleared for cultivation, security and veterinary purposes along the length of the Limpopo River.

Elephants also had, and still have, a significant impact on the riparian and floodplain vegetation in the region. Elephants are steadily destroying closed canopy forest and the density of trees is declining drastically, even in formally protected areas. The canopy has started opening with an increase in the creeper component such as *Combretum microphyllum* (De Beer, 2006).

Riparian vegetation, with associated closed canopy forests and floodplains, is regarded as sensitive and threatened habitats and ecosystems. These ecosystems are being destroyed, either by human interference or a lack thereof, or other natural components of the ecosystem. Degradation of these ecosystems can result in for instance a loss in biodiversity (species and numbers), degradation of the functioning of the river, forest and floodplain systems, a loss in habitat suitability for many faunal and floral species, an increase in soil erosion, and a decrease in water quality.

Vegetation communities

Different plant communities develop as a result of differences in geology, topography, rockiness, drainage, soil texture, soil depth, slope, and historic management. Each plant community usually represents a different habitat, has its own inherent grazing and browsing capacity and represents a specific habitat for certain types of fauna species.

The study area is dominated by tree and shrub forms of *C. mopane*, *T. prunoides*, *Commiphora, Grewia* species and the grasses *A. congesta, E. cenchroides* and *B. deflexa*. A large portion of the study area, adjacent to the Limpopo River, has totally been transformed through agricultural practises.

The diversity of plant species of the study area are summarised in Table 2.1.1.7(a) and a plant species list, as compiled during surveys conducted by Dubel, is included in the specialist report (Annexure C). This is not a comprehensive list because the survey period was limited to one season; however, the information was supplemented with other studies on adjacent farms as provided in Table 2.1.1.7.

Table 2.1.1.7(a): Plant species diversity (amount of species)

<table>
<tr><th></th><th>Dubel
2009</th><th>Van Rooyen
2008</th><th>Van der Walt
2008</th></tr>
<tr><td>Trees</td><td>43</td><td>36</td><td rowspan="2">66</td></tr>
<tr><td>Shrubs</td><td>26</td><td>23</td></tr>
<tr><td>Grasses</td><td>47</td><td>36</td><td>36</td></tr>
<tr><td>Liana</td><td>3</td><td>3</td><td>1</td></tr>
<tr><td>Palm</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Dwarf shrubs</td><td>3</td><td>4</td><td rowspan="6">314
{large area: from Pontdrift (west) to Malaladrift (east) and from the northern most point of the Limpopo River (north) to approximately 22 30' in the south}</td></tr>
<tr><td>Climbers</td><td>4</td><td>4</td></tr>
<tr><td>Forbs</td><td>23</td><td>47</td></tr>
<tr><td>Succulents</td><td>6</td><td>4</td></tr>
<tr><td>Geophytes</td><td></td><td>2</td></tr>
<tr><td>Sedges</td><td>4</td><td>4</td></tr>
<tr><td>Total</td><td>160</td><td>164</td><td>418</td></tr>
</table>

Of these 18 species have medicinal properties and 9 species have poisonous properties (mostly poisonous for cattle and sheep).

Protected species

Table 2.1.1.7(b) provides a summary of all listed protected species. A high diversity of protected species (22), occur in and adjacent to the study area. Twelve (12) of these species are known and have been confirmed to occur in the study area.

Table 2.1.1.7(b): Protected vegetation species

NAME	SPECIES IN STUDY AREA	SPECIES IN REGION/ADJACENT FARMS
Aloe littoralis (Sa)	12	
Apple-leaf (Sa)		
Baobab (Sa)		
Devil's Claw (Sa)		
Hoodia corrorii subsp. *Lugardii* (Sa)		
Impala lily (Sa)		
Leadwood (Sa)		
Marula (Sa)		
Peristrophe cliffordii (Sa)		
Peristrophe gillilandiorum (Sa)		
Shepherd's tree (Sa)		
Stapelia spp (all species) (Sa)		
Barleria holubii (R)		10
Hibiscus waterbergensis (R)		
Huernia (R) – adjacent farms		
Orbea (R) – adjacent farms		
Orbea maculate ssp. maculate (R)		
Otholobium polyphyllum (R)		
Plinthus rehmanni (R)		
Psoralea repens (R)		
Tavaresia spp (all species) (R)		
Torchwood (R)		

During the surveys of 2008 and 2009, Dubel distinguished the following landscape-vegetation communities in the study area – also refer to Figure 2.1.1.7.

- 1 Floodplain
- 1a Open *Salvadora australis* floodplain
- 1b Open tree floodplain
- 1c Medium height shrub *A. tortilis* floodplain
- 2 Limpopo riverine forest
- 3 Mopane
- 3a Open mopane sandveld
- 3b Shrub Mopane
- 3c Shrub mopane on rocky slopes
- 3d Shrub mopane on quartsite
- 3e Mopane on limestone
- 3f Dense Mopane veld
- 4 Mixed *C. mopane* - *Commiphora* - *T. prunioides*
- 5 Eroded Mopane
- 6 Drainage line mopane woodland
- 7 Drainage line woodland
- 8 Rocky outcrops
- 9 Quartzite Rocky outcrops
- 10 Sandstone ridge
- 11 Plato sandveld
- 12 Pans / springs
- 13 Old lands
- 14 *Catophractes alexandri* shrubveld

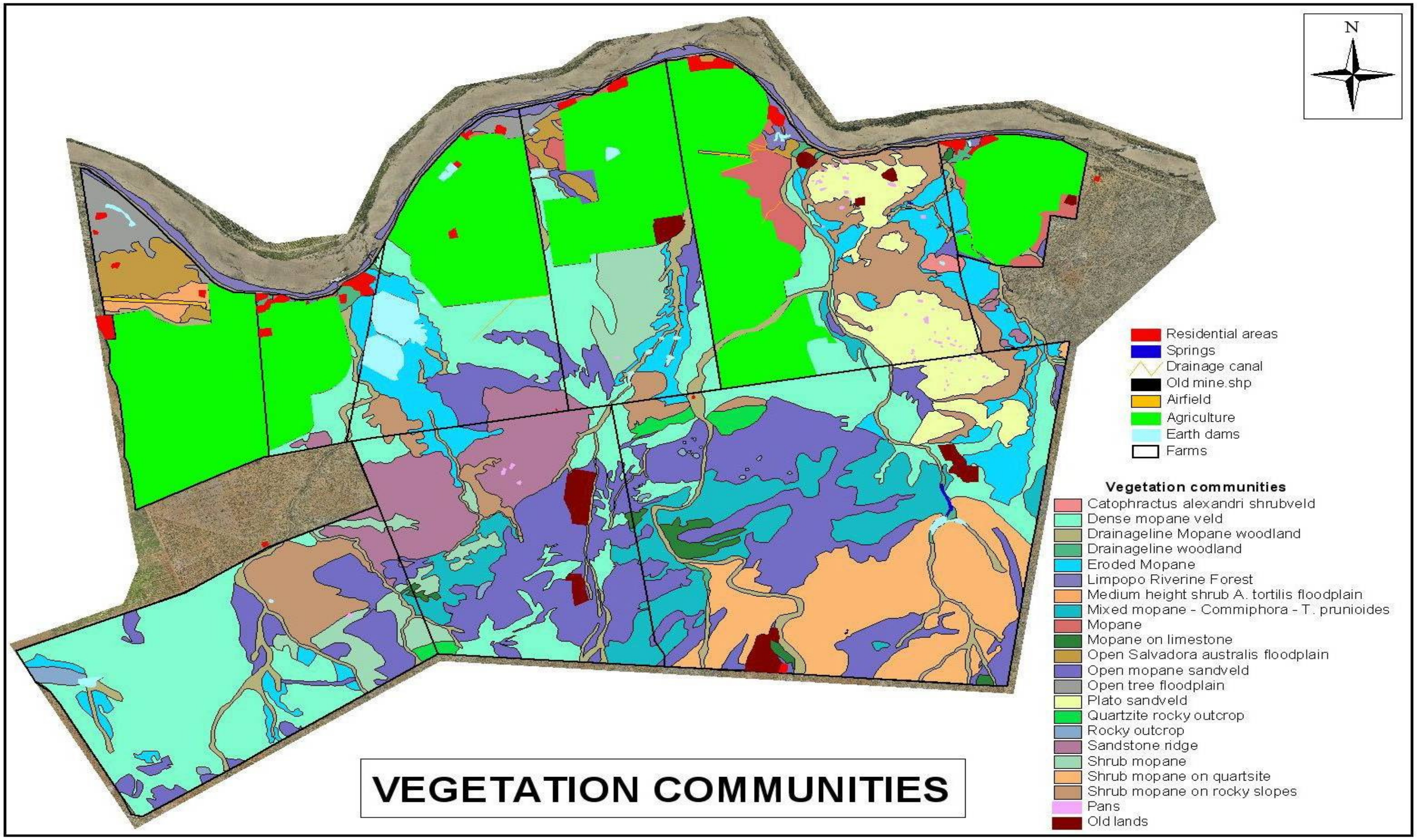


Figure 2.1.1.7: Plant vegetation communities in study area

2.1.1.8 Animal life (Dubel, 2009 – Annexure C)

The diversity of faunal species associated with mopane veld areas in the study area is lower than that of many other areas within the veld type and even other veld types. This is mainly because of low rainfall and shallow rocky sandy soils that result in poorer nutritional status of the veld. Habitat degradation, mainly because of agricultural practises and long-term overgrazing, also had an influence on the natural distribution patterns of many faunal species in these areas.

The development of the game farm industry over the past 30-40 years, especially the hunting industry, also influenced the occurrence and distribution of many faunal species in these areas, especially antelope species and predators. Many antelope species have been introduced or reintroduced, some outside of their natural distribution range, and predators have been earmarked as so-called "problem animals" and were deliberately removed on many farms for many years.

The development of the game farm industry also had secondary affects on the occurrence and distribution of faunal species. The confinement of a fairly large amount of antelope, species and numbers, on relatively small areas (farms) resulted in an increase in the availability of food (prey) for many predator species and thus a natural increase in predator numbers over time. The so-called "problem animals" therefore increased and thus also the actions to remove such animals.

Typical management actions associated with game or livestock farming, such as the provision and increase in the distribution of permanent water, resulted in an increase in the availability of water in these arid areas. A critical limiting factor that determined the occurrence and distribution of many faunal species had been eliminated as a result and habitat suitability for many species increased. This alteration of the functioning of the ecosystem did not only influence the occurrence of large mammal species, but also small mammals, reptiles, birds etc.

Detail species lists of the mammals, avifauna, herpetofauna, pisces and invertebrates are provided in Section 5.7 of the specialist report (Annexure C) and is not repeated here.

<u>Protected species</u>

Table 2.1.1.8 provides a summary of all listed protected species. A high diversity of protected species (46), occur in and adjacent to the study area. Twenty (20) of these species are known and have been confirmed to occur in the study area. Only one (1) bullfrog species (*Pyxicephalus edulis*) has been confirmed to occur in the study area. The absence of *Pyxicephalus adspersus* has been confirmed, thereby reducing the protected species to 20 (previously stated 21).

Table 2.1.1.8: Protected species list

TAXA	NAME	SPECIES IN STUDY AREA	SPECIES IN REGION/ADJACENT FARMS
Amphibia	African Bullfrog (Sa)	1	
Pisces	Tigerfish (R)		1
Reptilia	African Rock Python (Sa)	> 1	
	Nile crocodile (R)		>1
	All other species of reptiles excluding water monitor, rock monitor, and all indigenous snakes not listed in this Schedule		
Avis	Bateleur (Sa)	10	
	Cape vulture (Sa)		
	Kori Bustard (Sa)		
	Lappet-faced Vulture (Sa)		
	Long-tailed Starling (Sa)		
	Martial Eagle (Sa)		
	Saddlebilled stork (Sa)		
	Southern Ground-Hornbill (Sa)		
	Tawny Eagle (Sa)		
	White-backed Vulture (Sa)		
	Bat hawk (R)		7
	Black Stork (R)		
	Corncrake (R)		
	Lesser Kestrel (R)		
	Pel's fishing owl (R)		
	Peregrine Falcon (R)		
	White-headed Vulture (R)		
Mammalia	African civet (Sa)	8	
	Brown Hyaena (Sa)		
	Giraffe (Sa)		
	Hyaena, brown (Sa)		
	Klipspringer (Sa)		
	Leopard (Sa)		
	Lion (Sa) -occasionally		
	Steenbok (Sa)		
	Aardwolf (R)		17
	African elephant (R)		
	African Wild Dog (R)		
	Ant bear (R)		
	Bushbaby, Lesser (R)		
	Cheetah (R)		
	Hippopotamus (R)		
	Honey badger (R)		
	Hyaena, spotted (R)		
	Jameson's red rock rabbit (R)		
	Mongoose, Selous (R)		
	Pangolin (R)		
	Serval (R)		
	Sharpe's grysbok (R)		
	South African Hedgehog (R)		
	Wild dog (R)		
	Yellow-spotted rock dassie (R)		

2.1.1.9 Surface water (WSM Leshika, 2009 – Annexure D)

<u>Catchment description</u>

The study area is situated along the southern bank of the Limpopo River within quaternary sub-catchment A71L. The catchment area used for the hydrogeological evaluation is A71L, sub-catchments a, b and c. The mining site encompasses 4.9% of the total quaternary catchment area of 1,765km².

The naturalized Mean Annual Runoff (MAR) is 3.2mm. No afforestation or other substantial direct uses of the runoff occur except for the off-channel storage irrigation dams which have a negligible impact and therefore the actual MAR equals the naturalized MAR. This quaternary catchment area has the lowest rainfall and highest MAE of all of the catchments in the tertiary catchment area A71.

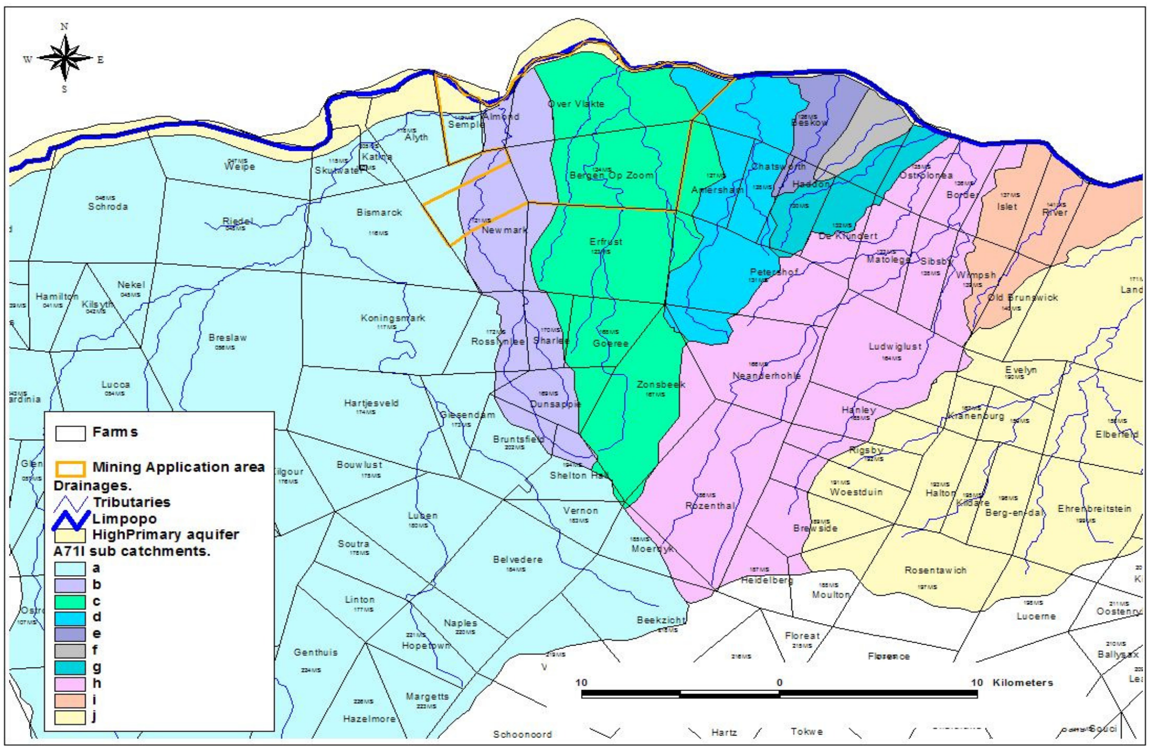


Figure 2.1.1.9(a): A71L sub-catchments

<u>Flood peak and floodline estimation</u>

The floodpeak and floodline determination is described in detail in the specialist report (Annexure D) and is not repeated here. Figure 2.1.1.9(b) overleaf shows the 1:50 and 1:100 year floodlines for the Limpopo River, as well as the buffer zones for the non-perennial site tributaries.

It is of interest to note that the Limpopo River floodline is approximately on the line indicating the extent of alluvial deposits.

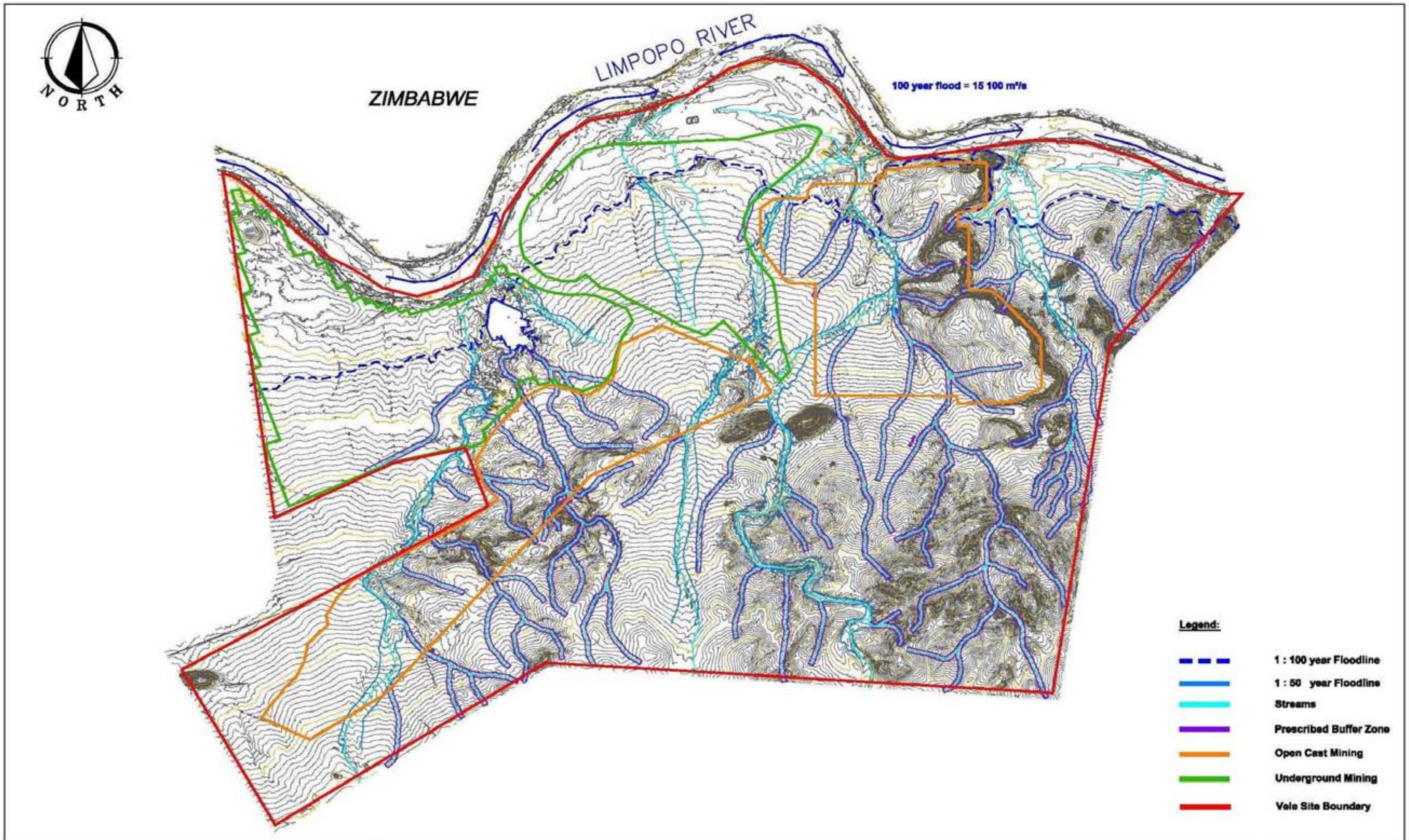


Figure 2.1.1.9(b): Floodlines and buffer zones

Water quality

Water quality data was obtained from the Department of Water Affairs and Forestry (DWAF) for their measuring stations at Pont Drift, about 50 km upstream of Vele and for the two gauges at Beit Bridge, some 32 km downstream of Vele.

The mean values are shown in Table 2.1.1.9(a) below and serve as background data on surface water quality in the Limpopo River.

Table 2.1.1.9(a): Surface water quality: DWAF data for Limpopo River

Monitoring point name	Ca	Cl	DMS	EC	F	K	Mg	Na	NH4	NO3+NO2	pH	PO4	SAR	Si	SO4	TAL	Turb
1	16.40	9.60	141.00	18.54	0.33	3.68	5.26	9.12	0.03	0.18	8.02	0.05	0.51	5.36	10.08	70.08	183.00
2	23.45	21.05	203.80	31.41	0.26	3.27	9.90	16.83	0.04	0.53	7.21	0.03	0.75	7.33	13.27	242.40	92.98
3	32.21	80.60	411.04	58.64	0.32	4.90	20.16	57.88	0.07	0.23	8.10	0.04	1.76	4.55	36.41	145.40	89.56

1). A6H034Q01 LIMPOPO RIVER AT PONT DRIFT (1994)
2). A7H004Q01 LIMPOPO RIVER AT BEIT BRIDGE (1980 – 1993)
3). A7H008Q01 DOWN STREAM OF BEIT BRIDGE ON LIMPOPO RIVER (1993-2007)
DMS = Dissolved Major Salts

Note that the sampling size at Pont Drift is small (five only), while the older station at Beit Bridge (sampling point number 2) had 20 samples and at the new location downstream of the bridge, 67 samples were analyzed. There seems to be a deteriorating trend at the relocated Beit Bridge point, where samples have been collected since 1993. A point source may contribute to this and the border town in Zimbabwe is a likely candidate, although this has to be confirmed.

The values above, even for sampling point number 3, indicate that the water quality are generally in line or of better quality than the groundwater sampling results reported in the hydrogeological study.

In March 2009 after good summer rains the Limpopo River started flowing and some of the smaller site streams had surface water flowing. Three samples were collected and tested, the sampling positions as indicated in the diagram overleaf: In the Limpopo River upstream of Vele (SURFW 1) and downstream (SURFW 3) and on Bergen op Zoom below a spring (SURFW 4). The test results are shown in Table 2.1.1.9(b) overleaf.

The river samples compare well to the results of DWAF while the spring sample has elevated values for total dissolved solids (>3 000), and for fluoride, sulphate, chloride, calcium, magnesium and sodium. The spring is located in a relatively pristine area and the sample thus represents the natural groundwater quality as sampled in the stream, in lieu of river flow..

Table 2.1.1.9(b): Surface water quality: Site samples

SAMPLE ID		SURFW 1	SURFW 3	SURFW 4
ANALYSIS TYPE	*UNITS*			
pH		7.19	6.98	7.64
Conductivity	mS/m	24.5	23.5	538.0
T.D.S.	mg/l	152	148	3261
Nitrate : N	mg/l	2.21	1.88	0.00
Fluoride	mg/l	0.00	0.00	0.82
Sulphate	mg/l	9.1	8.1	345.1
Chloride	mg/l	24.5	25.7	588.1
P-Alkalinity	*	0.0	0.0	0.0
M-Alkalinity	*	42.7	42.6	616.5
Carbonate	*	0.0	0.0	0.0
Bicarbonate	*	52.1	51.9	751.6
Total Hardness	*	95.5	94.3	773.6
Calcium Hardness	*	49.0	49.9	117.5
Magnesium Hard	*	46.5	44.3	656.1
Calcium	mg/l	19.6	20.0	47.1
Magnesium	mg/l	11.3	10.8	159.3
Sodium (diss)	mg/l	14.4	14.8	739.2
Potassium (diss)	mg/l	2.75	2.33	14.34
Iron (dissolved)	Mg/l	0.000	0.000	0.000
Manganese (diss)	mg/l	0.000	0.000	0.000

NOTE: Coloured cells show constituents above the maximum allowable SABS (2001) drinking water standards, i.e. in Class III standard.

Current surface water sources and use

The Mean Annual Runoff (MAR) from the site is very low at only 3.2 (or 1.6) mm and can generally be discarded as a source. The only present utilisation of surface water runoff is the two ephemeral streams feeding into to the dam to the west of the site. The dam is utilised as off-channel river storage and the contribution of the two streams to the impoundment is relatively small.

The current water sources include groundwater and the runoff in the Limpopo River. The groundwater sources include the primary aquifer (alluvial sand of the Limpopo River main channel and close banks) and secondary aquifers in the whole of the A71L quaternary catchment.

By abstracting large volumes of water from the Limpopo River when it is in flood, surface water is utilised. It was found that the water abstracted from the Overvlakte aquifer is three times more than the estimated available storage, which indicates the surface water component utilised. The river water is abstracted by either using 'well points' in or close to the river, or by constructing a channel from about midway in the river (i.e. from the international boundary) to the river banks where pumps mounted on rafts convey the water to the irrigation points or to storage facilities. A number of smaller holding dams are being used, while on the farm Overvlakte the storage capacity of the very large existing off channel storage dam is augmented by the construction of a new dam. The total capacity of the two dams amounts to approximately 1.65 million m³.

The current irrigation water use is summarised in Table 2.1.1.10(c) (Section 2.1.1.10) below. Considering the data for <u>all</u> of the properties included in the mining rights application, the following applies:

DWAF registered use:	21.7 million m³
Actual usage as quoted by farmers:	14.8 million m³
Estimated usage based on irrigated area:	15.7 million m³

The water usage is limited by the quantity and quality of the water in the primary aquifer.

It is currently envisaged to transfer the existing surface water rights of Overvlakte 125 MS (Ptns 3, 4 and 5) for mining use and the quantities have been evaluated as shown in Table 2.1.1.9(c).

Table 2.1.1.9(c): Registered water use and estimated current usage of Overvlakte portions 3, 4 and 5

PORTION OF OVER-VLAKTE	REGISTERED WATER USE (million m³/a)				IRRIGATED AREA (ha)	ESTIMATED CURRENT USAGE (million m³/a)
	RIVER	BOREHOLES	TOTAL	STORAGE (m³)		
5	1.1	3.0262	4.12	24 500	232	2.57
3	1.1	1.9	3	-	290	3.07
4	1.1	0.23	1.33	74 000		
TOTAL	**3.3**	**5.1526**	**8.45**	**98 500**		**5.64**

A total of 8.45 million m³/a water use is registered, but the licence quantity will depend on the actual use in the prescribed period. To be on the conservative side we therefore assume that the lawful use, to be verified from satellite images in that period, equals the current use as shown in the last column of the table above, i.e. 5.64 million m^3/a.

To allow for the different levels of assurance of supply, the reliable supply to the mine may be taken as 3.3 million m^3/a**,** i.e. only 58% of the current use. This factor was derived from the Storage-Draft-Frequency curves for the larger tributaries of the Limpopo River, i.e. Crocodile, Mokolo and Sand Rivers, given in WR90. The 50-year to 10-year gross draft ratio for relative small storages is in the order of 60%.

A new dam is under construction in the Shashe River, upstream of the site. Unless specific provision has been made for river releases, such a dam may cut off a large proportion of the flow which feed the alluvium river bed aquifer of the Limpopo River downstream of the confluence. Note that the flow contribution from the Limpopo River branch, upstream of the confluence with the Shashe, is smaller than the flows from the Shashe River.

Enquiries at DWAF have revealed that river release equipment will be installed at the dam, but they will have to assure the present users that no negative impact on the available flows will occur.

2.1.1.10 Groundwater (WSM Leshika, 2009 – Annexure E)

A borehole census was conducted on the farms outlined in green in Figure 2.1.1.10(a). The farms are Katina, Alyth, Semple, Overvlakte, Beskow, Newmark, Voorspoed, Bergen op Zoom, Amersham, Chatsworth, Erfrus and Petershof. Two sets of borehole data are available i.e. the National Groundwater Data Base (NGDB) data and the data collected in the field. Borehole data generated during the recent drilling program was added to the hydro census data. The hydro census data and the NGDB data is plotted on Figure 2.1.1.10(a). There is some duplication of the boreholes in the two data sets but the distribution of boreholes, particularly along the river is well illustrated. Where possible water levels were measured and abstraction information obtained.

In addition, 23 percussion boreholes holes were drilled within the limits of the proposed coal mining area to obtain site specific groundwater data. The data includes water levels, strike depths, chemistry and transmissivities. Some existing boreholes were also tested. The borehole localities are indicated on Figure 2.1.1.10(b). Borehole targets were selected to evaluate potential inflows into the mine and to obtain representative transmissivities of the mining area.

A further 14 percussion boreholes were tested for hydraulic properties, whilst two NQ sized diamond core holes were drilled for packer testing, to obtain site specific data of the permeabilities of the main geological horizons away from structure.

A total of 8 water samples were taken and submitted for macro chemical analysis. Chemical data was also obtained from some of the farmers who keep records of seasonal fluctuations in salinity in the alluvial aquifer. An additional 5 samples were submitted from the drilling exercise.

Aquifers

Aquifers in the study area are represented by 2 types (see figure 2.1.1.10(a)), namely:

(i) Primary aquifers which occur when the inherent fabric of the rock is porous and permeable and can host abstractable quantities of water.

(ii) Secondary aquifers which occur when the consolidated fabric of the rock has been disrupted by means of crustal processes to allow infiltration and abstraction of water.

***Primary aquifers*:** The Limpopo River has deposited unconsolidated alluvial sand and pebbles within the channel and along its banks in excess of 25m depth and over 2km in breadth in places. Many boreholes/abstraction points have been developed along the river banks and within the channel. The alluvium consists of coarse sands with intermittent pebble horizons and clay lenses. The sands and pebbles are highly permeable and high yielding and the clay lenses low yielding. In the study area the alluvial aquifer consists of two compartments separated by the outcropping of the Solitude and Fripp formations above the sand at Semple. These formations are erosion resistant and separate the Weipe alluvial aquifer from a smaller alluvial compartment downstream. For purposes of this report the smaller alluvial aquifer has been termed the Overvlakte alluvial aquifer. The Clarens Formation appears to favour the development of alluvial aquifers.

The water held in the alluvial sand is mostly saline and therefore abstraction is limited to the river bank fringes and in the river channel where river flow is abstracted via the sand. Abstraction for agriculture continues for a while after the river stops flowing every winter but water quality deteriorates rapidly preventing major exploitation of the water stored in the alluvium.

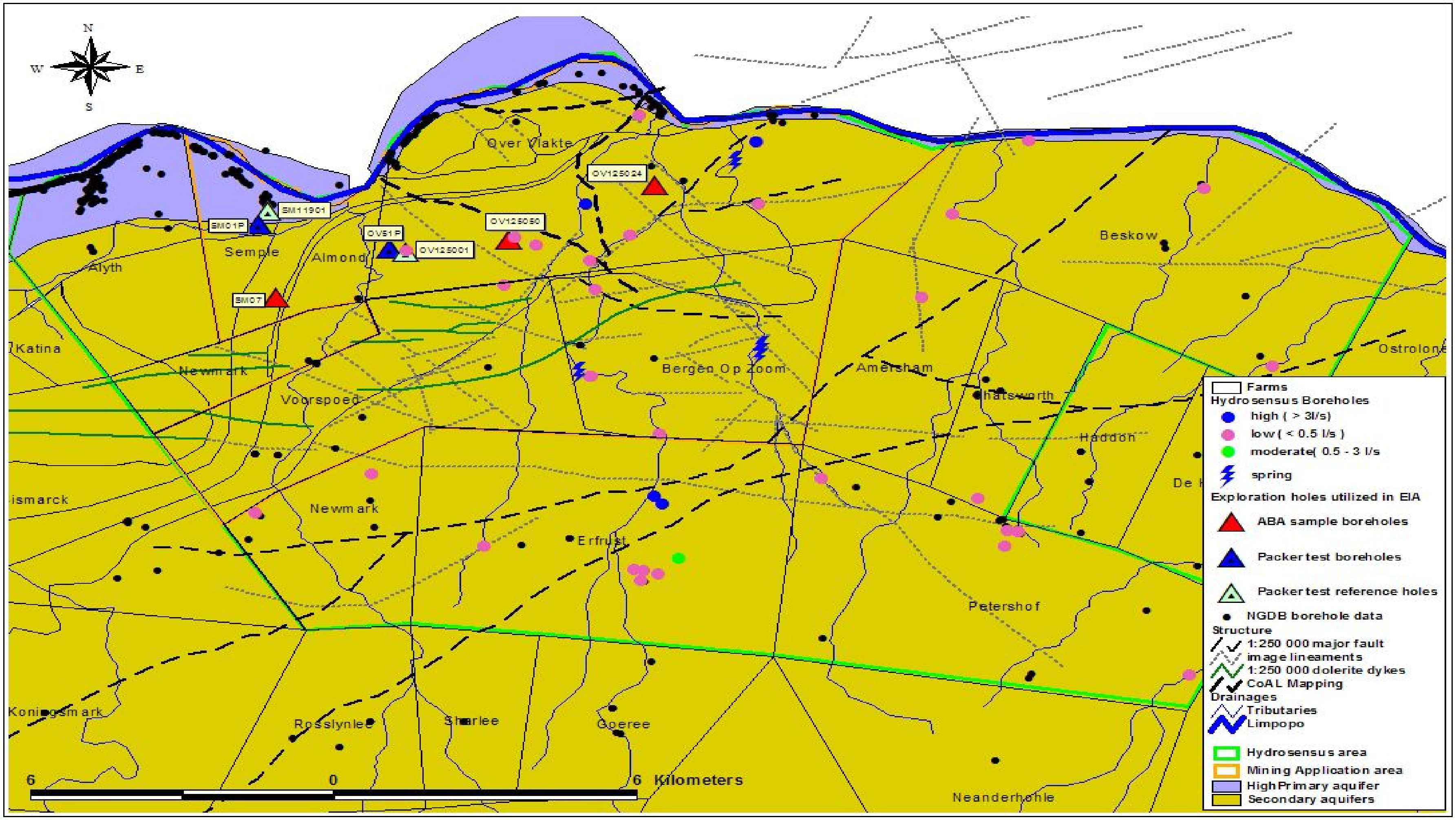


Figure 2.1.1.10(a): Hydrocensus data and hydrogeology

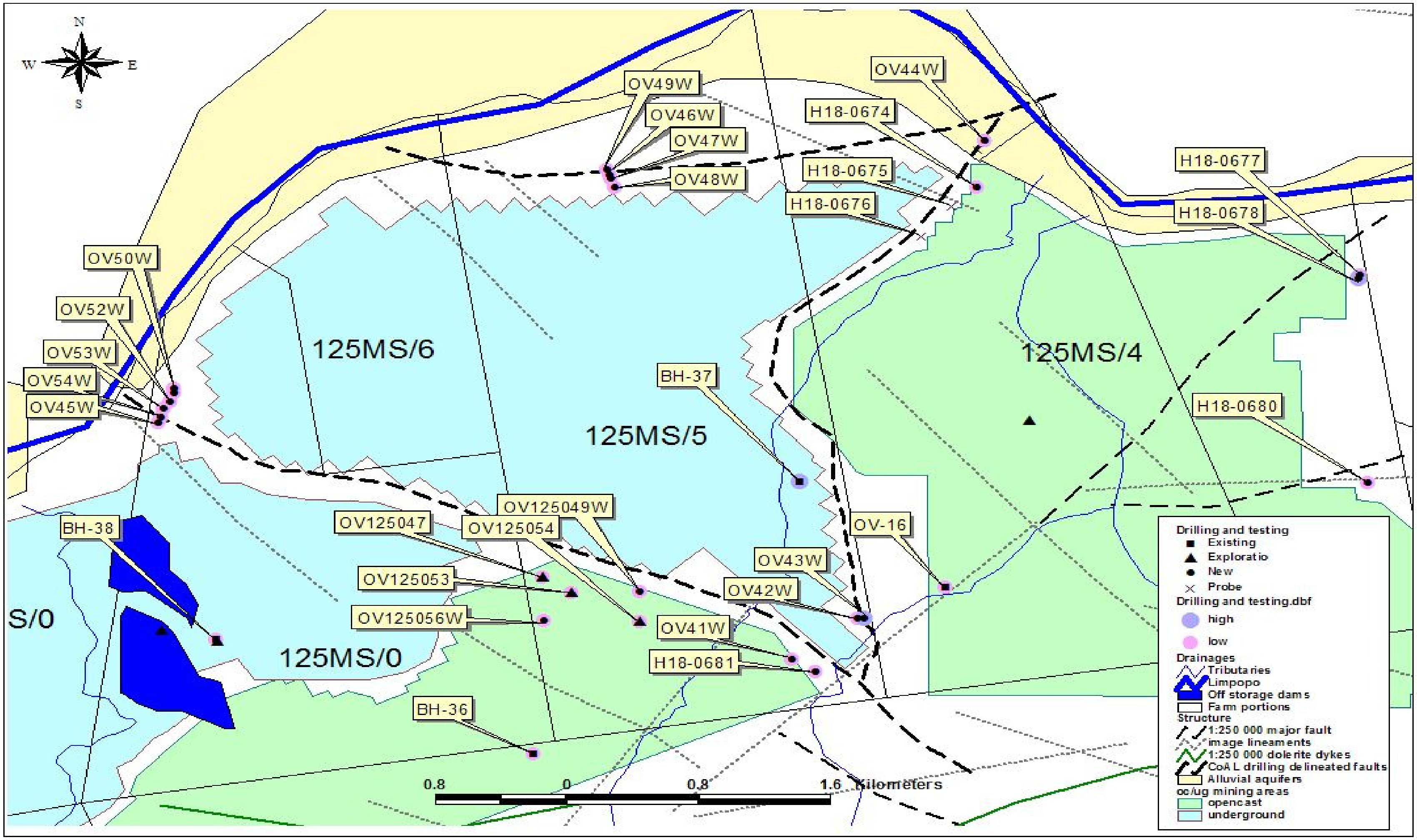


Figure 2.1.1.10(a): Localities of drilled and tested boreholes

Some unconsolidated material does occur away from the influence of the Limpopo consisting of alluvial fan and sheet wash material associated with the non-perennial braided streams which drain towards the Limpopo River.

Secondary aquifers are associated with water located in faults/shear zones and dykes or a combination thereof within the consolidated rocks of the study area. The stratified rocks of the Karoo can generally be regarded as being of low groundwater potential away from structures with the interbedded sandstones having a moderate potential.

The Limpopo Mobile Belt rocks away from structure are also generally of low potential. The borehole data confirms this view.

The drilling program and data from the exploration drilling indicate that the fault bounded central graben displays varying transmissivities. The eastern N-S trending fault is water bearing whilst the remaining two systems are relatively dry. The low yields can be attributed to the ductile response of the shales/mudstones to faulting. Water occurred within the more competent or brittle sandstone and coal horizons and in the gneissic basement below the Karoo.

The east-west trending dykes tend to be non-transmissive and to act as barriers as reflected in the drilling and a number of low yielding artesian holes drilled into dykes.

Several springs were encountered and recorded as part of the hydrocensus data.

<u>Water levels</u>

Primary aquifer water levels within the alluvial system are generally between 0 -10mbgl and reflect the level of the river relative to the surface.

Secondary aquifer water levels can vary considerably for a number of reasons, namely 1) variations in topography, 2) separate aquifers in layered strata with different hydrostatic heads, 3) the presence of hydraulic partitions e.g. dykes and faults and 4) over abstraction.

Limpopo Mobile Belt (LMB) - of a population of 39 water levels 64% are between 5 – 20 metres below ground level (mbgl) and 80% are between the 5 – 30 mbgl range. The data reflects the crystalline nature of the basement and the generally shallow weathering profiles. Strikes can be expected to be shallow and available drawdown small. Frequencies taper off with depth.

Karoo Sequence. Out of a population of 22 boreholes 45% of the borehole population is in the 5 – 30 mbgl range. The frequencies of water levels outside of this range are more varied which can be expected from layered rocks.

Two artesian boreholes on Overvlakte (RE) are indicative of E-W trending dykes which act as flow barriers.

<u>Groundwater Flow</u>

Groundwater flow is oriented northwards towards the Limpopo River. Flow volumes are extremely low due to the low recharge and low permeabilities. Under natural conditions, groundwater drains via springs discharging from the basement aquifer, and evapotranspiration by riverine vegetation. Hence baseflow to the Limpopo is not generated. Evapotranspiration by riverine vegetation and the movement of saline groundwater, emanating from the basal marine deposits of the Karoo rocks, towards the Limpopo River causes a salt accumulation in the fringes of the alluvial aquifer, resulting in poor natural water quality.

Irrigation by wellpoints in alluvial sands has altered the water and salt balance by inducing fresh water inflows from the Limpopo into the sands during periods of runoff. Consequently, irrigation from the sands is largely of surface water origin, not natural groundwater. The irrigation, therefore, has not significantly altered groundwater conditions outside of the riverine area

Permeability / transmissivity

From the testing results, the following permeability ranges were concluded:

- Zone 1 - Intermediate sandstone horizon (Fripp fm) K = 7mm/day
- Zone 2 - Upper grey mudstone/shale horizon (Mikambeni fm) K = 0.3 to 10mm/day
- Zone 3 - Upper carbonaceous mudstone/coal horizon (Upper Madzaringwe fm) K = 0.3 to 10mm/day
- Zone 4 - Lower coaliferous/mudstone horizon (Lower Madzaringwe fm) K = 0.1 mm to 1mm/day

Except for the boreholes OV/BH-37, OV43W and H18-0678 transmissivities are generally low. The high yields in OV/BH-37 and OV43W suggest that the eastern boundary fault of the central graben is a high transmissive zone at least along the N-S section. The high yield in H18-0678 indicates open fractures within the gneisses below the Karoo.

Groundwater quality

Some 44 chemical analyses were obtained from the NGDB and 15 samples were collected and analyzed as part of the hydro census / drilling exercise. Three of these samples were from the primary aquifer and 12 samples were from fractured aquifers. The NGDB and hydrocensus data points are plotted on Figure 2.1.1.10(c) indicating TDS levels.

Primary aquifer water chemistry

Groundwater migrating towards the river will pick up solutes along the way. In arid areas and in rocks which are inherently saline such as the basal marine deposits of the Karoo. Groundwater feeding the alluvial system can be expected to have elevated salts. Evapotranspiration by riverine vegetation and the movement of saline groundwater, emanating from the basal marine deposits of the Karoo rocks, towards the Limpopo River causes a salt accumulation in the fringes of the alluvial aquifer. The salt build up along the alluvial fringes is exacerbated by the intense irrigation activity in the study area which flushes additional salts towards the Limpopo River. Some of the farmers have dug drainage channels to intercept salt laden excess irrigation water away from the crops lower down, or from abstraction areas.

Three samples were taken within the alluvial system to obtain a range of water quality from the centre of the river channel to the edge of the alluvium. The analyses are listed in the Table 2.1.1.10(a).

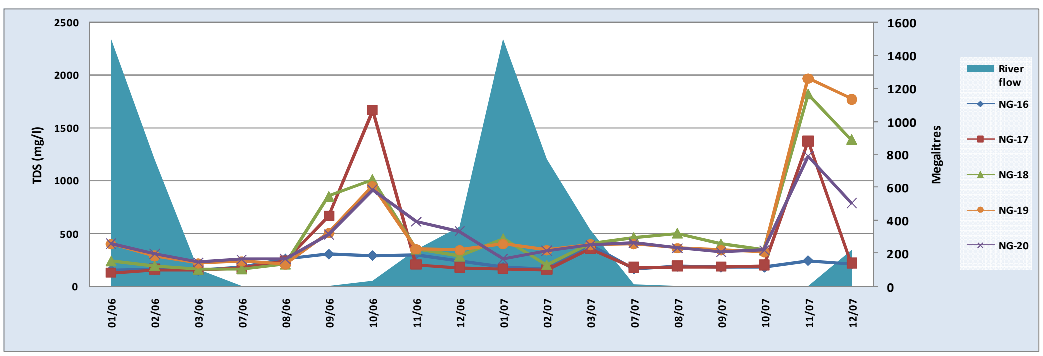
Table 2.1.1.10(a): Macro chemical analysis of water taken from alluvial sand

Class 0	Class I	Class II	Class III / IV

Borehole Number	E.C mS/m	TDS mg/l	Hardness mg/l	NO3 mg/l	F mg/l	Mg mg/l	Na mg/l	Cl mg/l	SO4 mg/l
NG-5	41.9	336.9	241.6	0.0	0.0	35.8	34.6	49.0	27.0
NG-16	52.2	324.7	235.2	0.0	0.0	27.1	29.5	61.3	40.0
NGR-1	64.1	463.8	274.0	0.0	0.0	34.4	69.5	107.8	53.5
H18-0674	43.1	286.0	254.6	0.0	0.0	43.3	14.9	22.9	19.0

Contrary to expectation the TDS concentrations in NGR-1 which is water taken from the sands in the centre of the river channel is higher than the samples on the river bank. This may reflect the water quality at the base of the sands. NG-16 is closer to the river bank edge than NG-5 by approximately 100m. NG-16 is of slightly better quality than NG-5 which is to be expected. The quality difference between the two holes is tempered by the water quality deteriorating downstream as the sands thin towards the edge of the Weipe aquifer. According to observations by the farmers in the area, when the river is in flood, agitation of the river bed and bank material releases salts into the surface water system resulting in a temporary deterioration in surface water quality.

Noordgrens management provided time based water quality data of their alluvial boreholes which they monitor regularly to assist them with managing the salinity levels of their irrigation water. The seasonal variation in salinity in four boreholes in relation to river flow is illustrated in the chart below.



The chart shows the months of September and October experience rapid increases in salinity in certain boreholes and rapid reduction in salinity on commencement of river flow.

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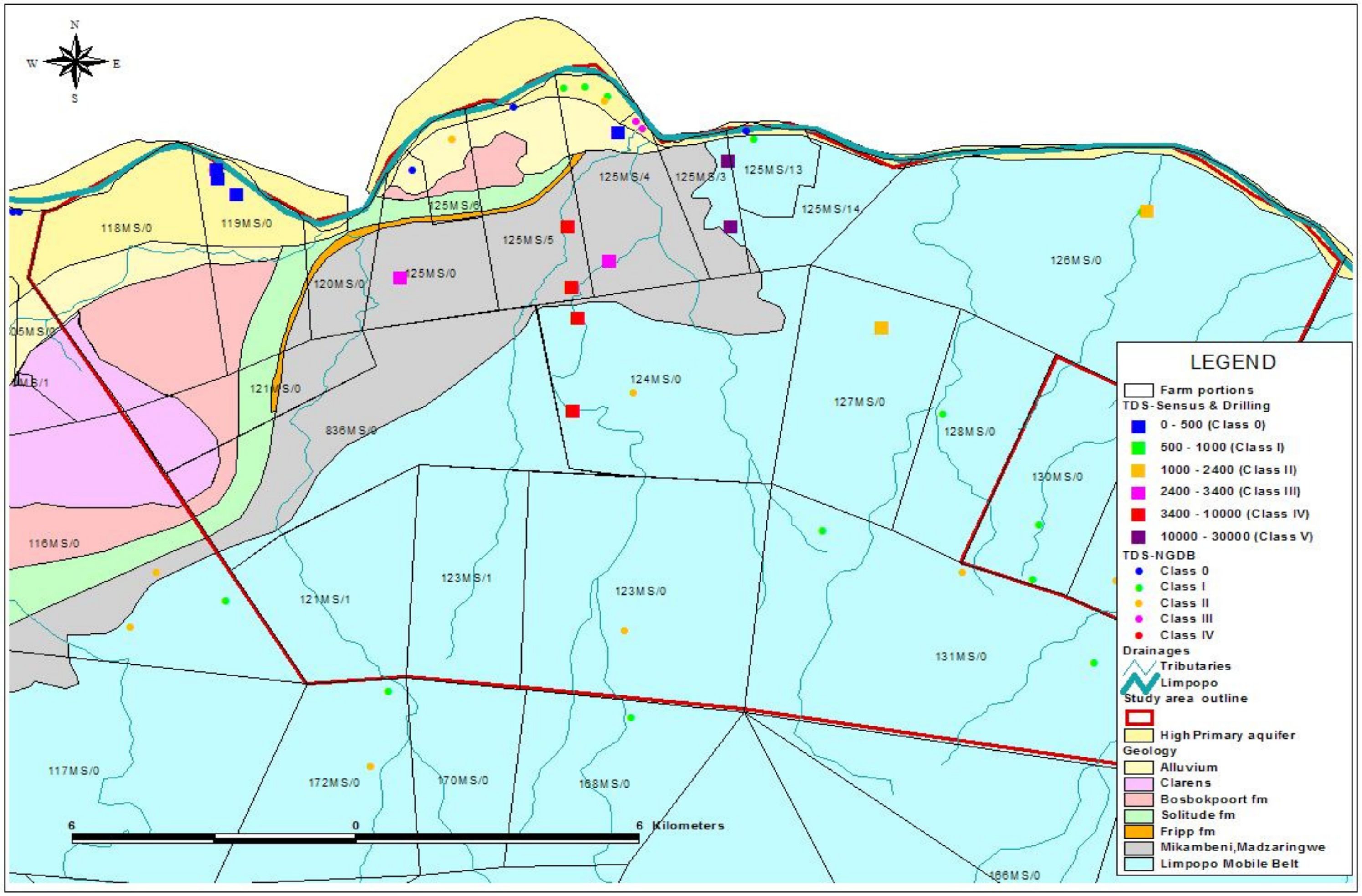


Figure 2.1.1.10(c): TDS Class ranges from hydrosensus/drilling and NGDM sample localities

Secondary aquifer water chemistry

Groundwater quality is dependant on the concentrations of soluble salts in the host rock and the residence time of water within the host rock. There is also a relationship between rainfall and general salinity i.e. arid areas tend to have higher salinities. The macro-chemistry of the nine samples taken during the hydrocensus and drilling is listed below.

Table 2.1.1.10(b): Macro chemical analysis of secondary aquifers

Class 0	Class I	Class II	Class III or IV

Borehole Number	E.C mS/m	TDS mg/l	Hardness mg/l	NO3 mg/l	F mg/l	Mg mg/l	Na mg/l	Cl mg/l	SO4 mg/l
AH/BH-1	375.0	2357.2	881.4	36.4	1.0	164.0	580.8	416.5	280.0
B2/BH-3	750.0	3723.5	773.7	33.9	1.6	149.8	1161.3	803.7	490.0
B2/BH-1	936.0	4864.8	891.3	47.1	1.6	201.0	1596.4	1107.5	426.0
BK/BH 2	318.0	1734.6	1312.2	112.9	0.8	249.7	213.0	460.6	43.8
OV/BH-38	489.0	3024.0	949.9	0.0	2.4	152.2	487.3	779.2	384.0
OV/BH-16	466.0	2075.2	626.7	0.0	1.9	73.6	565.2	735.1	413.0
OV/BH-16	485.0	3013.0	763.8	0.0	2.8	114.1	452.2	725.3	345.1
OV/BH-37	1338.0	7864.0	793.2	215.3	5.6	178.3	1925.1	1881.8	820.0
H18-0678	4470.0	26914.0	4093.2	0.0	0.2	566.0	6538.4	7938.7	4150.0
H18-0680	4180.0	24693.0	4837.4	75.2	0.1	827.5	6015.0	6811.6	5120.0
H18-0681	682.0	4018.0	763.8	0.0	0.2	123.7	782.6	695.9	570.0

Inspection of the NGDB/census - TDS values for the boreholes situated on Limpopo Mobile Belt rocks indicate that of a population of 27 boreholes, 70% of the samples have concentrations in the Class II to III range (500 -2400mg/l). These values can be regarded as normal in an arid area. The boreholes with extreme salt concentrations in the sampling data appear to be located at the base of the Karoo or along the outer margins of the Karoo. See Figure 2.1.1.10(c).

Chemistry data for boreholes situated within Karoo rocks numbered only 14 of which 38% exhibit extreme salinity in excess of 3400mg/l. The basal Karoo rocks are therefore associated with high salinity.

Existing groundwater use

The descriptions of the systems utilizing groundwater in the study area are separated into two sections, i.e.:

- systems abstracting from the primary aquifer
- systems abstracting from the fractured aquifers

The land distribution and irrigation activities are indicated on Figure 2.1.1.10(d).

Boreholes abstracting water from primary aquifers in the study area are generally high volume systems providing water for irrigation. The water use along the river out of the primary aquifer (boreholes) and direct abstraction from the river is summarized in Table 2.1.1.10(c) (overleaf).

The large scale users along the river are almost entirely dependant on flow in the river. Those farmers with citrus make use of off channel storage dams e.g. Noordgrens or depend on the small fraction of fresh water held in storage in the river bank margins and upper layers of channel sand to carry them through to the next flow event. Those farmers without suitable sand storage or off channel storage dams, farm with annual crops and plant and irrigate according to the river flow. Security of water then is a function of fluctuating annual flow cycles in the current climate regime and the ability to pump enough water to a storage facility to carry the operation through to the next flow event.

Boreholes abstracting water from fractured aquifers in the study area are generally low volume systems providing water to game farm operations and tourism (domestic use). Table 2.1.1.10(d) below gives the estimated use in the hydrocensus area.

Table 2.1.1.10(d): Groundwater use from secondary aquifers

Business	Farm	Estimated abstraction/annum (Ml)
Ludwigslust	PETERSHOF	15.8
	CHATSWORTH	3.2
	AMERSHAM	0.0
	BERGEN OP ZOOM	6.3
Dongola Ranch	ERFRUST	47.3
Maroi	BESKOW	9.5
Neels Louw	NEWMARK	3.2

In the total catchment area use from the secondary aquifers is estimated to be 380 Ml / annum. As no confirmed abstraction volumes are available from the alluvial aquifer (large portion abstracted directly from the river) an abstraction of 29 370 Ml / annum is assumed for the purpose of this study.

The total volume of water abstracted (primary and secondary aquifers) for the catchment area has thus been assumed to be 29 750 Ml / annum or 81.5 Ml / day.

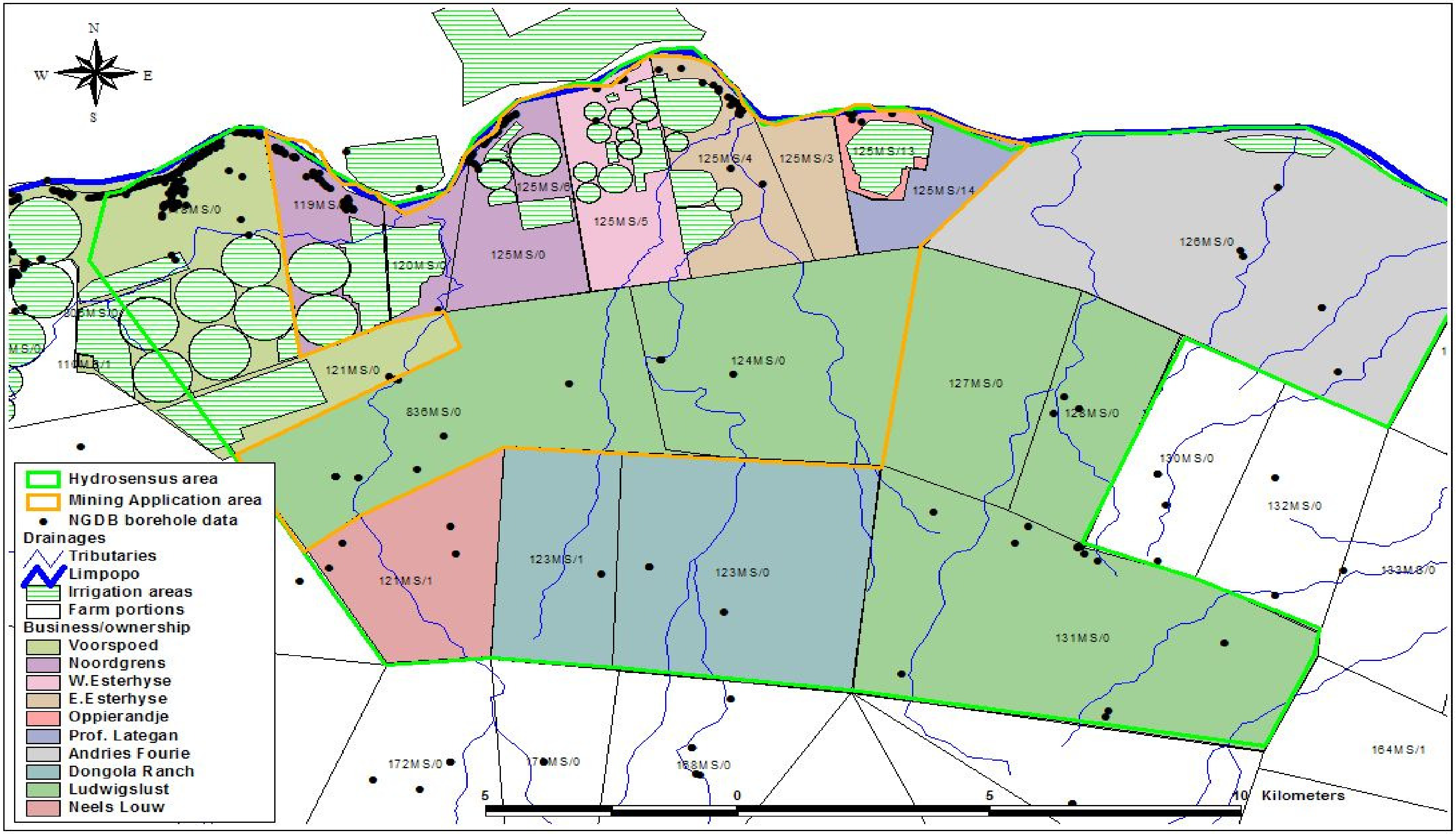


Figure 2.1.1.10(d): Land ownership and use

Table 2.1.1.10(c): Summary of water use from primary aquifer/river

Business name	Owner/Farmer	Farm	No	Aquifer compartment	Total Ha under irrigation	DWAF allocation	Annual abstraction "quoted" (ML)	Annual abstraction "estimated" (ML)	Weipe report
Maroi(Hannes Nel)	Andries Fourie	Beskow	126MS/1		62	?	?	621	?
Other	Other	Zimbabwe			680	?	?	6800	?
Oppierandje	Flip Nel	Overvlakte	125MS/13	Overvlakte	175	1500	657	1755	3230
B.Esterhuyse	B.Esterhuyse	Overvlakte	125MS/4	Overvlakte	289	4000	3000	3074	7400
W.Esterhuyse	W.Esterhuyse	Overvlakte	125MS/5	Overvlakte	233	4200	4126	2572	5650
Noordgrens	JJ.Smith / Bertus Dillman	Overvlakte Semple	125MS/0/6 155MS/0	Overvlakte Weipe	711	12000	7000	8283	11790
Voorspoed	H.Willemse	Alyth Newmark Skutwater	118MS 121MS/1 805MS	Weipe	1342	27000	12000	13927	24740
Other	Other	Skutwater	115MS	Weipe	367	?	?	3665	15054
Other	Other	Weipe	047MS	Weipe	737	?	?	7366	6540
Venetia	De Beers	Greefswald Schroda	037MS 046MS	Weipe				2000	
Other	Other	Zimbabwe		Weipe	181	?	?	1810	?

Total	51874
Total abstraction from Weipe aquifer system	31529
Total abstraction from Overvlakte aquifer system	20288

2.1.1.11 Air quality (Bohlwek-SSI, 2009 – Annexure F)

Currently a detailed emissions inventory for the area under investigation has not been undertaken. Based on site visits, aerial photos and site descriptions of the area, the following sources of air pollution have been identified:

- Vehicle entrainment and exhaust gas emissions;
- Veldt fires;
- Agricultural activities; and
- Other mining activities across the Limpopo River on the Zimbabwe side.

A qualitative discussion on each of these source types is provided in the subsections which follow. These subsections aim to highlight the possible extent of cumulative impacts which may result due to the proposed operations.

Vehicle entrained dust and exhaust emissions

Dust emissions occur when soil is being crushed by a vehicle, as a result of the soil moisture level being low. Vehicles used on the roads will generate PM-10 emissions throughout the area and they carry soils onto the paved roads which would increase entrainment PM-10 emissions. The quantity of dust emissions from unpaved roads varies linearly with the volume of traffic.

Vehicle exhausts contain a number of pollutants including carbon dioxide (CO_2), carbon monoxide (CO), hydrocarbons, oxides of nitrogen (NOx), sulphur and PM10. Tiny amounts of poisonous trace elements such as lead, cadmium and nickel are also present. The quantity of each pollutant emitted depends upon the type and quantity of fuel used, engine size, speed of the vehicle and abatement equipment fitted. Once emitted, the pollutants are diluted and dispersed in the ambient air. Pollutant concentrations in the air can be measured or modelled and then compared with ambient air quality criteria.

Veld Fires

Veld fires are widespread across the world, occurring in autumn, winter and early spring. In addition to controlled burning for fire-breaks and veld management, many fires are set deliberately for mischievous reasons. Some are accidental, notably those started by motorists throwing cigarettes out of car windows. Emissions from veld fires are similar to those generated by coal and wood combustion. Whilst veld fire smoke primarily impacts visibility and landscape aesthetic quality, it also contributes to the degradation of regional scale air quality.

Dry combustible material is consumed first when a fire starts. Surrounding live, green material is dried by the large amount of heat that is released when there are veld fires, sometimes this material can also burn.

Factors that affect the rate of fire spread:

- Weather(wind velocity, ambient temperature and relative humidity);
- Fuels (fuel type, fuel bed array, moisture content and fuel size;
- Topography (slope and profile); and
- Logistical problems (size of the burning area).

The major pollutants from veld burning are particulate matter, carbon monoxide, and volatile organics. Nitrogen oxides are emitted at rates from 1 to 4 g/kg burned, depending on combustion temperatures. Emissions of sulphur oxides are negligible (USEPA, 1996).

Agricultural Activities

Agricultural activities currently taking part within the study area include predominantly game farming with citrus and cotton farming also being undertaken. Agricultural activities can be considered a significant contributor to particulate emissions.

The main focus internationally with respect to emissions generated due to agricultural activity is related to animal husbandry, with special reference to malodours generated as a result of the feeding and cleaning of animals. Animal feeding operation and other agricultural activities are more likely to contribute air pollutants such as particulate matter to the atmosphere during hot, dry weather. Ammonia emissions from animal agriculture account for about 50% of the total ammonia emissions into terrestrial systems. Ammonia, through chemical reactions in the atmosphere, causes acid rain increasing acidity of surface waters and soils. Nitrogen emissions, as ammonia, are a major nutrition issue.

Little information is available with respect to the emissions generated due to the growing of crops. The activities responsible for the release of particulates and gasses to atmosphere would however include:

- Particulate emissions generated due to wind erosion from exposed areas;
- Particulate emissions generated due to the mechanical action of equipment used for tilling and harvesting operations;
- Vehicle entrained dust on paved and unpaved road surfaces;
- Gaseous and particulate emissions due to fertilizer treatment; and
- Gaseous emissions due to the application of herbicides and pesticides.

Agricultural activities currently taking part within the study area include predominantly game farming with citrus and cotton farming also being undertaken. Agricultural activities can be considered a significant contributor to particulate emissions.

Mining Activities

Due to an existing mine located on the Zimbabwean Border it is possible for the mitigation measures and rehabilitation plans to differ from those in South Africa. As a result of this there is the possibility that air quality impacts from that mine could influence the cumulative air quality impacts at and near the site.

Sensitive Receptors

The distance to any large settlements is in the order of 20-30 km resulting in little chance of impacts as a direct result of the mine. It must be noted that smaller settlements as well as surrounding farms and conservation areas are more likely to be affected as a result of the mining activity. Public roads are also noted to pass close to the proposed site, as a result of this particular care needs to be taken to avoid dust blown across these roads.

The main sensitive receptors identified in the area include (also refer to Figure 2.1.1.12):

Receptor	Distance from Mine (km)	Orientation in relation from mine
Beit Bridge	25	East
Musina	37	South East
Baobab Reserve	37	South West
Vhembe Nature Reserve	22	West
Mapungubwe Hill	22	West
Mapungubwe National Park most eastern boundary	5.4km	West
Farm houses& lodges, School on Overvlakte, Church	Within 1km	Surrounding areas

2.1.1.12 Noise (JKA, 2009 – Annexure G)

Measurements and *auditory observations* were taken at eight main sites in order to establish the existing ambient noise conditions of the study area. Conditions for the daytime and evening periods at these points were ascertained.

In order to complement the short-term noise measurements in the study area, the existing 24-hour residual noise levels related to the average daily traffic (ADT) flows on Route R572 were also calculated.

For a detailed description of the main measurement sites and for more technical details of the measurement survey refer to Appendix B of the noise specialist report (Appendix G).

In overview, the existing situation with respect to the existing *noise climate* in the study area was found to be as follows (JKA, 2009):

- The existing typical residual noise climate in the study area is typical of a rural/agricultural environment as defined in SANS 10103:2008, that is, areas where ambient noise levels generally do not exceed 45dBA during the day and generally do not exceed 35dBA during the night-time. This area may be so defined even though the measured residual (prevailing ambient) noise levels were higher than that prescribed by SANS 10103. The reason for this is that the source and nature (qualitative aspect) of the sounds as well as noise levels need to be considered. In this instance the windy conditions which prevailed on both of the survey days resulted in slightly higher than normal ambient noise climate for such rural sites, as the sound of the wind in foliage and trees in the near field predominated. Another example is where ambient noise conditions at night are significantly enhanced by sounds from insects and frogs particularly in areas close to riverine areas and wetland areas.
- The existing *noise climate* alongside Road R572 is degraded with regard to rural residential living. Residences in some areas are negatively impacted from traffic noise (particularly at night) for distances up to 1000m from this road.

The main sources of noise in the area are from:

- Traffic on Provincial Road D1483 (Route R572) (intermittent noise)
- Traffic on the farm roads through the area (intermittent noise)
- Coal mine in Zimbabwe
- Pump stations along river (not major source of noise)
- General farming activities (not major source of noise)
- Hunting activities on the various game farms (not major source of noise)

<u>Sensitive receptors</u>

It is the existing residences and the schools in the study area that may defined as noise sensitive land uses. The main noise sensitive receptors in the area are:

- Various farmhouses, farm labourer residences and game lodge accommodation
- Farm school on the farm Overvlakte 125 MS
- Various nature reserves and game farms

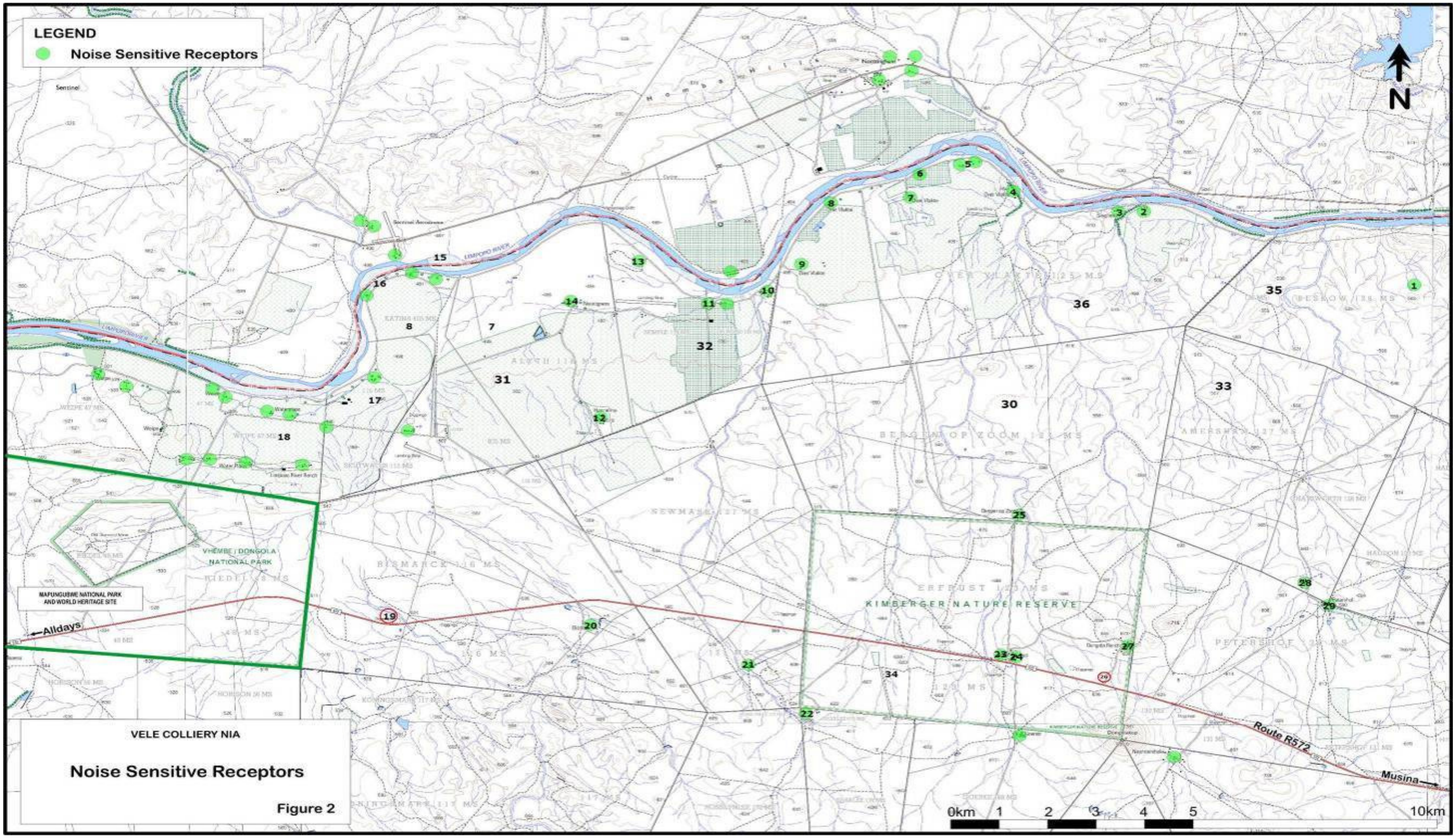


Figure 2.1.1.12: Sensitive receptors

2.1.1.13 Sites of archaeological and cultural interest (Roodt, 2009 – Annexure H)

The study area falls within what is best known as the Mapungubwe Cultural Landscape. The core area of the Mapungubwe Landscape to the west has been intensively studied for decades. Until recently, up to about 1999, the emphasis was mainly on the core area on the farm Greefswald and to a certain extent the neighbouring farms Samaria and Schroda. Mr. E.O.M. Hanish of the University of Venda, and formerly from the National Culture History Museum in Pretoria, has also systematically surveyed areas to the west and south of the Mapungubwe core area. Since 1999, the Archaeological Department of the University of the Witwatersrand engaged in an ongoing long-term project called “Origins of Mapungubwe”, involving extensive surveys, test excavations and postgraduate studies into the ethno-archaeology and archaeology of rainmaking in the Limpopo Basin.

The Early Stone Age in the Limpopo Valley is currently being studied by Dr. Kuman of Wits, but the Middle Stone Age has not received extensive attention and the only source is that of Thakeray (1992). In the last two millennia the valley was occupied by the San hunter gatherers and Khoe herders/hunter gatherers who left behind their paintings and Stone Age implements. Eastwood and Cnoops (1998) addressed the rock art of the Limpopo Basin, while Hall and Smith (2000) attended to the interaction between Hunter-gatherers and farming communities during the first and early second millennia AD.

The first Early Iron Age farmers in this part of the Limpopo valley were of the Kalundu Tradition (the western stream of migration into South Africa); know as Happy Rest (find site on the southern foot of the Zoutpansberg at Schoemansdal) and dating back to the 5^{th} – 7^{th} centuries AD. From about AD 700 to 900 the climate became colder and drier and no Early Iron Age sites from this period have been recorded in the Shashe-Limpopo basin.

At about AD 900 when the climate improved at the beginning of the Mediaeval Warm Epoch the basin was again settled by the next Early Iron Age inhabitants who belonged to the Zhizo archaeological facies, a ceramic phase of the Nkope Branch of the central stream of migration. The Zhizo capital at Schroda, a central cattle pattern settlement, is the earliest Iron Age site in Southern Africa to yield a substantial amount of ivory objects and imported glass beads. It seems that the Shashe-Limpopo basin, through the Zhizo group, was probably the first area in the interior to be integrated directly with the Indian Ocean trade network.

According to the archaeological record, Schroda lost control of the interior portion of the trade at about AD 1000 to a new group of people known as Leopard’s Kopje. They established their capital at K2 (on the farm Greefswald), also a central cattle pattern settlement, while commoner K2 sites are spread throughout the Basin. K2 produced a great number of ivory objects and an even greater quantity of glass beads showing that the Leopard’s Kopje people had clearly taken over the interior portion of the east coast trade. The people at K2 melted down some of the imported beads in clay moulds and produced large cylindrical beads known as “garden rollers”, which they in turn traded into the present day Botswana to where the Zhizo leadership had moved. The wide distribution of the “garden rollers” and limited distribution of other types of beads demonstrates the pivotal role K2 played in the trade network. Recent work by Calabrese at Little Muck indicates that the K2 chiefdom incorporated some Zhizo people who remained in the basin. The Zhizo derived pottery, called Leokwe, shows that they maintained their separate identity.

The great amount of trade goods at K2 shows that the trade had enhanced the leader’s status. It was two to three times the size of the Zhizo capital at Schroda. The general population of the basin increased during K2 times. This increase, in combination with the control of the east coast trade, helped to intensify social ranking and contributed to the development of a bureaucratic class its associated worldview, which manifested itself at Mapungubwe.

At AD 1220 the K2 leader shifted the capital to the flat hill called Mapungubwe about 2 km from K2. Here the king moved to the hilltop while the majority of his people lived below. This led to the final transformation of the central cattle pattern into the Zimbabwe Pattern where the leader was physically separated from his followers.

It is now known that the Zimbabwe culture evolved in the Shashe-Limpopo basin and that Mapungubwe was the first Zimbabwe capital. Consequently, archaeologists divide the culture into three chronological periods named after the important capitals;

(1) Mapungubwe (AD 1220-1290)

(2) Great Zimbabwe (AD 1290-1450)

(3) Khami (AD 1450-1820

Mapungubwe is known for its gold objects although it is not clear how gold was first discovered. Presumably Swahili traders recognised alluvial gold in the basin as it washed down the Shashe River and placed a value on it. At the beginning of the trade, gold was probably more of a means to wealth than wealth itself. However, by AD 1220 gold objects had been locally manufactured and Mapungubwe produced unique items such as the golden Rhino's, sceptre and bowl that were made from thin sheet tacked onto wooden cores. Gold was also produced from reef mining as far as West Nicholson and Gwanda district of Zimbabwe.

Mapungubwe's power and territorial sovereignty grew and it controlled up to 30 000 km^2. At its peak in the 13th century, Mapungubwe's own population was probably between 3 000 and 5 000 people making it the first urban centre and capital of the first state in Southern Africa.

At the end of the 13th century the climate throughout Southern Africa appears to have been affected by the spread of the Little Ice Age, and it became colder and drier in the interior. In some areas it was no longer possible to cultivate traditional grain crops. As a consequence, Mapungubwe was abandoned, the entire basin depopulated and the state disintegrated. Great Zimbabwe became Mapungubwe's economic, cultural and political successor.

Khami sites dating to after AD 1450 are found in the Basin. Prior to this and shortly after the demise of Mapungubwe, the first Sotho/Tswana people moved into this part of the interior from East Africa. This early facies of the pottery tradition is called Icon after the farm south-west of Mapungubwe. Icon pottery occurs on Khami sites north of the Zoutpansberg and similarly Khami pottery occurs on Icon sites south of the Zoutpansberg. Khami and Icon merge to form the Letaba style that is associated with Venda-speaking people today.

Huffman (2007) proposed the under-mentioned cultural sequence for the Mapungubwe cultural landscape in this general area.

- Zhizo (AD 750-1050)
- Leokwe (AD 1050-1220)
- K2 (AD 1000-1200)
- K2 Transitional (AD 1200-1250)
- Mapungubwe (AD 1250-1300)
- Great Zimbabwe (AD 1300-1700)
- Icon (AD 1300-1500)
- Khami (AD 1400-1820)

More broadly, Huffman's distribution sequences of the Iron Age in the study area may include the remains of the under-mentioned culture historical groups:

- *Uruwe Tradition*, originating in the Great Lakes area of Central Africa, was a secondary dispersal centre for eastern Bantu speakers. It represents the eastern stream of migration into South Africa.
    - Kwale Branch:
        - Mzonjani facies (Broederstroom) AD 450 – 750 (Early Iron Age)
    - Nkope Branch:
        - Zhizo facies AD 750 – 1050 (Early Iron Age)
        - Leokwe facies AD 1050 – 1220 (Middle Iron Age)
    - Moloko (Sotho-Tswana) Branch (Late Iron Age)
        - Icon facies AD 1300 – 1500: This pottery is associated with the first Sotho Tswana people entering the country.
- *Kalundu Tradition*, originating in the far North of Angola, was another secondary dispersal centre for eastern Bantu speakers and represents the western stream of migration into South Africa.
    - Benfica Sub-branch:
        - Bambata facies AD 150 – 650 (Early Iron Age)
    - Happy Rest Sub-branch:
        - Happy Rest facies AD 500 – 750 (Early Iron Age)
        - Eiland facies AD 1000 – 1300 (Middle Iron Age)
        - K2 & Transitional facies AD 1000 – 1250 (Middle Iron Age)
        - Mapungubwe facies AD 1250 – 1300 (Middle Iron Age)
        - Great Zimbabwe facies AD 1300 – 1700 (Late Iron Age)
        - Khami facies AD 1430 – 1820 (Late Iron Age)
        - Letaba facies AD 1600 – 1840 (Later Iron Age)

Archaeological sites of the Mapungubwe landscape have been recorded at Skutwater (Van Ewyk: 1987) and Bismarck (Roodt: 2001) adjacent farms immediately west of the study area.

Archaeological and Historical Remains (Roodt, 2009 – Annexure H)

Stone Age Remains

The study area seems to fall within a region where evidence suggests that Early Stone Age, Middle Stone Age, and Late Stone Age occupations occurred in the area, with Middle Stone Age being most visible. No specific concentrations were recorded to date, but isolated and scattered Middle Stone Age material was found over most of the study area. No rock art sites were found.

On the farm Newmark 121 MS an incomplete Acheul hand axe was recorded at **Site 21** (*S22º 11' 32.0" E29º 36' 11.0"*) where sheet erosion has exposed the gravels. An Acheul cleaver was recorded at site 22 (*S22º 12' 28.4" E29º 36' 45.0"*) where it laid on the surface of an open area.

Site 20 (*S22º 12' 23.4" E29º 34' 48.4"*) is a hilltop Stone Age site containing Late Stone Age and possibly some Middle Stone Age flakes. This particular hilltop will not be affected by the mining.

Iron Age Remains

A number of Iron Age sites were recorded in the study area. Many were identified only by a small number of pottery fragments and the particular open nature of the terrain, which was probably induced by human occupation. Others contain clear deposits and or grain bin stands.

Site 1. *S22º 08' 35.6" E29º 40' 45.0"*: An open area containing archaeological deposits, which includes diagnostic pottery fragments. The pottery is tentatively identified as belonging to the Happy Rest facies of the Early Iron Age. Significance: Medium.

Site 2. *S22º 08' 47.8" E29º 40' 53.3"*. A brackish fountain and although it is an ecological feature, it would have been used by Iron Age people especially for salt making and thus has cultural significance. Because of this, the area contains pottery fragments. Significance: Medium.

Site 4. *S22º 09' 45.7" E29º 37' 27.2"* – This is an extended Middle Iron Age site with the key feature being the grain bin stand found scattered over the area. The site is immediately northwest of the dam on Overvlakte 125 MS, and was probably disturbed during construction of the dam – some features may be below water level. The pottery is identified as Transitional K2 facies. Significance: Medium.

Site 5. *S22º 10' 35.6" E29º 40' 29.1"*. An open area containing archaeological deposits, which includes diagnostic pottery fragments. The pottery is identified as belonging to the Mapungubwe facies of the Middle Iron Age. Significance: Medium.

Site 9. *S22º 09' 19.3" E29º 35' 35.3"*. A large open area containing a scattering of pottery fragments. Unidentified. Significance: Low.

Site 10. *S22º 08' 59.3" E29º 35' 13.8"*. A large site on a sandy plateau. Contains non-diagnostic pottery, mainly from disturbed warthog burrows. Significance: Medium.

Site 11. *S22º 08' 27.2" E29º 38' 54.6"*. A small kopje containing ashy deposits and K2 pottery. Already disturbed by the construction of a reservoir. Significance: Medium.

Site 12. *S22º 11' 24.8" E29º 38' 58.7"*. Small open area on an eroded calcrete outcrop containing non-diagnostic pottery fragments. Significance: Low.

Site 13. *S22º 11' 10.0" E29º 39' 00.4"*. Large open area containing a few non-diagnostic pottery fragments as well as two grain bin stands. Probably a K2 site. Significance. Low.

Site 14. *S22º 10' 44.2" E29º 39' 18.4"*. This site contained only an upper grinder. Significance: Low.

Site 15. *S22º 10' 53.0" E29º 39' 20.2"*. This site contained pottery fragments, metal working depris, a hammer head, Iron Bangle remains and a piece of woven copper wire. The pottery is identified as Khami, and it seems to be a metal working site and not a living site. Erosion has disturbed much of the site. Significance: Medium.

Site 16. *S22º 10' 49.1" E29º 39' 51.2"*. This is a sheet eroded open ashy area with scattered pottery fragments and a grain bin stand. Probably K2. Significance: Low.

Site 17. *S22º 10' 51.9" E29º 39' 47.9"*. This site is similar to site 16 above. Significance: Low.

Site 18. *S22º 10' 25.3" E29º 40' 19.4"*. This site consists of a large open are with a few non-diagnostic pottery shards. Evaluation here is inconclusive and therefore it must be given at least a medium significance rating.

Site 19. *S22º 10' 25.4" E29º 40' 28.6"*. The site consists of an open area with clear ashy deposits, grain bin stand and an upper grinder. The pottery is non-diagnostic. Significance: Medium.

Site 23. *S22º 08' 32.3" E29º 40' 56.0"*. This site contains ashy deposits with non-diagnostic pottery. It also contains two stone circles of about 5 m. in diameter, but no historical rubble, meaning that it probably pre-dates the colonial period. Significance: Medium.

Site 24. *S22º 08' 56.0" E29º 41' 14.4"*. This site contains grain bin stands and ashy deposits with large number of pottery fragments identified as K2/Mapungubwe. Site has been subjected much sheet erosion. Significance: Medium.

Site 25. *S22º 09' 03.6" E29º 41' 09.2"*. This site is near 24 above and is very similar. Significance: Medium.

Site 26. *S22º 08' 53.1" E29º 39' 22.4"*. This site contains a scattering of non-diagnostic pottery. Significance: Low.

Recent Historical Remains

Site 7. *S22º 12' 04.3" E29º 40' 27.4"*. This is an old mineshaft – age could not be determined. If older than 60 years, it is protected by section 34 of the National Heritage Resources Act. Significance: Low.

Site 8. *S22º 12' 19.6" E29º 40' 01.4"*. This is the old farmhouse on Bergen Op Zoom, which may be older than 60 years and must be verified. A nearby antique water pump also has cultural significance.

Graves

Site 3. *S22º 09' 39.3" E29º 37' 02.0"* – An informal graveyard directly west of the existing dam on Overvlakte 125 MS. Six (6) graves were identified - probably Zimbabwean farm workers who were buried here recently. Significance: High.

Site 6. *S22º 11' 14.6" E29º 41' 11.5"*. The site contains a stone cairn that may possibly be a grave near the foundations of a demolished structure. Significance: High if it is a grave and must be verified.
The probability that Iron Age archaeological sites may contain unmarked burials is >80%.

Landowner's Family Graves - The Esterhuyse family graves consist of Natasha Betsy Willemse - died on 18 Feb 1994 and Barend Burk Esterhuyse – died on 6 August 1993, and are located on the farm Overvlakte.

Palaeontological Remains (Durand, 2009 – Annexure I)

No fossiliferous material was found *in situ* in the outcrop or weathered out in the alluvium below the outcrop, mainly because most of the fossiliferous layers are presently covered by alluvium and non-fossiliferous geological strata.

However, previous studies confirmed the presence of vertebrate fossils in the Tuli Block and the Solitude, Klopperfontein and Clarens Formations. Thus, when the soil cover is stripped in the region and these formations are opened, vertebrate fossils will probably be exposed.

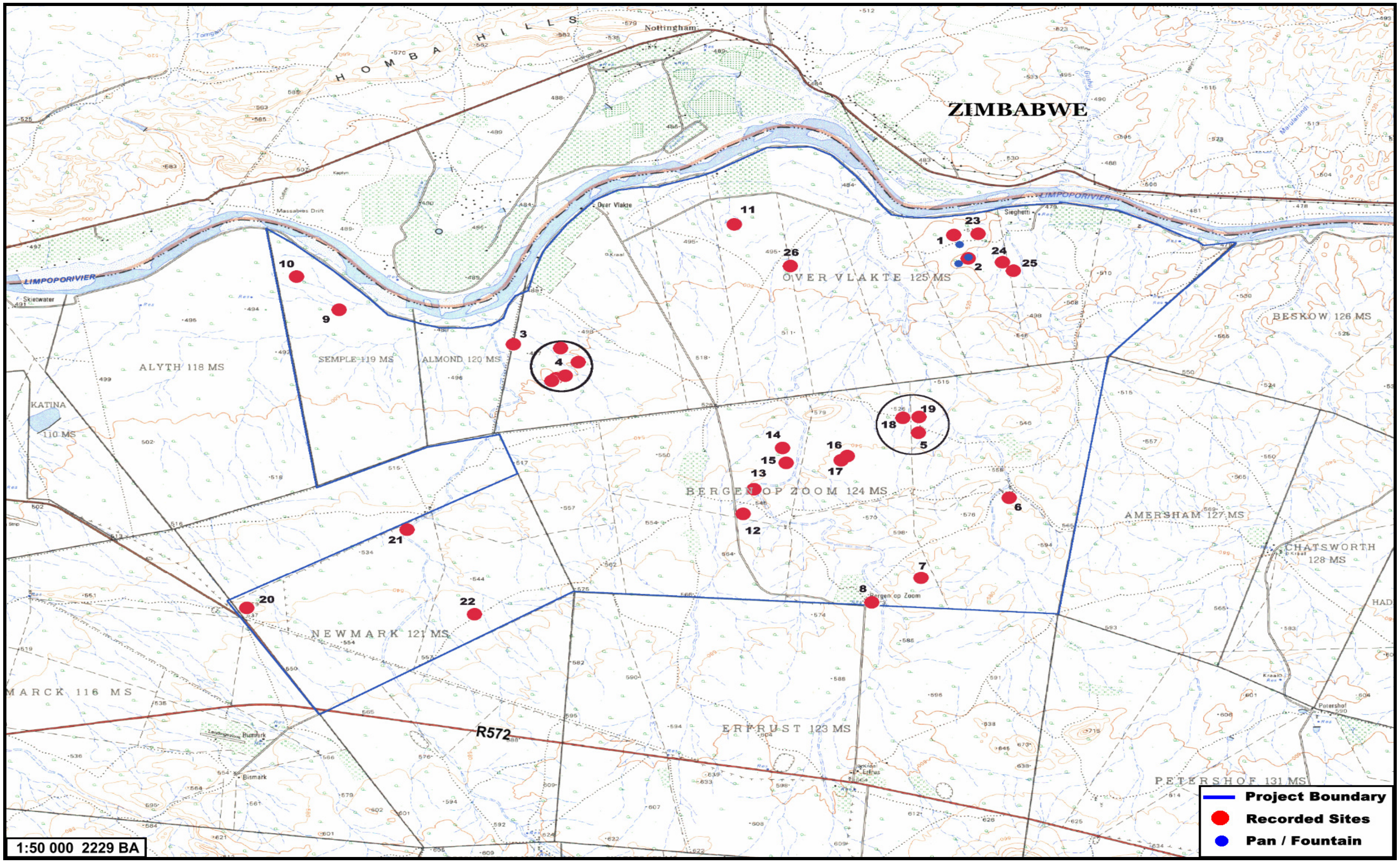


Figure 2.1.1.13: Position of identified heritage sites and graves

2.1.1.14 Sensitive landscapes

Mapungubwe World Heritage Site and National Park

The Mapungubwe Cultural Landscape achieved world heritage status in 2003 based on the following criteria:

- This landscape contains evidence of an important interchange of human values that led to far-reaching cultural and social changes in southern Africa between AD 900 and 1300.
- The remains of this landscape are a remarkable complete testimony of the growth and subsequent decline of the Mapungubwe state which at its height was the largest kingdom in the African subcontinent.
- The establishment of Mapungubwe as a powerful state trading through the East African ports with Arabia and India was a significant stage in the history of the African subcontinent.
- The remains in the Mapungubwe cultural landscape graphically illustrate the impact of climate change and record the growth and then decline of the kingdom of Mapungubwe as a clear record of a culture that became vulnerable to irreversible change.

The core area of the Mapungubwe cultural landscape is the Mapungubwe National Park. In line with the above SANParks (2006) emphasises these criteria as vital attributes underpinning the value proposition of the Park:

The Mapungubwe Cultural Landscape exhibits an important interchange of human values, over the time period between AD 900 and 1300 in Southern Africa, on developments in technology, and town-planning, bearing a unique or at least exceptional testimony to a cultural tradition or to a civilisation which has disappeared from the Limpopo/Shashe area; it is an outstanding example of a type of architectural and technological ensemble and landscape which illustrates a significant stage in human history, and it represents an outstanding example of a traditional human settlement and land-use which is representative of a culture that became vulnerable under the impact of irreversible change.

This is an organically evolved landscape, constituting both:

- a relict (or fossil) landscape in which an evolutionary process came to an end at some time in the past, either abruptly or over a period. Its significant distinguishing features are, however, still visible in material form; and
- an associative cultural landscape by virtue of the powerful religious, artistic and cultural associations of the natural elements of the landscape rather than material cultural evidence, which may be insignificant or even absent.

The Mapungubwe cultural landscape is thus highly significant and could have stretched as far as east of Musina town, although limited surveys have been undertaken and little is known of the landscape east of the core area.

Limpopo-Shashe Transfrontier Conservation Area

The Limpopo-Shashe Transfrontier Conservation Area (TFCA) was formalised in 2006 with the Trilateral Memorandum of Understanding (MoU) that has been drawn up with the objective of establishing this conservation area of 5,040 km^2. On 22 June 2006, the MoU signaling the three nations' intent to establish and develop this TFCA was signed by Mr Kitso Mokaila, Botswana's Minister of Environment, Wildlife and Tourism, Mr Marthinus van

Schalkwyk, South Africa's Minister of Environmental Affairs and Tourism and Mr Francis Nhema, Zimbabwe's Minister of Environment and Tourism.

The establishment of the TFCA will further, as one of the objectives, serve as a buffer zone for the Mapungubwe Cultural Landscape.

During a meeting with Sanparks, Peace Parks Foundation, DEAT and SAHRA on 23 January 2009, it was established that the tri-lateral MoU for the TFCA that was signed in 2006 only refers to three of the areas, namely the Mapungubwe National Park in SA, the Northern Tuli Game Reserve (Notugre) in Botswana and the Tuli Circle Safari Area.

The currently proposed TFCA boundaries (according to the websites of SANParks, Peace Parks Foundation and the Mapungubwe National Park EMP) are shown in Figure 2.1.1.14. Thus, the proposed mining area falls outside the current planned areas for the TFCA. This is probably due to the fact that most of the area is currently utilised for intensive agriculture.

It must be noted however that plans for the extension of the TFCA footprint has been developed; however, these have not yet gone through the consultation and approval processes stipulated in the National Environmental Management: Protected Areas Act, 2003 (Act No 57 of 2003).

Private nature reserves

A number of private nature reserves were proclaimed in and adjacent to the proposed mining area, namely:

- Sighetti, 1965 – Overvlakte 125 MS (Portion 3?)
- Skuldwater Ranch, 1965 – Alyth 118 MS
- Vereuell Ranch, 1967 – Beskow 126 MS

The legal status of these nature reserves, according to the National Environmental Management: Protected Areas Act, 2003 (Act No 57 of 2003), is at this stage also uncertain and clarification needs to be obtained. However, apart from the farm Beskow 126 MS, large portions of the said nature reserves are currently extensively cultivated.

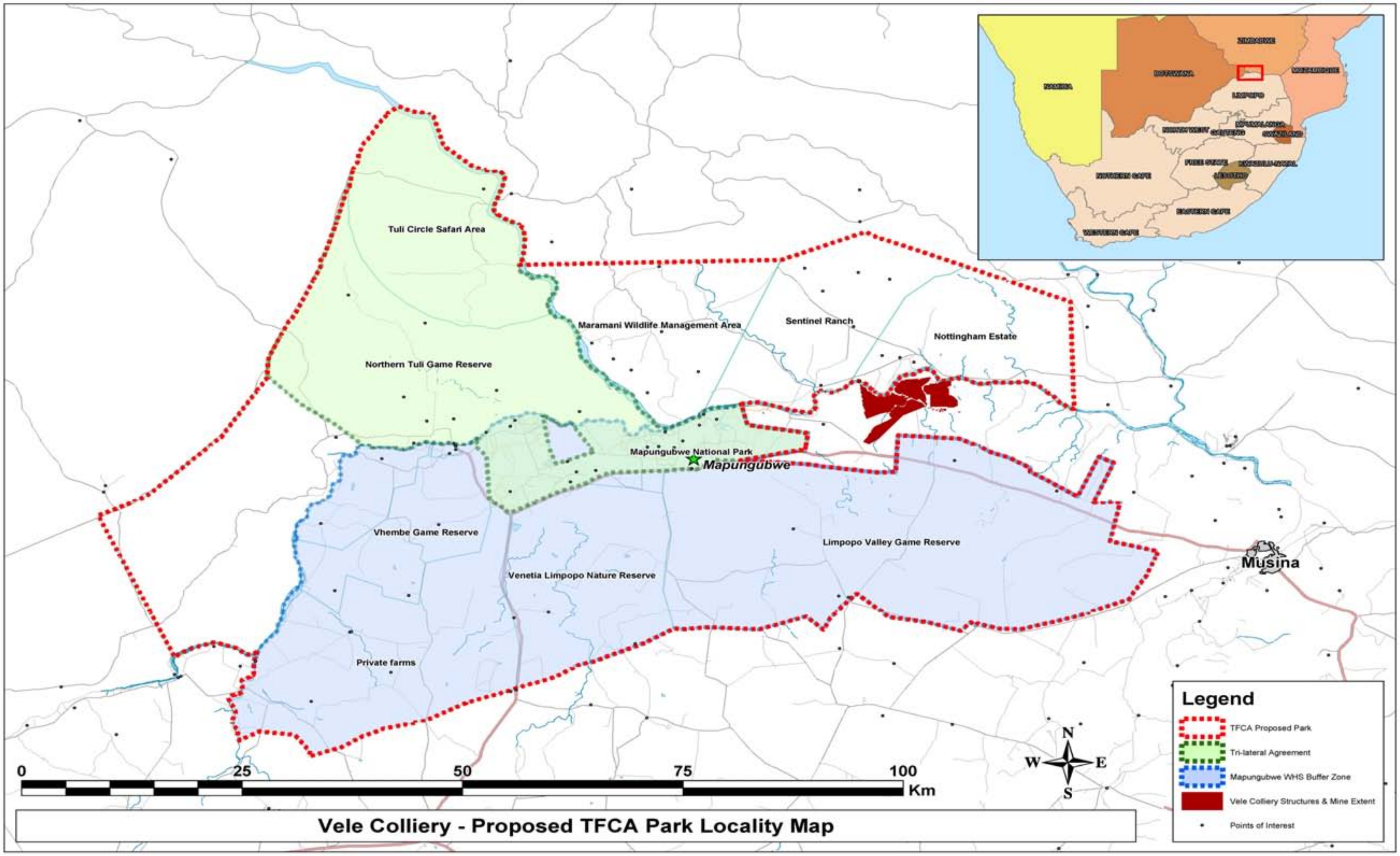


Figure 2.1.1.14(a): Proposed Limpopo-Shashe Trans-Frontier Conservation Area

Ecological Sensitivity (Dubel, 2009 – Annexure C)

An ecological sensitivity analysis, based on the landscape-vegetation communities, was conducted by the biodiversity specialist (Dubel, 2009).

In summary, the floodplains, Limpopo Riverine forest, rivers, rocky outcrops, pans and springs are considered to be of high conservation value. The sandstone ridges and platos are considered as unique habitats in this mopane veld because it provides diversity and have a higher species diversity than other areas in the study area.

The riparian wetlands in the study area are regarded as the most sensitive areas and have a unique species composition and ecosystem functioning. These systems provide habitat for several amphibious, invertebrate, flora and other fauna species. The two (2) permanent springs on Bergen op Zoom also provide a critical source of drinking water for all fauna species during the dry winter months when water availability is problematic. Together with the depressions (pans), these water bodies fulfil a critical role in thermoregulation of fauna species during the hot summer months.

Although currently degraded, alluvial areas in the agricultural areas can be classified and are regarded as part of the riparian wetland system. These areas are also specifically delineated in the capability soil class classification as riparian areas. These areas are important for rehabilitation in terms of functioning of the sensitive river and riparian ecosystem.

The sensitivity map is shown in Figure 2.1.1.14(b).

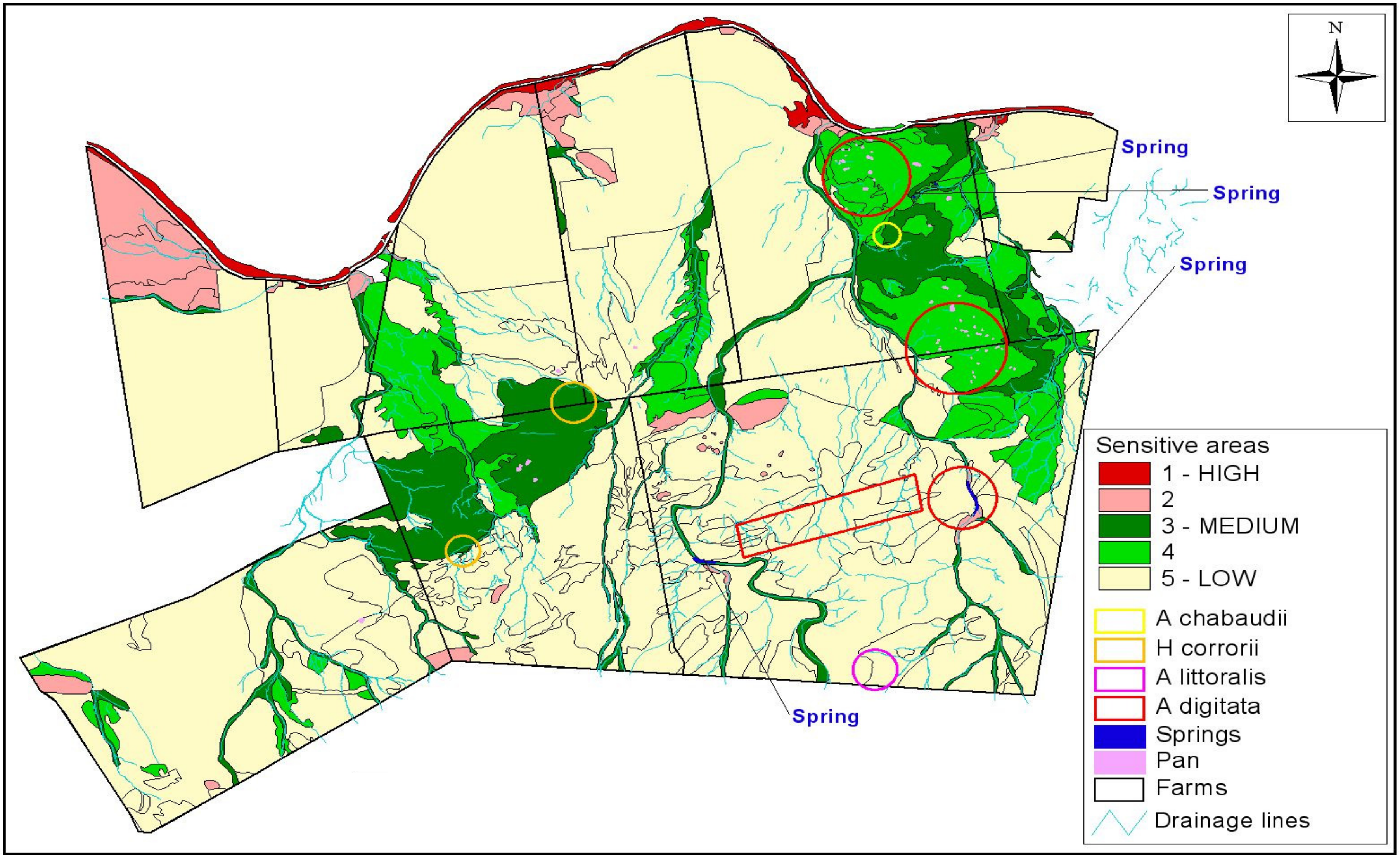


Figure 2.1.1.14(b): Ecological sensitivity map

2.1.1.15 Visual and aesthetic aspects (MetroGIS, 2009 – Annexure J)

The landscape character, from a visual and aesthetical point of view, is formed by vegetation and topography and the way in which it has been transformed by human activity.

The proposed mine is situated in a low lying area immediate south of the Limpopo River. The floodplain areas of the river are being cultivated for crops ranging from citrus to corn, with the remainder of the study area mostly in its natural state. Tourism, game farming and hunting are the main economic activities in these areas.

The way in which elements of vegetation and topography contribute to the sense of place is briefly described as follows:

Vegetation: According to the SANBI Vegmap (2006) database the vegetation of the area consists mainly of *Musina Mopani Bushveld*, and *Limpopo Ridge Bushveld* associated with rocky slopes. *Subtropical Alluvial Vegetation* is associated with the floodplain areas of the Limpopo River. High visual quality is brought about by the abundance of trees and shrubs which dominate the field of vision, especially along the roads and places of interest associated with tourism.

Topography: The topography can be described as unfolded plains with isolated granite outcrops and ridges. The terrain slopes from high ground in the south towards the Limpopo river with a difference in elevation of approximately 200m (excluding koppies). Rocky outcrops caused by erosion provide for unique geological formations with high visual qualities.

Sense of Place: Visiting the area is an experience of calmness. Together with the generally low presence of people in the area, the Mopane veld with the isolated occurrence of Baobab and Granite koppies gives a distinct character to the stretched out plains of the study area. The sense of place can be described as quiet and peaceful. Night time experiences are very quiet with complete darkness during moonless nights. This allows for excellent views of the night skies and the brightness of stars contrasted against the black of darkness.

The visual qualities of the environment and the particular sense of place leave one with a good perception of the area, which is quite vulnerable to the introduction of mining and industrial activities.

Sensitive receptors

Four groups of potential viewers have been identified as having differing observer incidences and/or perceptions. These are:

- *Permanent residents*: The permanent residents in the study area are mainly farm owners and workers. Farmsteads occur in a linear pattern along the Limpopo River and the R572 road. Farmsteads within the core area of visual impact (< 10km) and with a direct line of sight to any part of the mine are likely to experience medium to very high visual impacts, depending on the extent of exposure. In this context residents in Zimbabwe north of the mine are expected to experience the highest visual impact by virtue of their proximity and elevated vantage point in relation to the mine.
- *Private lodge owners and tourist safaris*: The concerns raised by this group include the visibility of the mine; the impact that the proposed development will have on the sense of place as it is currently experienced in the area; and the impact of lighting and associated sky glow in the absence of any other light sources. It is evident from the comments by this group that the proposed mine is perceived to have a negative impact on their business operations. This is of concern within the core area of visual impact, especially where a direct line of sight will expose the mine to visitors.

- *Road travelers*: Roads concentrate people who use it to reach a routine destination (e.g. shopping), a recreational destination, or just as part of a leisure experience. The R572, as the only main road going through the study area, is carrying relatively low volumes of traffic at present. The number of potential sensitive viewers on this road is therefore low and will mostly be local residents, tourists and incidental travellers.
- *Mapungubwe National Park:* SANParks have delineated a *viewshed protection area* around the park which is overlapping the west pit by approximately 50%, as illustrated by the map. This zone is particularly concerned with visual impacts, both day and night.

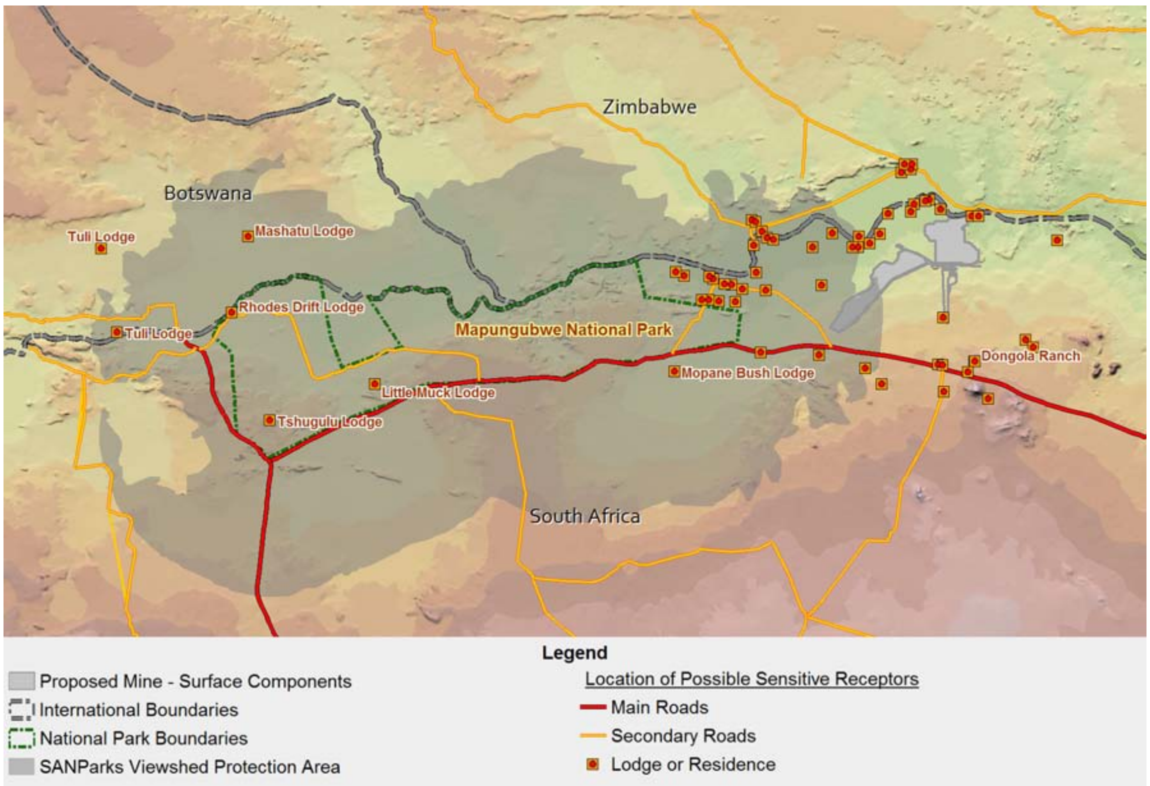


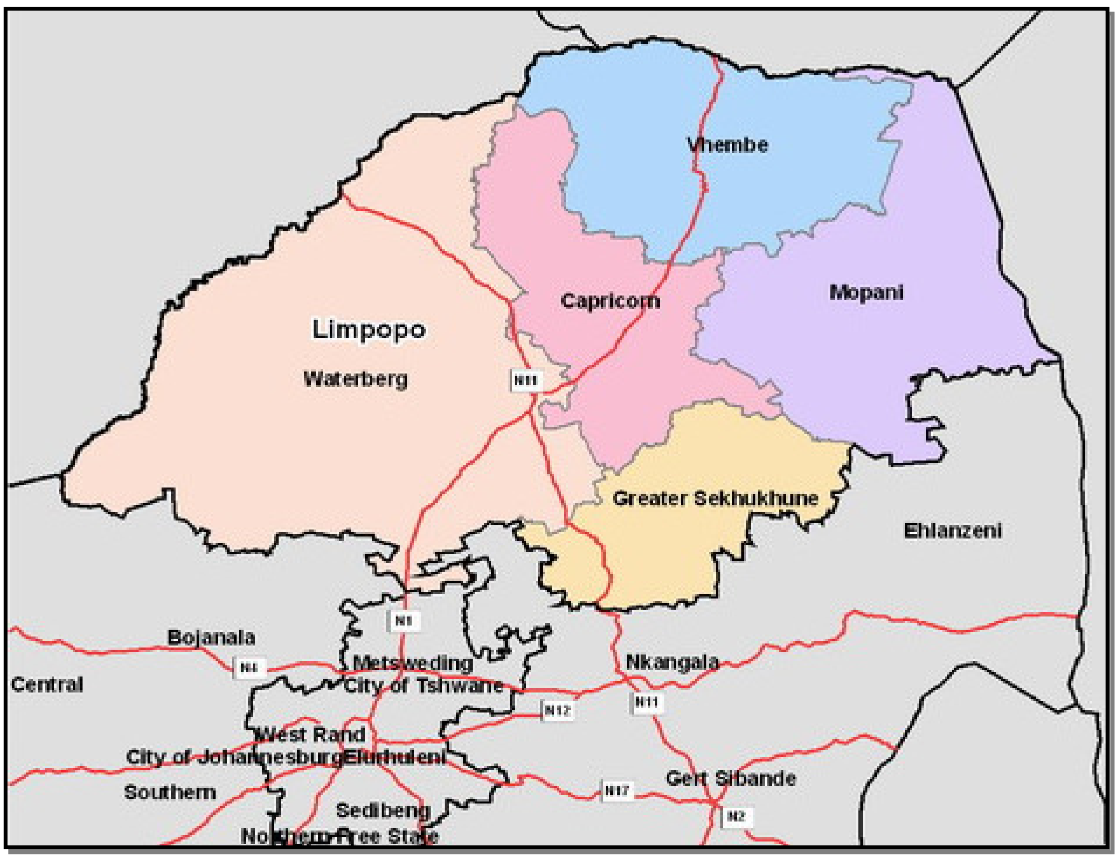
Figure 2.1.1.15: Location of possible sensitive receptors

2.1.1.16 Regional socio-economic structure (Naledi, 2009 – Annexure L)

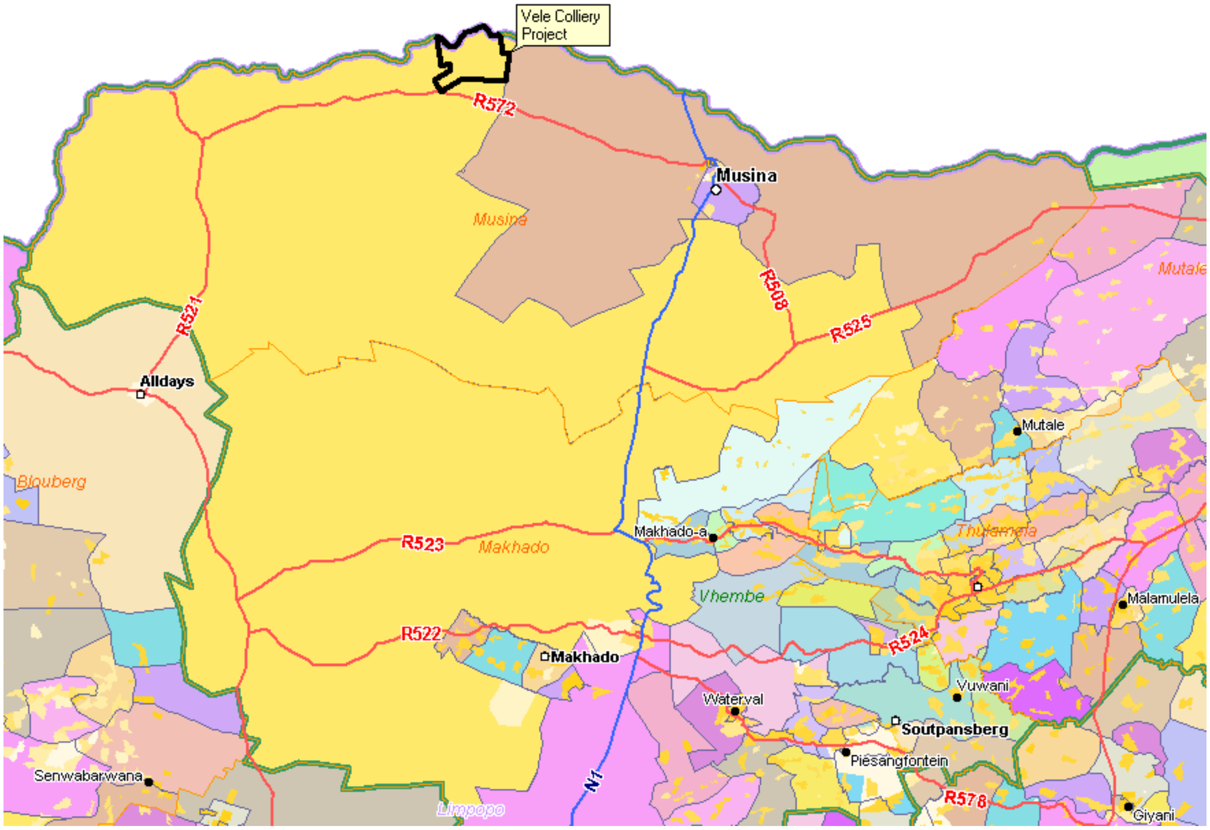
The project area is within the Musina Local Municipality and Vhembe District situated in the Northern part of Limpopo Province, sharing borders with Zimbabwe in the north.

Vhembe District Municipality with its head quarters in Thohoyandou was established in 2000 through the process of transformation of Local Government. It was established in terms of Municipal Structures Act 117 of 1998 as a demarcated sphere of governance. It is composed of four local municipalities, namely; Makhado, Musina, Thulamela and Mutale. It covers 21,407 km^2 and has population of over 1.1 million living in 274,480 households.

The Musina Local Municipality is located in the very north of the Vhembe District, covering an area of approximately 757 829 ha that extends from the confluence of the Mogalakwena and Limpopo River in the west to the confluence of the Nwanedi and Limpopo River in the east and from Tshipise and Mopane in the south to Botswana/Zimbabwe borders (Limpopo River) in the north.



The Musina Municipality is made up of five municipal wards, of which three falls within the urban centre of Musina. Ward one stretches from the western boundary of Musina Municipality to Tshipise in the east. Wards 1 and 2 are the largest wards and are of a rural nature. Wards 3, 4 and 5 make up the peri-urban and urban settlement of Musina. Musina Municipality is characterized by a relatively equal urban-rural population split with nearly half of the population in Musina Municipality residing in the urban areas centred on Musina town. Commercial activities are also almost exclusively concentrated in these areas.



Musina can be described as a provincial growth point due to their relative high level of economic activity and rendering of services to local and surrounding communities. Two industrial nodes are found in Musina i.e. Musina ext 3 and Musina ext 1; Industrial node 1 is located to the south of Musina, to the west of the N1-National Road. The industrial area has rail facilities and caters mainly for heavy and noxious industries. Sufficient land, which is owned by the municipality, is also available to extend the industrial node towards the south. Industrial node 2 is located to the north of Musina, to the east of the N1-National Road. This industrial area caters only for light and service industries.

The economy of Musina Municipality is concentrated, with the mining sector making the biggest contribution to the economy of Musina Municipality. The agricultural sector is fairly well established, focused mainly on game farming and horticultural production. Horticultural and particularly the vegetable production seasons are significantly longer in the municipality than in other parts in the country, as a result of its favourable climatic conditions. This provides considerable development potential for the expansion of production, as well as the diversification of agricultural production into other commodities. Significant development potential also exists in the expansion of the game farming industry.

Musina Municipality also boasts a number of unique tourism attractions, based mainly on natural beauty, wildlife conservation and hunting and the cultural heritage of the region related to the people of Mapungubwe. The Mapungubwe site, declared a world heritage site, forms the anchor attraction to the Municipality, with a number of rock art sites and private game farms and lodges complementing this attraction. These attractions, if marketed effectively, create opportunities for increased tourism flows to the Municipality. The strong tourism sector in the Municipality also creates opportunities for the development of locally produced arts and crafts.

Musina Municipality and Musina town in particular also benefits from an advantageous strategic location in relation to the N1 and the Beitbridge and Pontdrift border posts. This creates opportunities for this locational benefit to be exploited and marketed to potential.

Population and gender distribution

Year	South Africa		Limpopo Prov		Vhembe District		Musina LM	
	2001	2004	2001	2004	2001	2004	2001	2004
Total population	44,551,828	45,857,654	5,259,673	5,466,931	1,189815	1,245015	39,061	42,656
Average annual growth	1%		1.3%		1.5%		3%	
Male Female	48% 52%	48% 52%	47% 53%	48% 52%	47% 53%	47% 53%	48% 52%	50% 50%

Musina Municipality had a population of over 42,000 people in 2004 with a comparatively higher average per annum growth rate (3%) than that of the District (1.5%), the Province (1.3%) and South Africa as a whole. The higher population growth could most probably be linked directly to the large influx of population being experienced from neighbouring countries such as Zimbabwe. This might create a problem as it will put pressure on all services as well as have an influence on unemployment. The influx of these people might increase in future but to predict to what extend numbers will decrease or increase is difficult to determine, making future planning problematic. Population growth is, however, affected by the HIV/AIDS prevalence in the area and it is thus important to take the HIV/AIDS prevalence into consideration when population projections are made.

HIV/AIDS		Ages 0 – 14		Ages 15 - 64		Ages 65+	
Actual	%	Actual	%	Actual	%	Actual	%
532.16	12%	209.95	2%	51.10	17%	1.38	0%

Approximately 12% of the total population in the Musina Municipality is HIV positive or has AIDS. The Table above indicates that the highest HIV/AIDS prevalence is found in the ages between 15 and 64, which also make up the potentially economically active group of the population. The HIV/AIDS prevalence rate in the 15-64 (17%) age category is also shown to be higher than the Municipality's (12%) overall total. This is problematic in that the high HIV/Aids prevalence in the potentially economically active age group could negatively affect the Municipalities economic performance in the future. It will also put strain on existing healthcare facilities. The prevalence rate is lowest among the elderly members of the population, that is those who are 65 years and older. HIV/AIDS prevalence has been significantly increasing from 1995 to 2004. The implication of the high prevalence rate in the 15-64 year age group is a decrease in the labour force and an increase in child-headed homes. In 1995, the HIV/AIDS prevalence rate was below 5% for both the overall total in Musina Municipality and the 15-64 year age category. The HIV/AIDS prevalence started to rise speedily from 1997 to 2004.

There are slightly more women (52%) than men (48%) in South Africa, and the male and female proportions have remained relatively equal for the years 2001 and 2004. The Provincial, District and Municipal gender distributions are relatively in line with National trends. In the Musina Municipality there were slightly more women than men in 2001 (52% female and 48% male), while in 2004 the male female distribution was equal.

Race distribution

Year	South Africa		Limpopo Prov		Vhembe District		Musina LM	
	2001	2004	2001	2004	2001	2004	2001	2004
Black	79%	79%	97%	98%	99%	99%	93%	94%
Indian	9%	9%	0%	0%	0%	0%	0%	0%
Coloured	2%	2%	0%	0%	0%	0%	0%	0%
White	10%	9%	2%	2%	1%	1%	7%	5%

From the Table above it is clear that the proportion of Coloured and Indian population groups represent less than one percent of the Limpopo Province, the Vhembe District and Musina Municipality. Musina Municipality had a higher percentage (5%) of White population in 2004 than the Province (2%) and the District (1%). The majority of the population in Musina Municipality is Black South Africans, represented by 94% of the population in 2004.

Urban/non-urban distribution

Distribution	South Africa	Limpopo Prov	Vhembe District	Musina LM
Urban	58%	12%	6%	49%
Non-urban	42%	88%	94%	51%

South Africa has approximately 58% people residing in urban areas and 42% in non urban settlements. The Limpopo Province and the Vhembe District have far higher proportions of people residing in rural or non-urban areas, whereas, Musina Municipality has a relatively equal urban (49%) and non-urban (51%) share. In other words, nearly half of the population in Musina Municipality resides in urban areas, which is a much higher proportion compared to that of the Province (12%) and the District (6%). The higher proportion of people residing in urban areas within Musina Municipality is possibly due to the fact that Musina Municipality has fewer main places/towns with a larger concentration of people compared to other areas in the Vhembe District which are more sparsely populated. The fact that people are concentrated in fewer areas within Musina Municipality implies that it is easier to distribute services compared to other areas within the Vhembe District, where the population is geographically dispersed over larger regions. It may however put a lot of pressure on the infrastructure and services of the municipality. This also implies that equal attention should be given to urban and rural development in Musina Municipality. According to the IDP of Musina Municipality, approximately 44% of the total population is residing on commercial farms, which comprises almost the whole of the non-urban areas in the Municipality.

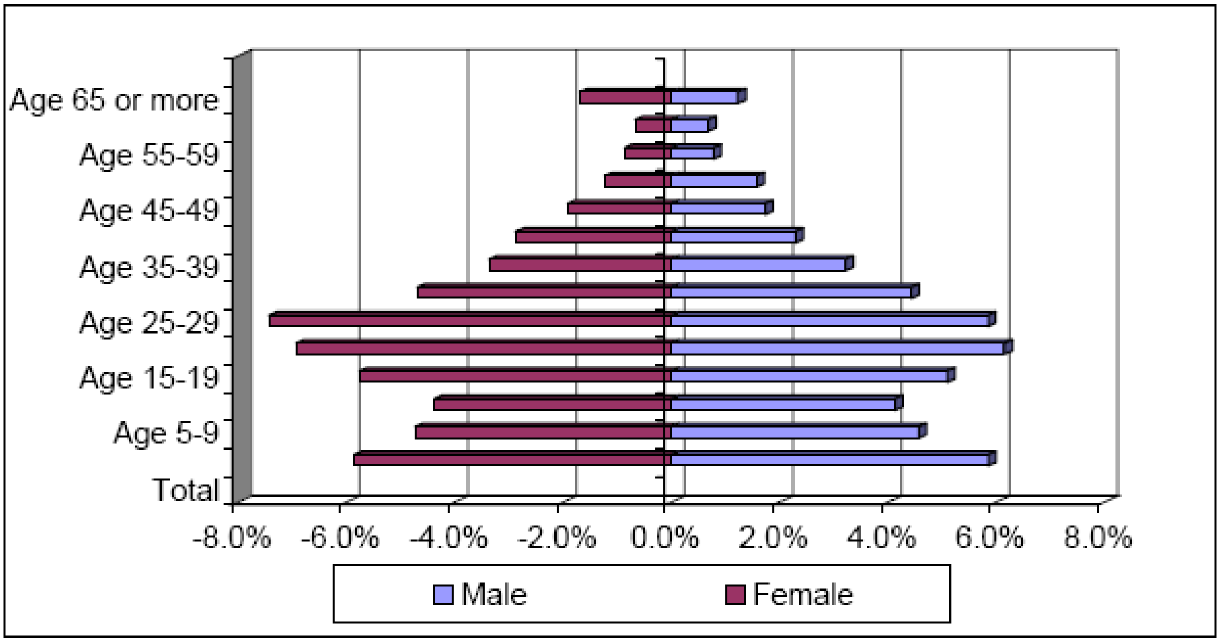
Place	Population	Percentage
Musina Non Urban area	13179	34%
Nancefield	8444	21%
Musina town	4384	11%
Harper Mine Compound	3883	10%
Soutpansberg Non Urban area	3642	9%
Kempo Mine Compound	1793	5%
Madimbo	1690	4%
Dzanani Non Urban area	681	2%
Feskraal	773	2%
Lost City	442	1%
Folorodwe	250	1%
Doppie	72	Less than 1%
Bergview East	51	Less than 1%
Total	**39,284**	**100%**

The Musina peri-urban area comprises by far the largest proportion (34%) of the total population in Musina Municipality. Nancefield sub-place comprises the second largest population share with 21%. Bergview East has the smallest population share (51 persons), followed by Doppie (72 persons), both contributing less than 1% to the total population. The Mutali main place (comprised of Doppie, Feskraal, Folorodwe and Madimbo) contributes only 7% of the total population, while the Musina main place (comprising Dzanani rural area, Musina peri-urban area and Soutpansberg rural areas has a concentration of nearly half (45%) of the Municipality's population. The Musina main place (comprising Musina town, Bergview East, Harper Mine Compound, Kempo Mine Compound and the Lost City) has the second highest concentration of population (27%), and Nancefield contributes approximately 21% to the total population of Musina Municipality.

Place	Number of people	Number of households	Area (km^2)	Population Density	Household Density
Musina Non Urban area	13183	4360	5363	2.5	0.8
Nancefield	8443	2442	1.7	4995.9	1445
Musina town	4389	1124	12	362.4	92.8
Harper Mine Compound	3879	1117	0.8	4910.1	1413.9
Soutpansberg Non Urban area	3651	894	2196	1.7	0.4
Kempo Mine Compound	1795	464	0.3	5439.4	1406.1
Madimbo	1693	376	1	1292.4	287
Feskraal	773	178	1	696.4	160.4
Dzanani Non Urban area	686	378	659	1	0.6
Lost City	448	116	0.3	1244.4	322.2
Folorodwe	253	107	0.2	1686.7	713.3
Bergview East	79	12	1.5	32.2	7.9
Doppie	68	11	0.2	340	55
Total	**39310**	**11579**	**8237**	**4.8**	**1.4**

Although population totals give a general indication of where the majority of people are located, they do not consider the size of the areas covered in each area. In this respect, density totals give a better indication of where the largest settlements are found. The overall density of Musina Municipality was only 4.8 persons per square kilometres in 2001. This is due to the large size (8237 square kilometres) and the relatively low population (approximately 40,000 people) of Musina Municipality. The highest population densities occur in Kempo Mine Compound (approximately 5 500 people per square kilometre), followed by Nancefield (5000 people per square kilometre), and the Harper Mine Compound (with 4 900 people per square kilometers). Dzanani rural area have the lowest population density with only 1 person per square kilometre and Soutpansberg rural area has a concentration of 2 people per square kilometres. This indicates that the demand for services and infrastructure in the densely populated areas will be a lot higher than in the lesser dense areas. Social problems and unemployment will also be a bigger problem in these densely populated areas.

Age and gender distribution

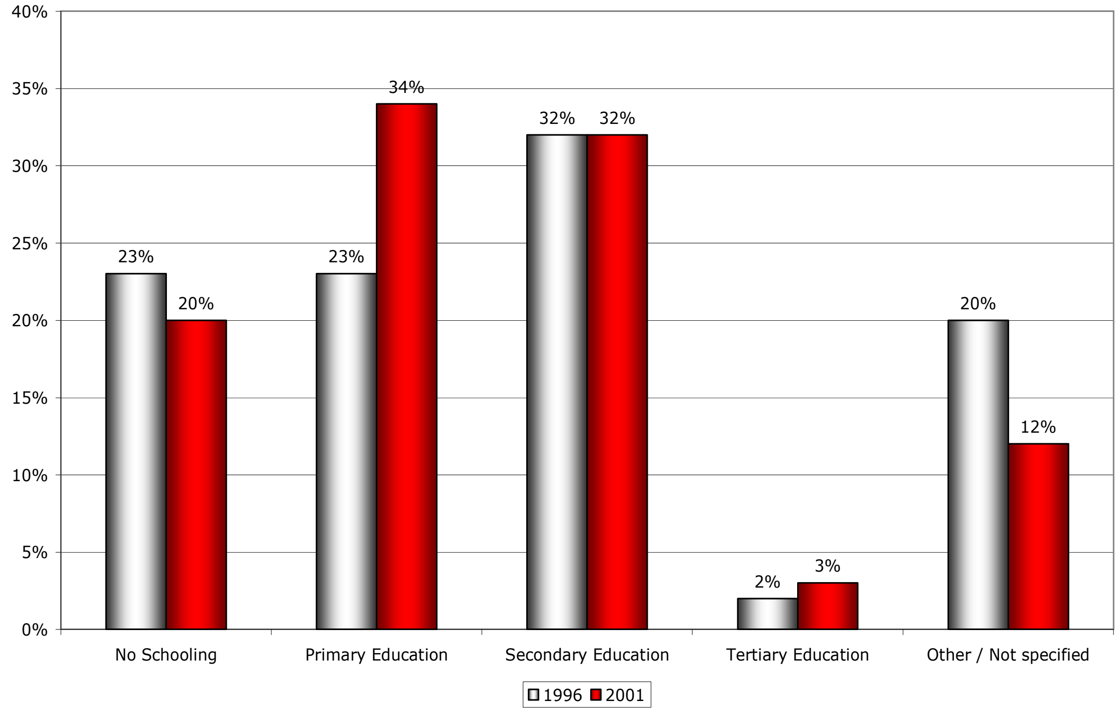


The schematic above indicates a high percentage of economically active people (age group 18-60), especially in the age group 25-29. The Musina Municipality has the highest percentage of people who are potentially economically active (70%), higher than the District (57%) and the National (58%) percentages. This might indicate an influx of people into the area in search of employment, suggesting a lack of employment opportunities elsewhere. This could also mean that the area is perceived to have employment opportunities. If these people can be successfully employed it will have a positive effect on economic growth. It does however put pressure on the municipality to provide sufficient employment opportunities. This demand for work might increase as there are a lot of people in the age group 15-19, leaving school and joining the workforce in the near future. The employment situation might be aggravated even more by an influx of people from Zimbabwe. The high proportion of potentially economically active persons within the Musina Municipality implies that there is a larger human resource base for development projects to involve the local population and potentially a lower dependency rate due to the lower numbers of youth. Normally a high percentage of people in this age group results in a higher childbirth figure, as is evident from the higher amount of people in the group under the age of 5. This will result in a higher demand for educational facilities in future. The higher than usual amount of people in the age group above 65 will increase the demand for appropriate facilities (especially healthcare) to take care of these people.

Households

On average, there are 3.4 people per household in the Musina Municipality. Doppie has the highest household size; with approximately 7 people per household in 2001.Doppie is a farm that is owned by the Department of Agriculture, where the beneficiaries/farmers also reside on the land. Dzanani rural area and Folorodwe have the lowest household sizes, with an average of 2 people per household in both these areas.

Education levels



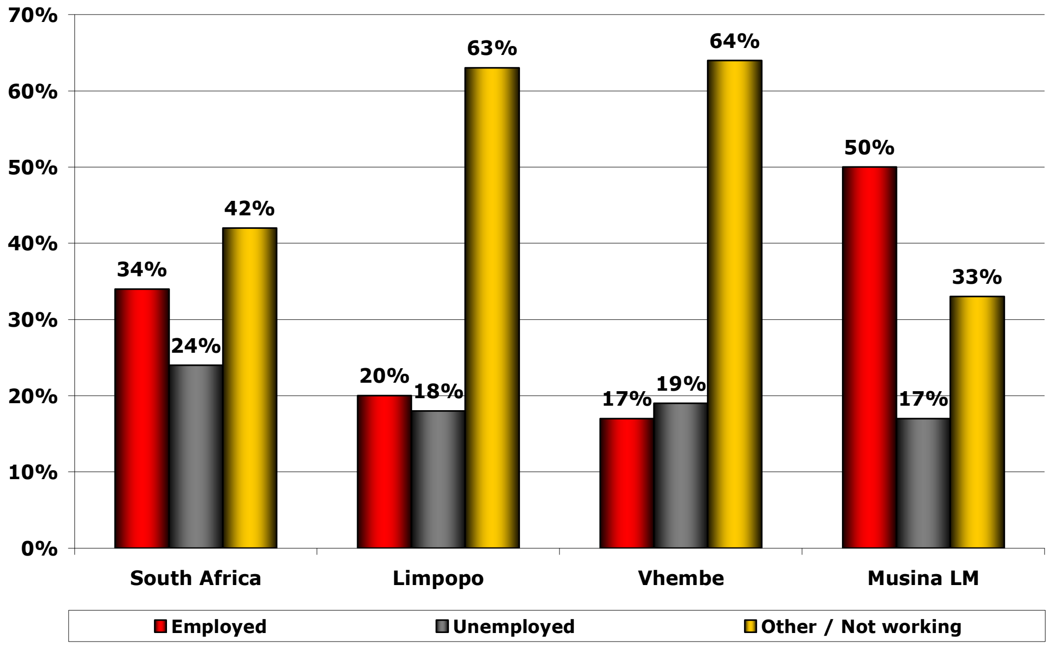
From the figure above it is also clear that the proportion of people with primary education has improved in the Musina Municipality from 23% in 1996 to 34% in 2001. Messina rural surroundings had the highest improvement (from 23% in 1996 to 36% in 2001) in terms of the proportion of people with primary education, with Soutpansberg Rural areas showing a 12% improvement from 23% in 1996 to 35% in 2001.

Of concern however is the increase in unschooled people in Dzanani Rural areas. This might suggest an influx of unschooled people; not being able to find employment elsewhere. This will have a negative effect on employment and social conditions in that area. Other places that experienced improved figures in respect of the percentage of people with primary education include Musina urban area (from 17% in 1996 to 27% in 2001), Feskraal (from 42% in 1996 to 48% in 2001) and Nancefield (from 27% in 1996 to 32% in 2001). Musina town, Dzanani Rural area and Soutpansberg rural area showed a decrease in the level of people with secondary education, while Musina peri-urban area, Feskraal and Nancefield showed improvements from 1996 to 2001. Overall, the levels of secondary education remained similar to that of the Municipal average, which increased from 23% in 1996 to 34% in 2001. The proportion of people with tertiary education improved slightly from 2% to 3% in the Musina Municipality over the aforementioned time periods. Messina SP, however, showed a large improvement in tertiary education from 4% in 1996 to 10% in 2001. Doppie also has a far larger than municipal average tertiary educated population, measuring at 13% in 2001. Although there is an improvement in education levels, it is obvious that a large number of people in the district are illiterate. This can be due to the following factors:

- The biggest number of people who attended school up to Primary, Secondary and Grade 12 are male.
- The type of Education they receive is not marketable. There is a high demand for technical skills and this is not properly addressed.
- A lack of education facilities and infrastructure results in a negative culture of learning.

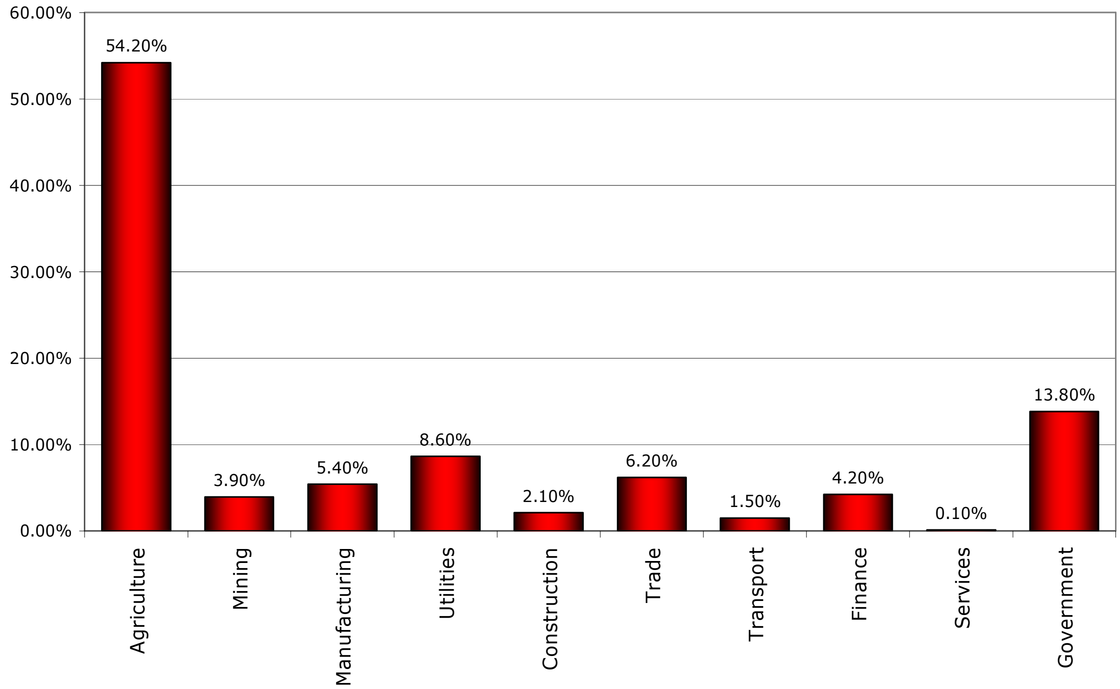
- There is a vast backlog of classrooms and learner support material, especially in rural areas that impedes proper teaching and learning.
- There is an unavailability of ABET centers that will respond to the high illiteracy rate among the adult population; the backlog of ABET centers in the district is 203 and only 98 have been built.

Employment



The figure above illustrates the proportion of people out of the total number of potentially economically active people in the Municipality that are employed. The figure indicates that in general, Musina municipality has a lower unemployment rate than the province as well as the rest of the district.

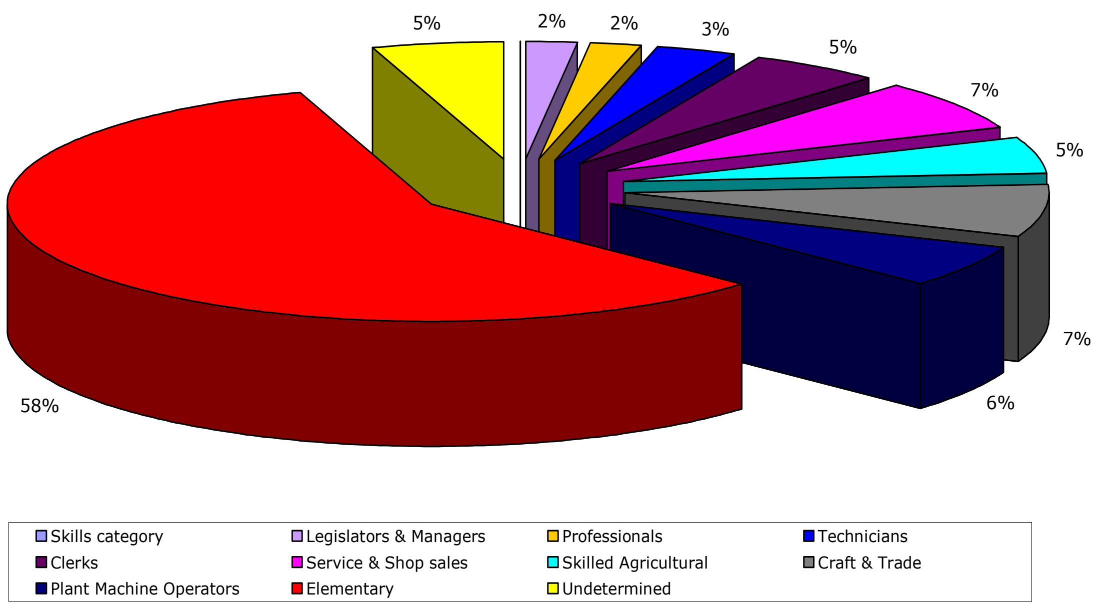
Approximately 75% of the economically active members of the municipal population are employed. In Folorodwe, the 156 members in this area are all employed, meaning that every person of working age has been able to secure a job and earn an income. Employment proportions are also higher than the municipal average for Dzanani rural area (94%), Soutpansberg rural area (94%), Musina peri-urban area (90%), Bergview East (77%) and Musina town (76%). Madimbo has the lowest employment rate (12%), or the highest unemployment rate, with 88% of the economically active population not being employed. It must also be noted that 37% of the population of Madimbo has no schooling. This area also has the second biggest household size (5 persons per household). It is thus clear that there are currently limited employment avenues in the area. Areas that are performing below the Municipality's average employment proportions are Kempo Mine Compound (39%), Harper Mine Compound (42%), Nancefield (54%) and Feskraal, with a 55% employment rate. It must also be noted that Kempo Mine Compound, Harper Mine Compound and Nancefield are amongst the sub places with the highest population density. The might indicate that these areas will experience a lot of social problems. The areas with higher unemployment rates are also noted as having higher female proportions. These areas can thus clearly be noted as having limited existing employment avenues, so much so that a large proportion of the male population have left the areas in search of employment elsewhere. This will have as result many single parent households, further complicating the social problems of these areas.



Industry	2000	2004	Growth Rate (%)	Average jobs created per annum
Agriculture	7,608	8243	2.03	154
Mining	586	589	0.13	1
Manufacturing	820	820	0.01	0
Utilities	6	7	1.81	0
Construction	288	324	2.93	8
Trade	879	940	1.69	15
Transport	220	221	0.21	0
Finance	607	639	1.28	8
Services	1,310	1313	0.06	1
Government	1,869	2114	3.13	58
TOTAL	**14,192**	**15,210**	**1.7**	**248**

The Agriculture sector by far made the largest contribution to the employment in Musina Municipality, absorbing more than half (54.2%) of the local employment. This is in line with the skills level of the people in the municipality. (58% of people only have elementary skills). The Government (13.9%) and Community Services (8.6%) sectors also made significant contributions to local employment. The Mining sector only provided employment for approximately 4% of the total labour force, this despite the fact that the Mining sector contributed almost a third of the GDP generated by the Municipality. This indicates that, while the Mining industry remains an important economic sector for the Municipality, it is not currently supplying a large number of job opportunities, but has the potential to of growing the number of job opportunities in mining where future development is approved. It is also important to note that work in the mining sector will require a higher level of skill than in the agricultural sector, which is currently the biggest employer. Given the skills level of the majority of people in the municipal area it must be assumed that even if the mining sector is able to generate more employment it will not necessarily improve the unemployment rate. Skills training is of vital importance before full advantage of possible work being created by the mining sector can be taken. It is also possible that more jobs were created by the mining sector but could not be filled within the community due to a lack of skills. Given the fact that the population growth figure is higher than the average for the province and that the unemployment figure did not reflect this, it is possible that people with higher skills levels migrating into the area are able to find work.

There was an increase in employment opportunities between 2000 and 2004 of 1 018 new job opportunities at an average of 248 jobs per annum. The fact that more employment opportunities are being created is an indication that the economy of the region is growing. However, an average employment creation of 248 jobs per annum is severely low. The highest growth rate in terms of employment was experienced in the Government Services sector, recording a growth rate of 3.13%. Higher employment growth rates were also achieved by the Construction (2.93%) and Agricultural (2.03%) sectors. The Agricultural sector generated an average of 154 jobs per annum during the aforementioned time period, creating 635 new jobs between 2000 and 2004.

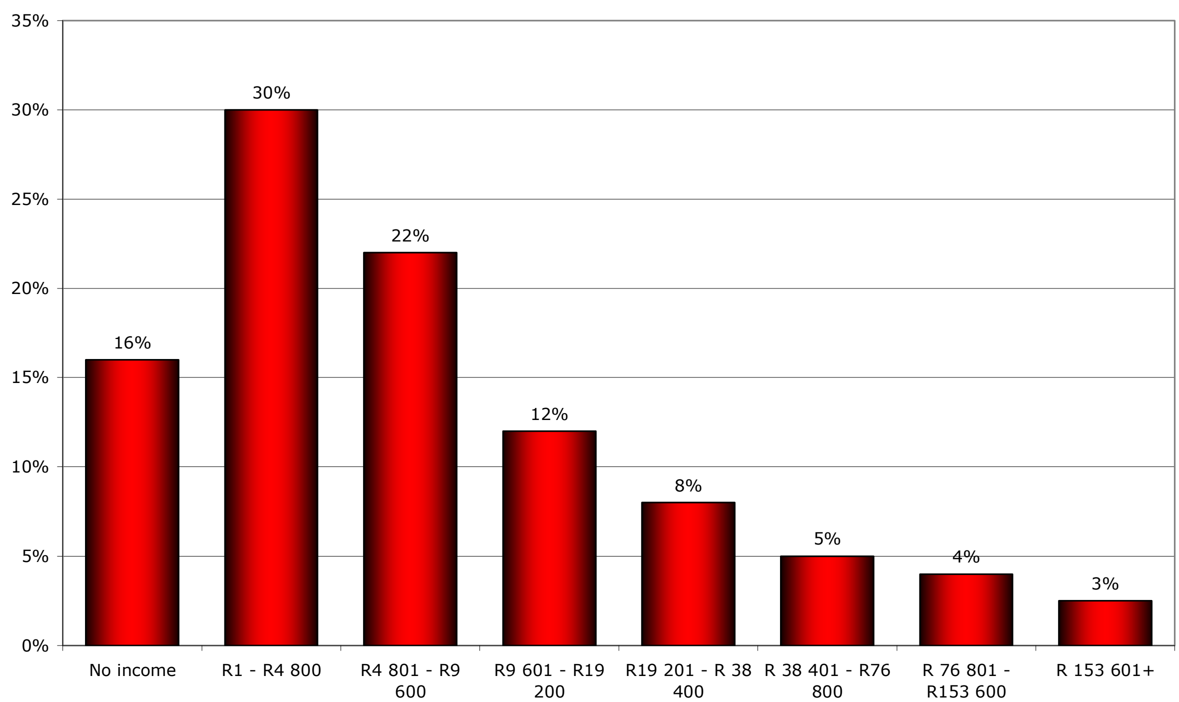


The majority of the employed population in the Musina Municipality is found in elementary occupations, represented by 58% of the population. Most occupations classified as elementary do not require high qualifications, often comprising routine tasks and some amount of physical effort. Even though the quantity of people employment in Musina Municipality is relatively high, the quality of occupation of the employed is relatively low and thus needs to be addressed. In Soutpansberg rural area approximately 80% of the people are employed in elementary occupations and in Musina peri-urban area approximately 70% are employed in elementary occupations. In Musina town the percentage distribution between the various occupations is relatively evenly spread, revealing a more diversified spread of occupations. In Bergview East the majority of employed people has occupations in service and shop sales (24%) and in the craft and trade sector (24%), followed by legislators and managers (18%), technicians (18%) and elementary occupations (18%). In Doppie the majority of the employed work in the service or shop sales sector (30%), followed by elementary occupations and technicians. The overwhelming majority of Madimbo residents are employed in crafts and trade related occupations, accounting for nearly 40% of the employed population. Nancefield has a large amount of persons employed in elementary occupations (31%), followed by service and shop sales (16%), clerks (12%), and crafts/trade (11%). The remaining areas have patterns of occupation similar to that of the municipal average. The largest proportions of people employed as legislators, senior officials and managers, as well as technicians and associate professionals (18%) are found in Bergview East, while Messina SP has the highest proportion of professional workers (11%) and clerks

(17%). This is consistent with the distribution of education in the sub-places, as Messina SP (10%) and Bergview East (6%) have the highest levels of tertiary education graduates in the Musina Municipality. The large proportions of people employed as legislators, senior officials, managers, service workers, shop and market sales workers and clerks is indicative of the urban nature of Bergview East, Messina SP and Nancefield. In general, the low levels of high qualifications, as revealed by the distribution of level of skills, show that people are limited in the ability to attain occupations that require higher level skills within the Musina Municipality. The Musina Municipality is largely populated by potentially economically active (68%) and young people (30%). This implies that there is a lot of human capital available for any kind of work, but also that there is space for training and developing young and economically active people in highly qualified occupations in the relevant fields needed in Musina Municipality. The level of employment and the type of occupations taken up by the population of the Municipality directly affects the income levels of its people.

	South Africa	**Limpopo**	**Vhembe**	**Musina LM**
Black	20,085,365	3,110,706	812,051	21,780
White	185,200	7,684	867	230
Coloured	765,231	2,047	453	23
Asian	81,624	475	96	0
Total	21,117,420	3,120,911	813,467	22,033

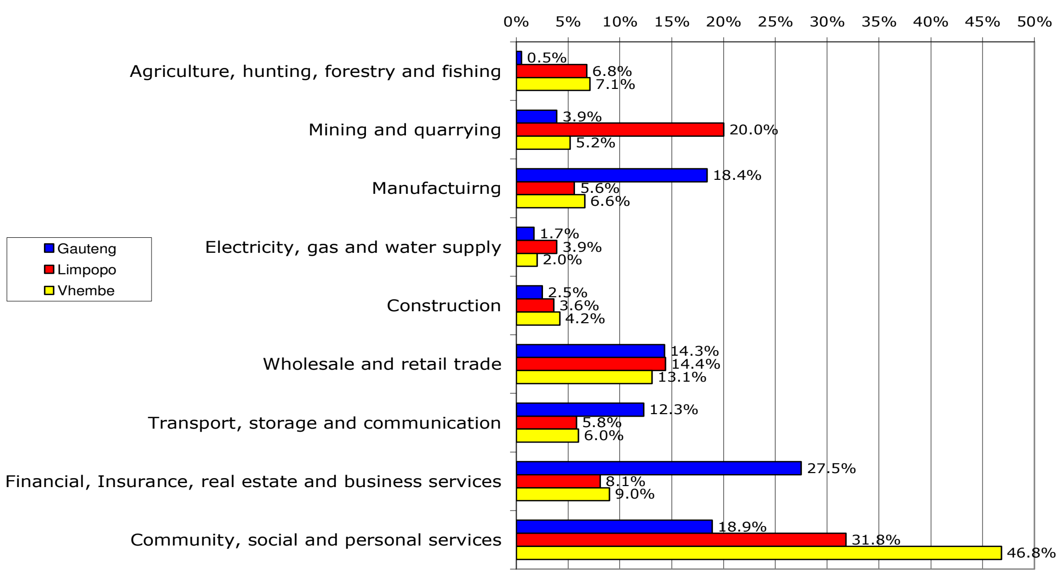
The above table indicates the number of people in poverty. This is directly related to unemployment as well as the type of employment and income earned. Although 75% of the economically active population is employed, 82 % of the population does not earn sufficient money to support themselves and their families. This can be related to the fact that most of the population is unemployable in anything but unskilled or semi- skilled employment. Although there has been economic growth in the area most of the population do not benefit from this as they lack the skills required to be employed in the better paid occupations. This stresses the importance of a program or programs to improve the skills levels of the general population.



The schematic above shows the percentage annual household income distribution. The highest percentage (34%) of income earners in the Municipality earn only between R1.00 and R4, 800 per annum. This means that more than a third of the employed people in Musina Municipality earn less than R400 per month. Approximately 16% of the population in the Musina Municipality receives no income at all. Feskraal has the highest proportion (59%) of people with no income. The Table on distribution of skills reveals that there are not any people employed as legislators, senior officials, mangers, professionals, technicians and associate professionals in Feskraal, Soutpansberg rural area, Dzanani rural area and Lost City. The level of skills in an area often corresponds with the levels of income. The highest levels of income per annum for Feskraal are R1-R4,800 (earned by 16% of the working population) and R4 801-R9 600 (earned by 16% of the population) per annum. Approximately 73% of the working population in Dzanani rural area earns between R1 and R4 800 per annum. This majority of these people is employed in elementary occupations (53%). Although Doppie has no persons earning no income, it also has no persons earning more than R19 201 per annum. Messina SP has the highest percentage of people who earn R153 601 per annum and above, represented by approximately 17% of the population in this sub-place. This corresponds with the level of skills among the employed, which shows that there are more people with higher qualifications and occupations (e.g. managers and professionals) in Messina SP than in other areas in the Municipality. In Bergview East, half of the population (50%) earns between R19 201 and R38 400 per annum, while the rest (50%) is shared evenly between those who earn between R9 601-R19 200 and R38 401-R76 800 per annum. The annual income Table, therefore, shows that people are limited by a lack of high quality skills, in order to obtain higher annual incomes.

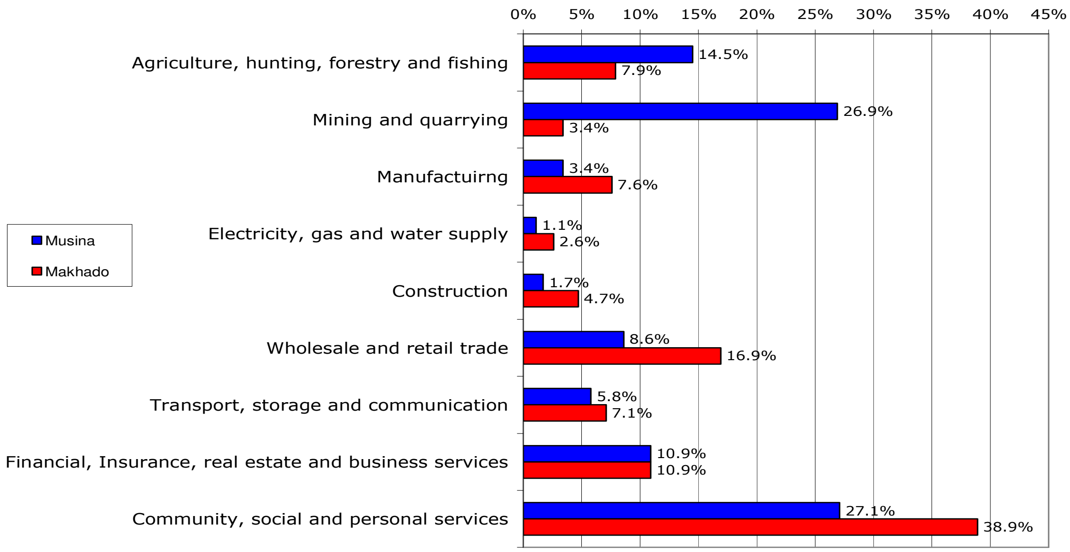
Sectoral economic structure

The sectoral structure of an economy is a good indicator of its diversification and dependency upon a particular sector. The figures below illustrate the economic structures of the Gauteng Province, Limpopo Province, Vhembe District and Local Municipalities that form part of the study area.



The figure above shows that the Gauteng economy is highly services-oriented. Approximately 73% of the Gauteng economy comprises of services industries, such as trade, transportation, financial and business services. Nevertheless, the Gauteng Province has a well-developed manufacturing industry that contributes 18.4% to its economy.

On the other hand, the tertiary sector in the Limpopo Province is as big as its primary and secondary sector put together. This shows a relative dependence of the Limpopo economy on the primary and secondary industries, in particular on mining. The largest sector in the Limpopo economy is the community and government services sector (20%), followed by the mining sector contributing 20% to its GGP.



The Local Municipalities that is part of the study area mirror the situation observed in the Limpopo Province. The Musina LM is highly dependent on the mining sector, as it contributes 26.9% to its economy. Unlike Musina, the Makhado LM economy is tertiary sector-oriented with the largest service sector the Community, social and personal services sector that contributes 38.9% to its economy.

The mining industry contributes 3.4% and manufacturing 7.6% to the local economy.

Municipal infrastructure

Water

Musina Local Municipality has a bulk water scheme abstracting water from the Limpopo River for purification and distribution. According to the Technical Manager of the municipality, the system requires upgrading and expansion to be able to address current needs of the Musina town.

1996		2001		2005	
Basic & above	Below basic	Basic & above	Below basic	Access (RDP stds)	No Access (below RDP)
7 324	1 077	12 797	1 158	14 503	400

All households in the urban area of Musina have metered yard connections. Households in the villages of Madimbo, Malale and Domboni have standpipes of RDP standard. At present all households have access to water.

Sewerage

Only one water-borne sewage works exists in the town of Musina.

1996		2001		2005	
Basic & above	Below basic	Basic & above	Below basic	Access	No Access
7 155	1 245	9 676	4 279	13 455	1 448

All households in the urban area are connected to a waterborne sewer system or on site septic tank system. Households in the villages have Pitlatrines or VIP toilets. With increasing connections to the sewer system the upgrading of the northern and southern exudation dams has become a priority issue.

Electricity

Four electrical sub-stations are located within the municipality, extending along an electricity network running up the N1 to the town of Musina, then along the R572 for some 60km before running down to the Venetia Mine and continuing between Bridgewater and Brombeek to Makhado Municipality (SDF, 2005).

1996		2001		2005	
Basic & above	Below basic	Basic & above	Below basic	Access	No Access
4 813	3 588	8 302	5 653	11 904	2 999

All households in the urban area have metered (conventional and pre-paid) electrical house connections. Madimbo and Malale are electrified and Domboni will be electrified during 2009. There is a backlog of 343 households, situated in the three rural villages. These are new houses but electricity is available in all 3 rural areas. Installation and upgrade of street lights is a priority in urban areas.

Refuse

The Musina Local Municipality has access to three landfill sites, excluding those privately operated by mining companies. The sites are located within Nancefield, Madimbo and at the border post. These sites have been classified as general disposal sites. The sites are currently not operated in terms of DWAF minimum requirements for waste disposal by landfill and are therefore not authorized (IWMP, 2007).

1996		2001		2005	
Basic & above	Below basic	Basic & above	Below basic	Access	No Access
5 620	2 781	6 627	7 325	7 889	7 014

Telecommunication

The table below indicates the number of households with access to telephones. The Musina Local Municipality has also recorded that there is a lack of public telephones in the settlements of Madimbo, Malale & Domboni further to this maintenance of the existing public telephones is not satisfactory.

1996		2001		2005	
Basic & above	Below basic	Basic & above	Below basic	Access	No Access
6 516	1 885	9 896	4 058	12 370	2 533

The project site area is serviced with Telkom lines, but cell phone network is very poor in parts and non-existent in most areas.

Transport system

Musina is located approximately 500km north of Pretoria, 224km north of Polokwane and approximately 108km north of Makhado, which is the nearest neighbouring town. Musina is situated 13km south of the Beit Bridge border post to Zimbabwe on the N1-national road and railway line, linking South Africa to the rest of Africa. Musina is very accessible and a number of provincial roads converge at Musina, i.e.:

- District Road D746 (R525) to Tshipise holiday resort (37km)
- District Road D1483 (R572) to Alldays in the west (Pontdrift road)
- District Road D2692 to Venetia Mine in the west
- District Road D1942 to Artonvilla and Pafuri.

Musina can be accessed by road and by air. Local tourists and visitors to the area have the option to travel via the N1 national freeway, northward, to Musina. Also discussed already in the previous groups, is the Alldays road (R521) which begins in Polokwane and can be used as an alternative to the N1 freeway to reach Musina from the eastern side of town in stead of the south. Local flights landing in Polokwane provides a faster journey to the area from other places in the country. The Polokwane airport is the closest airport to the area, but numerous private landing strips for private flights from Pretoria and Johannesburg, exist in the area as well. These landing strips are often used by tourist destinations, to give their patrons an easy and quick access to the area. International clients are particularly transported this way.

Visitors from across the borders in Botswana and Zimbabwe enter the area through the two border posts Beitbrdge (Zimbabwe) and Pontdrif (Botswana). Beitbridge is a mere 45 km from the project location, while Pontdrift is about 55 km away. This adds to the area being characterised as a gateway to shopping and other opportunities for cross border stakeholders who often flock to South Africa to stock up on commodities and access services.

The project area is situated between 50 and 62 km from the closest town of Musina. Two routes can be used to reach the town. The first route is the border road running along the fence and Limpopo River. This road is tarred but with some pot holes and severe undulation. The Beitbridge border post is reached 10 km from Musina. Much traffic is encountered on the last 10 km, as border traffic, including many large trucks, start queuing to enter the border control. The road along the border is affected by floods when the Limpopo River breaks its banks. In these times, this road cannot be used as an access route.

The second route to Musina is along the R572 Pontdrift road, which is a single-lane two-way tarred road in good condition. This road has an Average Annual Daily Traffic breakdown as follows (2008):

From	To	Light Vehicles	Heavy vehicles	Very heavy vehicles	Taxis	Buses	Total	Nr Passengers
0	16.23	130	48	14			243	318
16.23	18.77	138	52	14			256	335
18.77	30.38	110	28	8	3		186	262
30.38	41.96	98	22	27	1	2	153	254
41.96	87.43	448	90	72	1	2	764	1063
87.43	89.24	570	152	91			1017	1333
Average values / day		249	65	38	1	1	436	594

On average, one can expect 249 light vehicles to use the R 572 in a day, while 65 heavy and 38 very heavy vehicles pass along this road daily. Only one taxi and one bus can be expected per day. An average of 436 vehicles travel daily on the Pontdrift road. An average number of passengers per day amount to 594 people.

Apart from accessing the project area from Musina, on the N1, it can also be accessed using the R521 via Alldays. A provincial traffic study revealed that only 316 light vehicles use this road on an average day. The number of heavy (43) and very heavy (56) vehicles on this road is similar to that of the R572. More heavy vehicles are however found on this road than on the R572. There is also a slight increase in taxis (14) and buses (6) compared to the average daily count for the Pontdrift road. An average of 571 vehicles is found on a day on this road as shown below.

From	To	Light Vehicles	Heavy vehicles	Very heavy vehicles	Taxis	Buses	Total	Nr Passengers
6.01	31.70	492	66	114	24	4	925	1359
31.70	44.49	478	63	96	20	4	892	1574
44.49	46.78	611	80	84	24	5	1084	1838
46.78	49.65	413	62	79	13	12	784	1642
49.65	68.35	342	46	81	22	14	682	1651
68.35	69.88	391	31	49	30	15	646	1669
69.88	92.87	161	42	22	5	1	284	418
92.87	102.87	81	26	23			149	195
102.87	103.17	88	8	8		4	128	267
103.17	104.77	99	3	4		4	139	374
Average values / day		316	43	56	14	6	571	1099

Social Services

Health Facilities and Services

The Musina Local Municipality is served by 1 hospital and a clinic in Musina town as well as two mobile clinics. One mobile clinic team with 3 registered nurses operates from the Nancefield Health Centre and serves an enormous area which includes Alldays, Mopane and Tshipise. A mobile clinic that is stationed at the Filoam Hospital at Nzhelele is serving the area to the east that includes the settlements Madimbo, Malale & Domboni. According to the new departmental standards Musina should have 4 mobile clinic teams. A new Health Information Centre was constructed by the Department of Health and Welfare in Musina. This facility caters for health education (well-equipped auditorium) and offices for social workers and HIV/AIDS counselling.

Education Facilities and Services

The number of schools, learners, educators and classrooms and the respective ratio's are indicated in the table below.

School name	Type	Teachers	Students	Classrooms	Ratio	Capacity
Eric Louw	High School	25	430	25	1:18	Full
Musina	High School	60	1700	40	1:28	Full
Renaissance High	High School	5	142	3	1:28	Full
Makushu	Primary School	35	1233	20	1:35	Full
Beitbridge Primary	Primary School	5	245	4	1:49	Full
St Martin	Primary School	23	995	18	1:43	130
Gateway Primary	Primary School	11	329	11	1:30	Full

A need for secondary schools exists within Musina. Secondary schools have no capacity to take in any additional numbers of students. There is a definitive backlog of teachers and classrooms. The national norm for "pupil to teacher" ratios is 40: 1 and 35: 1 respectively for primary and secondary institutions. The "pupil to classroom ratio" should therefore be similar, as it is accepted that there should be one classroom per teacher or per 35 / 40 children. The table above indicates current ratio's. The information for some of the schools is lacking and could therefore not be compared with the national norms and standards.

A farm school exist of the farm Overvlakte 125 MS. The school provides access to education for the workers on the Overvlakte 125 MS farm and neighbouring farms. The school has 1 teacher and 1 principal, 40 students, and 1 classroom.

<u>Safety and Security</u>

Police Stations

The Musina police station falls within the area of jurisdiction of the Far North and reports to the Area Commissioner who is situated in Thohoyandou. The police station is responsible for policing the Musina Magisterial District, which covers an area of approximately 5 600km². The station handles approximately 250 – 300 cases per month and deports approximately 700 - 1 000 illegal immigrants from Zimbabwe per month. Musina has one police station and the following branches:

- Crime Intelligence Service: 7 policemen
- Crime Investigation Service: 18 policemen
- Dog Unit: 5 policemen
- Uniform Branch: 76 policemen (165 posts)
- Vehicle Custody Unit: 6 policemen

The Beit Bridge Border Control and Policing Service are located at the border post with Zimbabwe and operate separately from the Musina police station. A Vehicle Theft Unit is also stationed at the border post. The number and type of police stations are indicated in the Table below.

Area	**Main police station**	**Satellite police station**	**Magistrate's Court**
Musina town	1	1	1
Pontdrift Border post	1	0	0
Tshamatumba	1	0	0
Total	3	1	1

The types of crime that are prevalent in Musina Municipality are:

- Sexual offences.
- Woman and children abuse (violence against women and children).
- Housebreaking and theft – the high level of these types of crimes is amongst others caused by alcohol and drug abuse. The other common contributing factor is the high level of unemployment and the high element of illegal immigration.
- The high level of crime, according to the Municipal IDP, is being associated with the young people and illegal immigrants within the Municipality.

Magistrates Courts

The magistrate's office in Musina performs judicial functions for the whole of the Musina Magisterial District. The magistrate's court is a District Court and consists of the chief magistrate, assistant magistrate, one state prosecutor and administrative staff. The magistrate building has two courtrooms and the circuit court (District and Supreme court) also use these facilities for specific cases. The settlements of Madimbo, Malale & Domboni are being served by the court in Mutale. A periodical court is stationed at Masisi.

Emergency Services

The fire brigade which is owned by the municipality is responsible for a large area from Huntleigh, ±50km to the south of Musina, to Pontdrift ±100km to the west, to Pafuri ±170km to the east and to Beitbridge ± 13km to the north of Musina. The fire brigade also renders an across border service to Zimbabwe, but only for the areas located adjacent to the border (±12km). The Department of Health and Social Welfare provides the ambulance service in Musina.

Other communal facilities or services

The following other communal facilities and service exist within the Musina Local Municipality:

- According to the S.A. Post Office there are two post offices within the Musina Local Municipality, both within the town of Musina, one in the CBD and the other in Nancefield.
- There are two libraries in the municipality of Musina, both in the town of Musina.
- There are various sport facilities both in Musina and Nancefield
- Given the highly rural nature of the municipality, the only area requiring cemeteries is the Town of Musina. No shortage of cemeteries has been recorded.

Challenges

The majority of social facilities are located around Musina Town and to the east of Musina. Nineteen educations facilities exist in Musina municipality, of which only four are located to the west of Musina. There are three medical facilities within the municipality, two of which are in the town of Musina. One magistrate's court is located in Musina.

- There appears to be a shortage of education and health facilities in terms of the minimum access distance to these facilities, in the western portion of the municipality (western half of Ward 1).
- Other shortages of social facilities include libraries in wards 1 and 2; postal facilities (or at least post box facilities) in the same areas.
- Additional pension pay-points should be sought along the northern edges of the municipality and in the far western areas in order to achieve an equal distribution across the municipality.
- The rural settlements tend to be of a clustered nature and sparsely distributed outside of the eastern portion, within the municipality.

2.1.2 Assessment of Environment likely to be Affected

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

- Geology, Section 2.1.1
- Climate, Section 2.1.2
- Topography, Section 2.1.3
- Soils, land capability and land use, Sections 2.1.4, 2.1.5 and 2.1.6
- Ecology, Sections 2.1.7, 2.1.8 and 2.1.14
- Surface water and groundwater, Sections 2.1.9 and 2.1.10
- Air quality, Section 2.1.11
- Noise, Section 2.1.12
- Archaeology and cultural, Section 2.1.13
- Visual, Section 2.1.15
- Socio economics, Section 2.1.16

2.1.3 Environmental Features that may require Protection, Remediation, Management or Avoidance

With reference to Section 2.1.1.14 and Figure 2.1.3 overleaf, environmental features on the site that may require protection, remediation, management or avoidance include:

- Protected flora species
- Protected fauna species
- Limpopo River floodplain and riverine forest
- Rocky outcrops on Bergen op Zoom
- Springs and drainage lines
- Heritage sites

2.1.4 Closure or End-Use Objectives

- To rehabilitate disturbed areas to sustainable end land use, as close as possible to the original conditions
- To promote the rapid re-establishment of natural vegetation and restoration of site ecology
- To implement a sustainable long-term water management plan to deal with potential decant

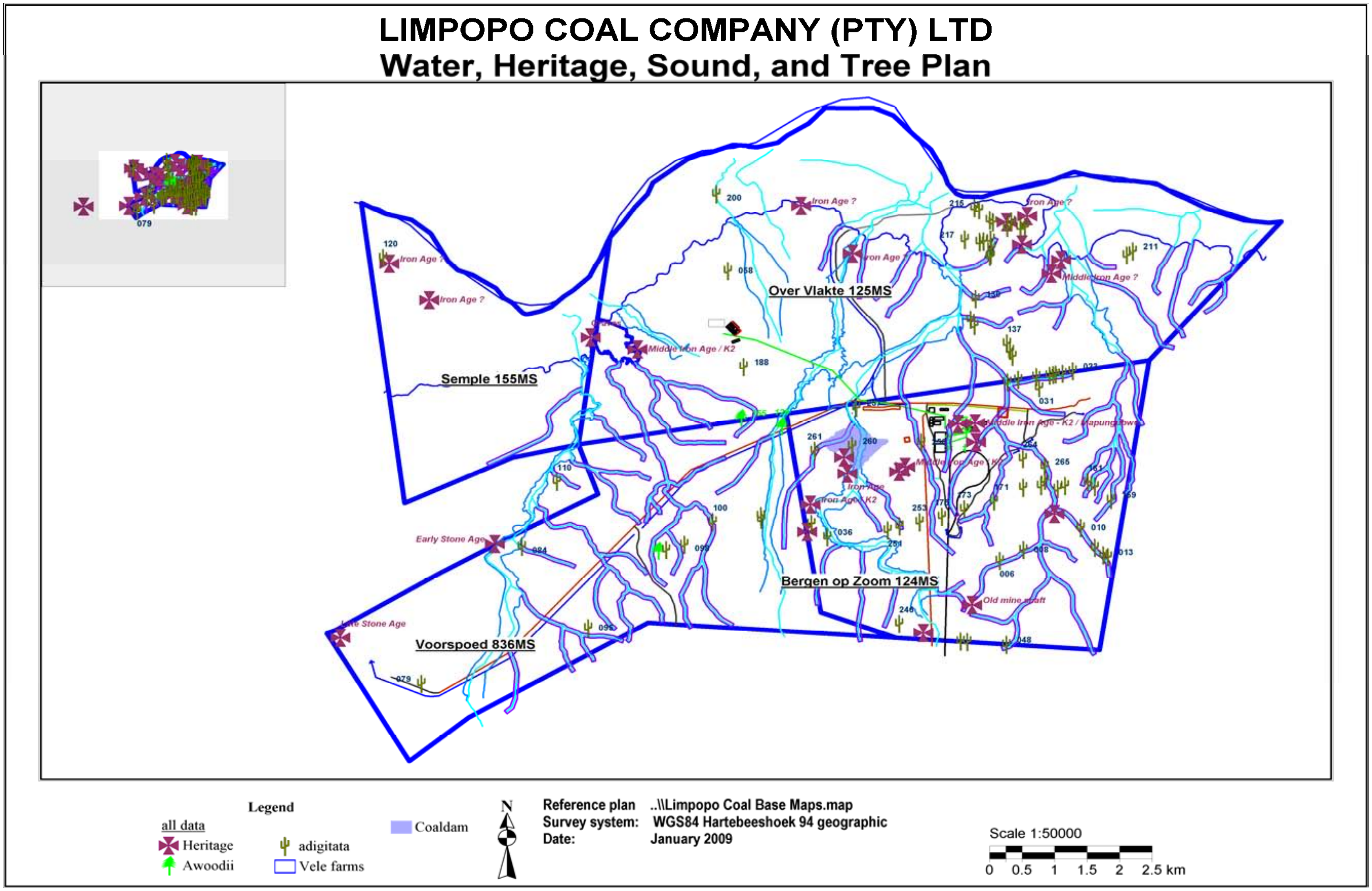


Figure 2.1.3: Environmental features that may require protection, remediation, management or avoidance

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

2.2.1 List of Main Activities

The main mining activities are: -

- Activity 1: Opencast Mining – Refer to Section 1.3.1.1
- Activity 2: Underground Mining – Refer to Section 1.3.1.2
- Activity 3: Processing – Refer to Section 1.3.2
- Activity 4: Coal Transport – Refer to Section 1.3.5

2.2.2 Plan(s) showing Main Activities

- Activity 1: Opencast Mining – Refer to Figure 1.3.1
- Activity 2: Underground Mining – Refer to Figure 1.3.1
- Activity 3: Coal Processing – Refer to Figure 1.3.3
- Activity 4: Coal Transport – Refer to Figure 1.3.5

Refer to Annexure A for large printout of the said figures.

2.2.3 Categorisation of Main Mining Activities

Categorisation of the activities is shown in Table 2.2.3 below**.**

Table 2.2.3: Categorization of activities

Activity	Construction	Operational	Closure	Post Closure
Opencast Mining		X	X	X
Underground Mining	X	X	X	X
Coal Processing	X	X	X	
Coal Transport		X		

2.2.4 Details of the Engagement Process with Interested and Affected Parties

Details of the public participation process, meetings with Interested and Affected Parties (IAPs), as well as the Issues and Response Register (IRR) are included in **Annexure N.**

2.2.5 Physical Impacts identified by IAPs and State Departments

Refer to the IRR included in **Annexure N.** The following main issues were identified:

- The impact of the proposed mine on the Mapungubwe World Heritage Site and National Park, as well as the proposed Limpopo-Shashe Trans-Frontier Conservation Area (TFCA), and eco-tourism as a whole in the project area.
- Biodiversity, noise and visual impacts are also of concern to the stakeholders, as was the sense of place, and how it would be affected by the development.
- The impact of pollutions such as noise-, light-, and dust pollution on the World Heritage Site and cultural landscape are of concern.
- The impact on the planned extension of the Limpopo-Shashe TFCA.
- The impact on the avifauna and the loss of habitat.
- The impact on the riverine forest.
- The impact on surface and groundwater quality and the potential for acid mine drainage.
- The impact on furthering the knowledge of potential archaeological heritage of the area.
- The change in land use of areas surrounding the project site, and specifically on the agricultural activities.
- The stimulation of a coal mine on similar industrial developments.
- Business development opportunities.
- Employment opportunities.

2.2.6 Potential Impacts of each of the Main Mining Activities

A description of the potential impacts of each of the aforesaid main mining activities will follow. The proposed mitigation measures will also be listed in this section and will be summarised again in table format in Section 2.6. **Table 2.2.9** summarise the impacts, the proposed mitigation measures, significance rating prior to mitigation and significance rating after mitigation. **Tables 2.6(a)-(e)** also in Section 2.6 shows the cost to implement the various mitigation measures.

Note that certain impacts and the associated mitigation measures are similar to all phases and for each of the activities. These will be addressed first with no reference to a specific activity or phase in Section 2.2.6.1 - Impacts all activities. Important to note that the cost to mitigate these impacts will be reflected in the relevant year when the expenditure will be incurred, as indicated in Tables 2.6(a)-(e). This is an attempt to prevent duplication of the same impact and mitigation description per activity and per phase.

2.2.6.1 Impacts – All Activities

Impacts associated with all activities and phases of the project include:

- Surface disturbance, with direct impacts on soil, land use and land capability, biodiversity
- Generation of dust
- Construction noise (similar to all activities)
- Waste management
- Impact on the conservation value of the area

Surface disturbance

Surface disturbance for the purpose of mining or infrastructure will lead to impacts on the soil, land use and land capability, natural vegetation and fauna. The estimated surface disturbance is as follow:

	Hectares
Opencast mining	1835
Plant infrastructure	62
Underground infrastructure	16
Other	60
TOTAL	**1973**

It is important to note that the revised mining plan, which is a combination of opencast and underground mining, has significantly reduced the area of surface disturbance. Subsequently the impact on existing land use, in specific agricultural activities, has reduced significantly and only approximately 8% of the total surface that will be disturbed impacts on agriculture.

The following mitigation measures will be implemented:

Rescue operations

- Identify and rescue of as many as possible fauna and flora species prior to construction and mining for relocation to suitable areas.
- A detailed species rescue, relocation and re-introduction plan will be developed and implemented by a qualified person before disturbance of the surface areas commence. This plan will at the least address the following:
  - Harvesting of seeds from herbaceous and woody vegetation to be used in the indigenous nursery and future restoration and rehabilitation plans.
  - Intact removal of protected plant species and capture of protected faunal species under permit.
  - Suitable relocation areas will be identified, e.g. protected areas such as Mapungubwe National Park, Messina Nature Reserve, Ludwigslust Game Farm.
  - Proper habitat suitability assessments will be done before reintroductions to reduce the risk of mortalities in both source and destination populations.

- All rescue, relocation and re-introduction programmes will be properly monitored and documented for future referencing on the impacts, restoration and rehabilitation programs within semi-arid areas.

- The rescue operation will be managed by a suitably qualified person.
- A herpetologist will be appointed during the bush-clearing phases of the operation to collect relevant study and live herpetofauna material, in particular fossorial species.
- The rescue operation will be repeated on an annual basis for the areas earmarked to be disturbed in the following 12 months.

Indigenous nursery

- An indigenous nursery will be established on site to cultivate indigenous herbaceous and woody species for future restoration and rehabilitation plans.
- A detailed plan will be developed before the indigenous nursery is established. This plan must at least address the following:
    - Incorporation with existing nurseries e.g. in Mapungubwe NP, Musina etc.
    - Location
    - Water requirements
    - Resources
    - Expertise
    - Management
    - Staff
    - Finance / budget
    - Capacity building
- The nursery must be managed by a suitably qualified person.

Rehabilitation plan

- A detailed rehabilitation plan will be developed for the mine. The following minimum standards will apply:
    - Vegetation will be left intact in areas not earmarked for immediate excavation for as long as possible to assist in prevention of soil erosion and mitigation of noise and particle pollution.
    - The above-ground vegetation layer will be stripped (cut down) prior to topsoil stripping and stockpiled. This organic material will be mulched and used with the topsoil as compost in the restoration and rehabilitation program.
    - All available topsoil will be stripped and utilised for rehabilitation. Direct placement will be implemented as far as possible, limiting the stockpiling of topsoil.
    - Rehabilitation (levelling & topsoiling) will be initiated within 5 strips of active pit.
    - Restoration of the vegetative layers will take place immediately thereafter using the mulch, harvested seeds and plants from the indigenous plant nursery. Ongoing research will be conducted to improve on the sustainable restoration of the natural veldt.
    - Soil analysis to provide corrective fertilisation regimes will be an ongoing procedure to facilitate vigorous plant growth.
    - Until the herbaceous (shorter period) and woody (longer period) vegetation layer is established, artificial watering of reclaimed areas will be applied.

- Erosion control measures will be implemented where necessary.
- The final profile will be free-draining. Ponding will be prevented as far as practically possible.
- The final end land use will reflect the initial land capability as far as possible. As a minimum, the final end land use should be grazing (topsoil depth = 0.25m).
- All rehabilitation programmes will be properly monitored and documented for future referencing on the impacts, restoration and rehabilitation programs within semi-arid areas.

- The implementation of the rehabilitation plan will be coordinated and supervised by a suitably qualified rehabilitation officer.

Other mitigation measures

- The entire designated infrastructure and mining areas will be fenced off to keep animals out of the area and to prevent theft / poaching.
- Management agreement will be initiated with adjacent landowners to create animal corridors.
- A comprehensive environmental monitoring programme will be implemented prior to commencement of site activities.
- Environmental educational and awareness programmes will be developed and implemented as part of the employee and contractor induction programme. Similar programmes will be initiated within surrounding communities.

<u>Dust impacts</u>

Dispersion simulations were undertaken to reflect the combined impacts from the sources of inhalable particulate and nuisance dust deposition rates from the proposed Vele site operations. This included the simulation of all point, area, line and volume sources identified. Isopleth plots reflect gridded contours which represent zones of impact at various distances from the contributing sources. The patterns generated by the contours are representative of the maximum predicted ground level concentrations for the averaging period being represented. These averaging periods are defined as being the maximum exposure level in a given time period, usually, as in this case daily and annual.

Figures 2.2.6.1(a) and (b) represent the daily and annual average predicted ground level concentrations for inhalable particulate matter that could results during the operation of the mine (assuming no mitigation is put in place). Figure 2.2.6.1(c) similarly represents the monthly dust deposition concentration predicted for these proposed mining activities.

Comparison of predicted daily and annual average ground level concentrations to the current RSA Standards of 180µg/m^3 and 60µg/m^3 respectively, indicated that there was no exceedance at or within the Vele site boundary. When comparison is made to the stricter SANS 1929 daily limit (75µg/m^3), there were exceedances noted for the daily averaging period, however these still remain within the site boundary. Dust fallout impacts are noted to fall above the SANS 1929 threshold deemed accepted for residential (600 mg/m^2/day) and industrial areas (1200 mg/m^2/day). With the exceedance of the residential limit noted to occur outside of the mine lease area.

Mitigation measures include the following:

- Regular watering (haul and in-pit roads) and application of chemical dust suppressants (main haul road)

- Access road will be tarred
- Vegetation of permanent stockpiles and berms
- Use of a water spray systems at stockpiles
- Sprays at all transfer points
- Cladding of ROM and product stockpiles
- Limit the drop heights during the transfer of material to control the dispersion of materials and dust particles
- Vehicle speed on unpaved roads limited to prevent dust creation
- Develop air blast control measures to limit dust from blasting
- Employ latest technology to reduce vehicle exhaust gas emissions

Figures 2.2.6.1(d)-(f) show the maximum predicted ground level concentrations with planned mitigation measures in place. As a result of these mitigation measures all predicted emissions fall below the South Africa Standards of 180µg/m³ and 60µg/m³ as well as the stricter SANS limits of 75µg/m³ and 40 µg/m³ for daily and annual limits respectively. This is with the exception of the residential dust fallout limit of 600 mg/m²/day which is still noted to be exceeded for a short distance outside of the southern most border of the mine lease area.

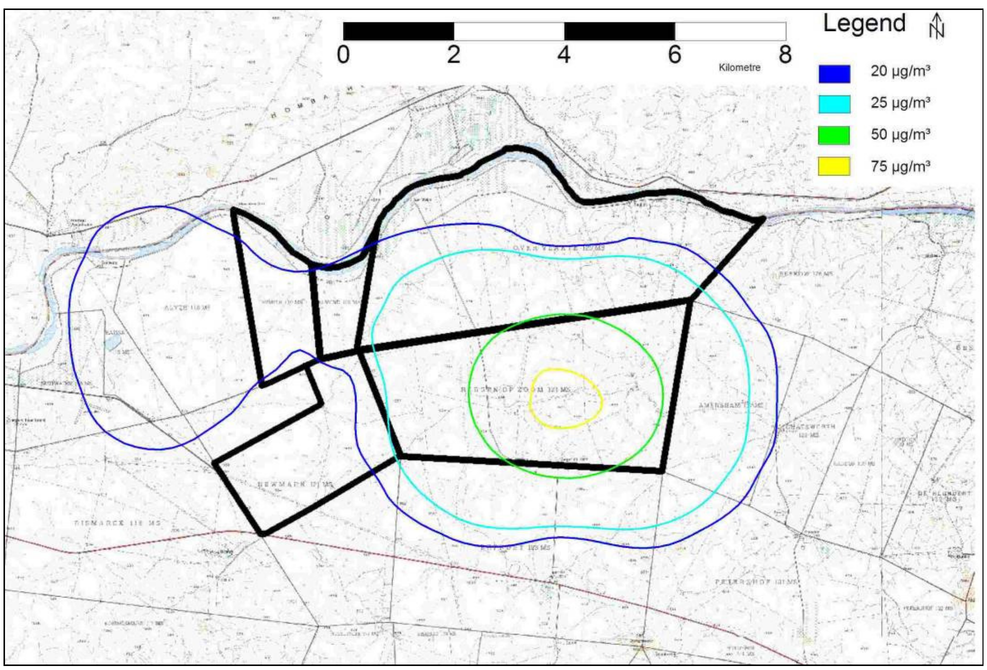


***Figure 2.2.6.1(a): Highest Predicted Daily Average PM_{10} Ground Level Concentrations at the Vele Site without Mitigation (SANS Limit - 75* µg/m³)**

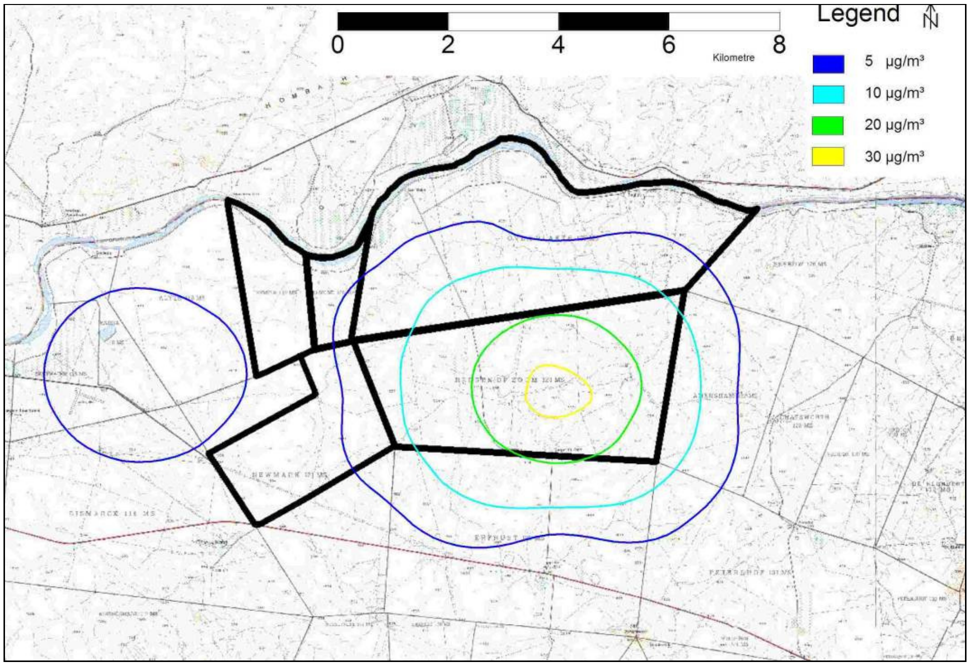


***Figure 2.2.6.1(b): Highest Predicted Annual Average PM_{10} Ground Level Concentrations at the Vele Site without Mitigation (SANS Limit - 40* µg/m³)**

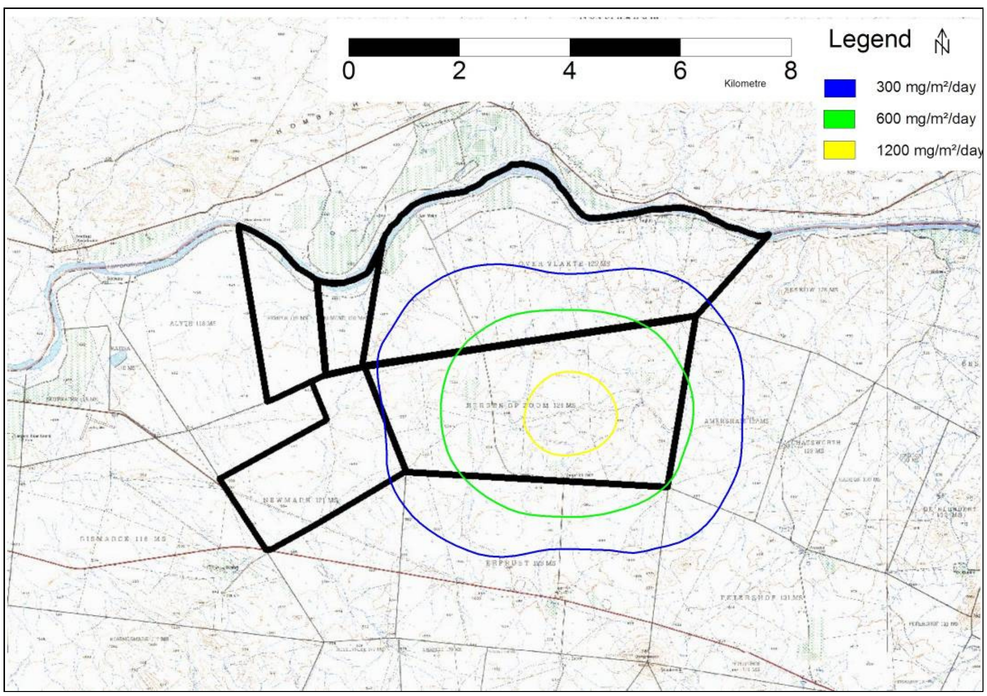


Figure 2.2.6.1(c): Monthly Dust Deposition Levels Predicted at the Vele Site without Mitigation

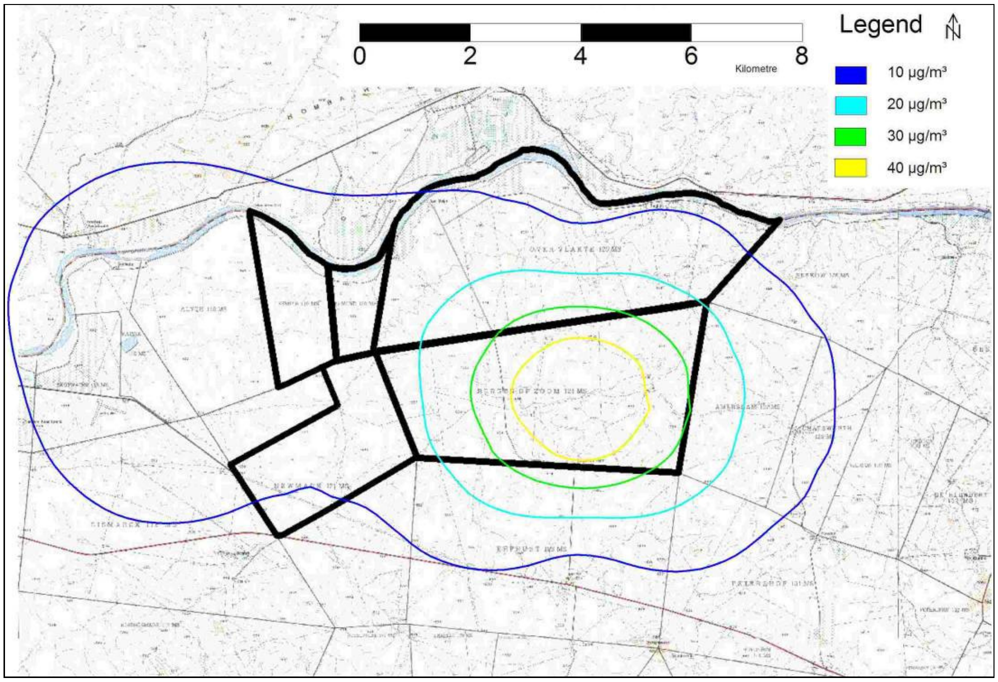


***Figure 2.2.6.1(d): Highest Predicted Daily Average PM_{10} Ground Level Concentrations predicted at the Vele Site with mitigation (SANS Limit - 75* µg/m³)**

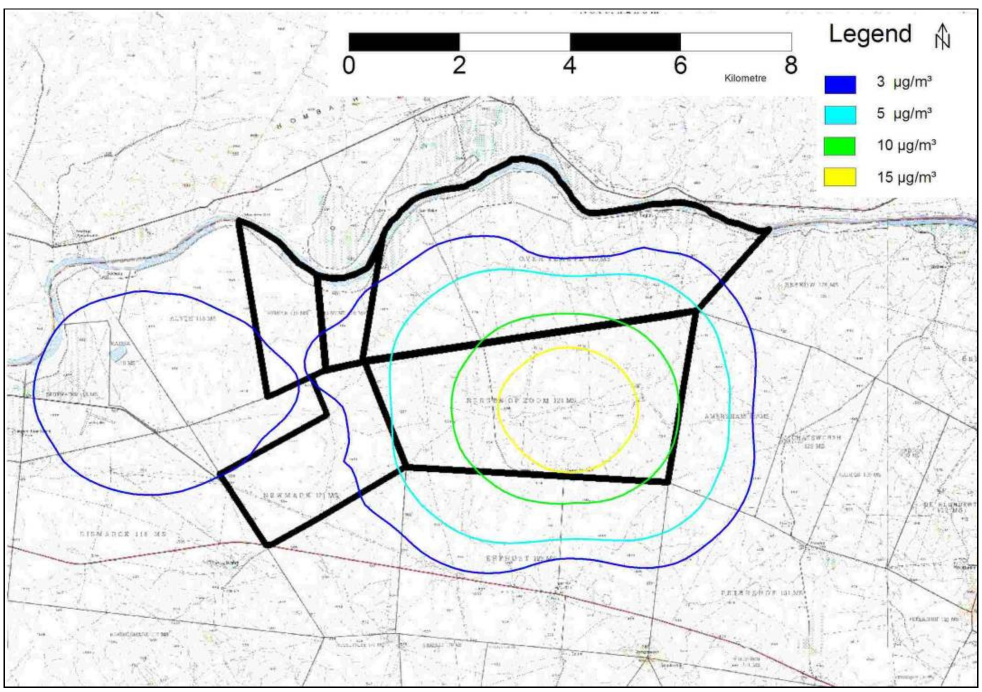


***Figure 2.2.6.1(e): Highest Predicted Annual Average PM_{10} Ground Level Concentrations Predicted at the Vele Site with mitigation (SANS Limit - 40* µg/m³)**

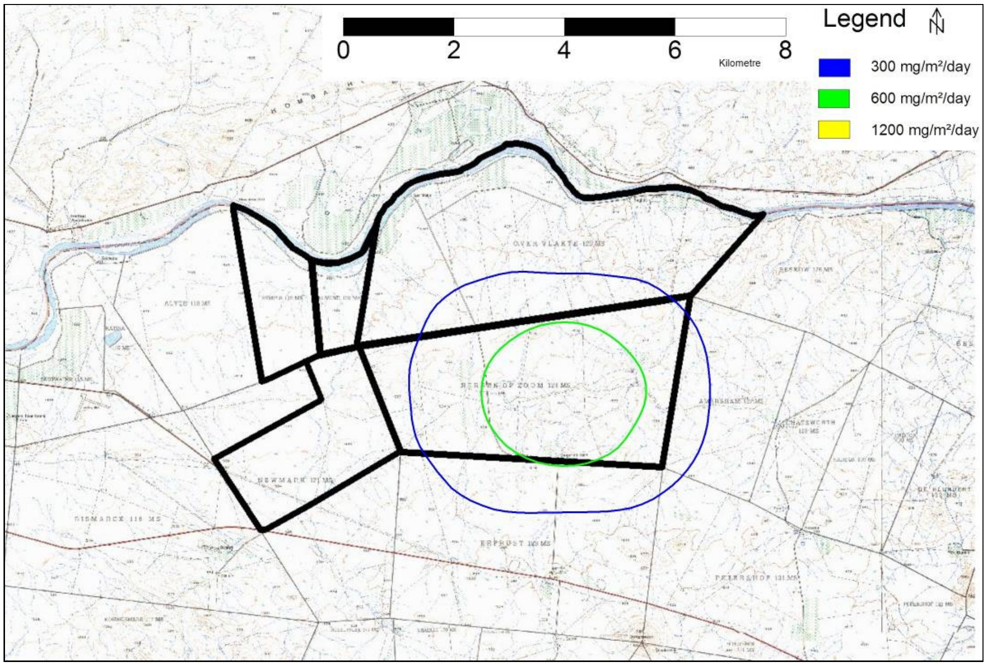


Figure 2.2.6.1(f): Monthly Dust Deposition Levels Predicted at the Vele Site, with mitigation

Construction Noise

Source noise levels from many of the construction activities will be high. Noise levels from all work areas will vary constantly and in many instances significantly over short periods during any day working period.

Working on a worst case scenario basis, it is estimated that the ambient noise level from general construction activities will negatively affect noise sensitive sites within a distance of 450 meters of the construction site. Night-time construction would have a significant impact on noise sensitive sites within a radius of 1000 meters of the construction site.

It has been estimated that the construction activities at the colliery site will on average generate no more than about 500 vehicle trips (two way trips) daily. The main percentage of the trips will be concentrated in the morning and evening peak periods. In general, the construction traffic will have a relatively minor effect on the noise climate alongside the main external roads in the area. Because of the character of the traffic (namely heavy vehicles), there is likely to be some nuisance factor with the passing of each vehicle at noise sensitive receptors along the access routes.

There are a number of noise sensitive receptors in the vicinity of the development site that are likely to be affected by construction noise. It should be noted that higher ambient noise levels than recommended in SANS 10103 are normally accepted as being reasonable during the construction period, provided that the very noisy construction activities are limited to the daytime and that the contractor takes reasonable measures to limit noise from the work site. Note that it has been assumed that construction will generally take place from 06h00 to 18h00 with no activities (or at least no noisy construction activities) at night. From the details presently available, it appears that the construction noise impact is not likely to be severe except at one or two isolated sites.

The noise mitigating measures to be considered during the construction phase are as follows:

- Construction site yards, construction worker camp and other noisy fixed facilities will be located well away from noise sensitive areas adjacent to the development sites.
- All construction vehicles and equipment are to be kept in good repair.
- Construction activities, and particularly the noisy ones, are to be limited to reasonable hours during the day and early evening.
- Construction staff working in areas where the 8-hour ambient noise levels exceed 75dBA must wear ear protection equipment.

Waste management

The following waste types will be generated during the course of the project:

- Domestic waste
- Hazardous waste
- Fluorescent tubes
- Scrap metal
- Used oil/diesel
- Building rubble (construction & demolition activities)

Mitigation:

- The different waste streams will be segregated and disposed of in appropriate designated receptacles.
- An approved, registered waste contractor will be appointed by the mine to manage the waste generation and safe disposal thereof.

Conservation value of the area

The project will impact on the conservation value, ambience and “sense of place” of the region. In order to mitigate this impact, the mine is committed to implement a sound management programme to prevent impacts as far as possible, and where prevention is not possible, to mitigate the impacts to an acceptable standard.

In addition, ***biodiversity offset programmes*** will be actively pursued throughout the life of the operation. These could include, but is not limited to:

- Restoration of degraded riparian wetlands
- Funding support for the Limpopo Valley Herb Project
- Co-funding / improvement of the conservation contribution of land and/or land use activities within the TFCA
- Establishment of a herbarium at Mapungubwe
- Support of other conservation initiatives, e.g. Ground Hornbill Research and Conservation Project

2.2.6.2 Impacts – Activity 1 (Opencast Mining)

No **construction phase** associated with Activity 1.

Potential impacts during the **operational phase** are as follow: -

- Impact on site streams and drainage lines
- Impact on quality of surface and groundwater resources
- Increased noise levels
- Impact as a result of blasting activities
- Visual impact associated with the opencast activities
- Generation of dust – refer to Section 2.2.6.1

Site streams and drainage lines

The streams and drainage lines are shown in Figure 2.1.1.9(b), as well as the outline of the proposed mining areas. With the drainage northwards towards the Limpopo River, the open pits span across numerous streams and unless diverted, runoff to the river will be reduced.

Rainwater falling on the open portions of the pits will be collected as dirty water and be re-used. If the total open pit area of 1 859 ha is deemed to be intercepting runoff to the river, the mean annual runoff will be reduced by 29 744 m^3 (based on a 1.6 mm runoff) which is equivalent to 1.05% of the runoff of the quaternary catchment area and 0.002% of the Limpopo River MAR (estimated at 1 700 million m^3/annum).

The pits will be continuously rehabilitated as mining progresses and the open areas will be much smaller than used in the estimate above. The impact of the open pits on the runoff is therefore considered very small indeed.

The wetland areas associated with the ephemeral or non-perennial streams located on the open pits will be affected by mining over a period of 29 years.

Proposed mitigation measures include:

East Pit

- In the original layout of the East Pit, the northern edge followed the Limpopo River meander, setting it well below the 1:100-year Limpopo River floodline. Extensive and high-risk flood protection berms would have been required to safeguard the workings and to protect lives. As a mitigation measure, the layout was therefore amended by moving the edge of the pit southwards to the position shown in Figure 1.3.4(b).
- On the *southern side*, the haul road acts as a cut-off and would divert clean stormwater around the pit. The *eastern edge* of the pit is on the verge of a low escarp and only a nominal berm would be required to prevent water ingress to the workings.
- At the *north west boundary* of the pit, berms to control floods and divert a stream are required as follows:
    - A flood protection berm, to be 6 m at its highest section, is required to prevent the Limpopo River's 1:100-year flood water from entering the workings where northward flowing streams have lowered the terrain. This is a high risk structure, to be designed as an earth dam with sufficient freeboard. Its capacity to withstand the Regional Maximum Flood (RMF) should be tested.
    - A stream diversion berm and concomitant earth canal are required to divert a stream flowing across the north western corner of the proposed pit into an

adjacent stream. The receiving stream flows parallel and fairly close to the stream which is to be diverted.

West Pit

- Figure 1.3.4(c) shows the preliminary proposed surface water mitigation measures at the west pit where work is scheduled to start only by 2024. The pit would be developed from east to the west and diversion of the northward flowing streams is required from 2024, to the east and west around the pit as shown. The haul road would again be constructed as the diversion berm.
- Before mining commences at the West Pit, further detail assessments are required to optimise the mining programme in order to obtain the most feasible, least impact option.

Haul road

- The haul road to serve the open pits is to be constructed on the southern upstream side of the pits and will be elevated above natural ground level. On the upslope side a drain will be provided to convey stormwater around the pits, or in the case of the plant area, dirty water will be channeled to the dirty water dam. The cross fall of the road would be to the northern, downstream side, except along the plant area, so that contaminated water can be collected in dirty water drains. The drains would convey the water into the pits where it will be contained and pumped out as part of the pit dewatering system.

Water quality impacts

Surface and groundwater contamination due to mining occurs when the rock is broken up, either by blasting or by excavation, to expose a greater surface area of mineralized rock to water and oxygen. Acid generating minerals such as pyrite are oxidised and soluble elements enter into the groundwater system. In the case of coal which is often sulphur rich, pyrite (FeS2), sulphur combines with water to form sulphuric acid enhancing its ability to dissolve other elements in the rock and is commonly known as acid mine drainage (AMD) or acid rock drainage (ARD). Sources of pollution from a coal mine in general include overburden and spoil piles, slurry and slimes dumps, return water dams, effluent and evaporation ponds and open cast pits.

Rock overburden and coal discards at the site are to be backfilled into the open pits and rehabilitated while mining progresses, hence surface dumps will be avoided. Seepage through this residue material will therefore remain in the pits and will have to be pumped out while mining is in progress. Leachate volume by rainfall through the waste rock is expected to rise to 1800 m^3/d, with total leachate of 2700 m^3/d due to groundwater inflows. Pumping of leachate from the pits is expected to peak at 2200 m^3/d in 2028, before declining once mining of the east pit is terminated and the pit starts to refill.

Sulphate concentrations of leachate will rise to 1750 mg/l due to the oxidation of pyrite, but when mixed with groundwater inflows, will be peak at just below 1200 mg/l but due to reduced leachate volumes being produced will drop off to about 885 mg/l in the longer term. Background groundwater has a median sulphate concentration of 570 mg/l, with peaks of over 5000 mg/l, hence leachate concentrations do not significantly impact on groundwater. The leachate will however be controlled and pumped into the dirty water system of the mine for mine use. It will not be released into the environment.
Acid-base accounting results show that the coal samples (and thus the discard / middlings) are likely acid generating, as are the carbonaceous mudstones. The upper 20 m of overburden is strongly neutralising. The acid generating material is expected to be a maximum of 10-20% of the total tonnage disposed of in the pit. In addition, this material will be placed in the bottom of the pit, where they will be submerged; hence the acid-generating

potential of the material will be restricted. The neutralizing potential of the waste rock will be available, regardless of its presence above or below the water table. For this reason, the specialist concluded that the waste rock is unlikely to generate acid leachate.

Mitigation measures include:

- Rock overburden and mine residue (discard and slurry) at the site are to be backfilled into the open pits and rehabilitated while mining progresses, hence surface dumps will be avoided.
- ROM and product stockpile sites must be carefully selected away from possible groundwater conduits. Stockpile sites must be compacted to limit percolation and leachate volumes.
- Potential acid generating horizons will be placed at bottom of pit and submerged below the water table, thereby preventing oxidation.
- Rehabilitation will be concurrent with mining, minimising the potential for oxidation of sulphide bearing rocks and controlling the migration of high sulphate leachate.
- Exposed residue material will be minimised by direct placement of overburden and topsoil.
- Vegetation will be re-established as soon as possible after topsoiling to minimise infiltration of water through residue material.
- Clean storm water will be diverted around the open pits and plant area.
- Leachate formed in open pits will be pumped to the processing facility for re-use.
- Due to the potential high salinity associated of the leachate, the return water dams must be lined.

Noise

Certain of the sounds generated from the open pit operations will be continuous (over 24-hours) while others will be intermittent. The loudest of the continuous noise sources will be from pneumatic drills (for blast holes), excavators, loaders and bull-dozers, dewatering pumps, and coal trucks. The intermittent noises will be from blasting, ancillary transport in pit (blasting truck, service truck, water truck, supervisory vehicles) and coal trucks moving between mine and surface workings.

The noise profiles associated with the East and West Pit are shown in Figures 2.2.6.2(a) and (b) respectively. The noise levels given are for unmitigated conditions and reflect a worst condition scenario (conservative) approach. In reality there will be greater attenuation with distance than shown where there are houses, other buildings, vegetation and terrain restraints in the intervening ground between the source and the receiver point.

The open cast mining 35dBA noise footprint covers a large area of approximately 21 km in a south-west to north-east direction and in places 13 km in a north-west to south-east direction. The footprint extends for about 4 km across the Limpopo River into Zimbabwe. There is a potential for several noise sensitive receptors to be impacted by the mining operation noise from both pits specifically during the night-time period. The noise levels from blasting are likely to be very loud at noise sensitive receptors relatively close to the open cast pit and can create a major noise nuisance. This will be dependent on the times and frequency of blasting.

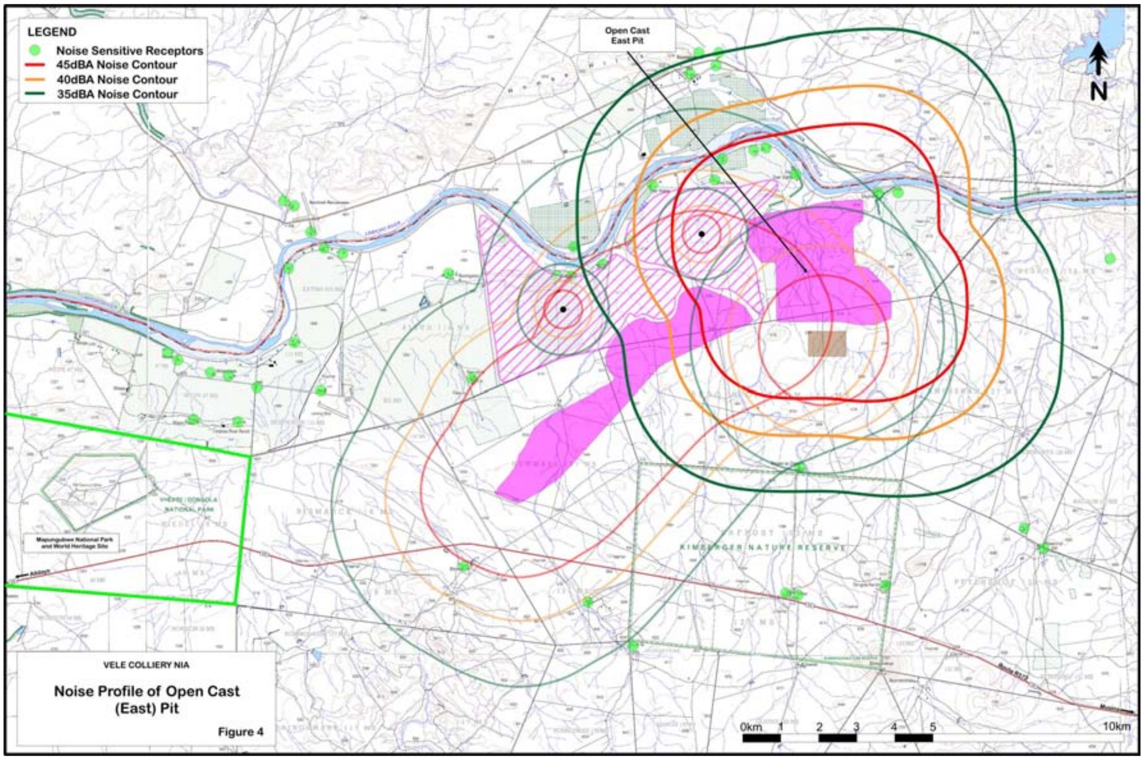


Figure 2.2.6.2(a): Noise profile for Vele East Pit

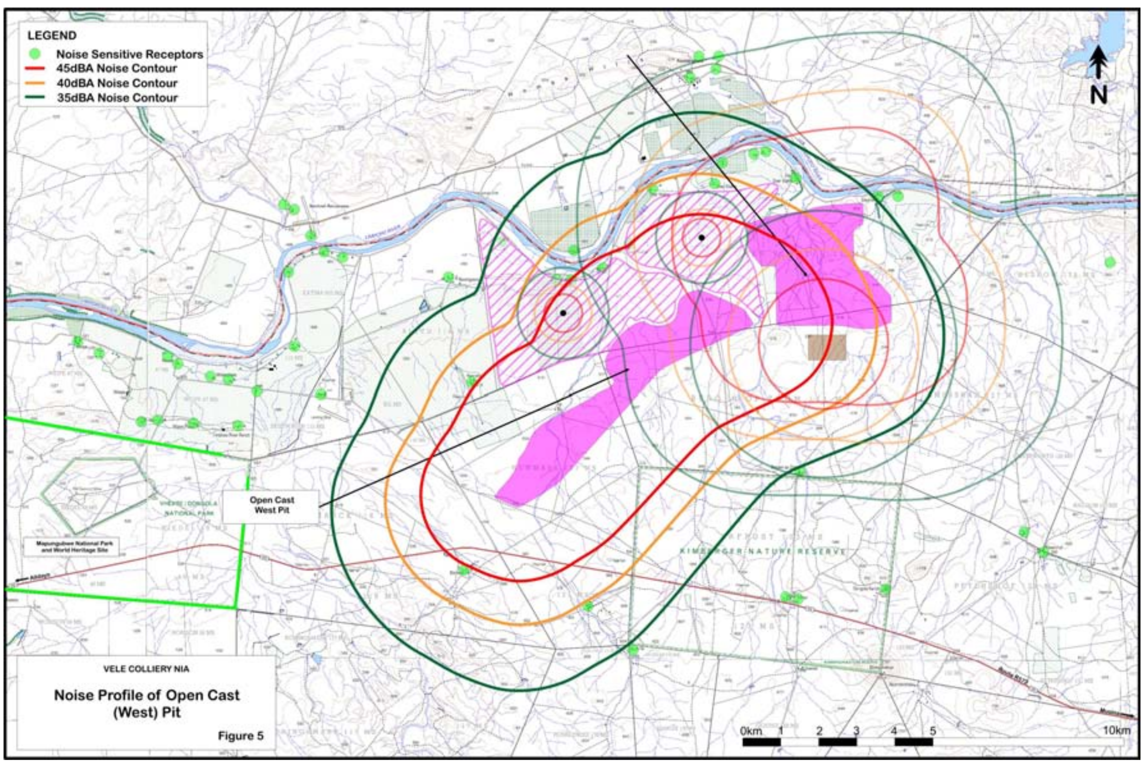


Figure 2.2.6.2(b): Noise profile for Vele West Pit

Mitigation measures proposed include:

- Noise suppression devices on heavy-duty vehicles – contract requirement
- Cladding of generator sets / low noise generator sets will be used
- Noise attenuation berms around opencast pits (also serve as stormwater / highwall drains)
- High noise activities, such as blasting, at regular times, restricted to 08h00 to 16h00
- All plant, equipment and vehicles to be kept in good repair

Blasting (Rorke, 2009 – Annexure K)

Impact as a result of blasting includes vibration, air blast, fly rock, dust and fumes and potential water pollution. The findings of the blasting impact assessment are briefly described below, followed by detail mitigation measures to reduce the potential impacts.

Vibration

- At distances of 1500 m or more from blasting, the negative impact significance to people will be low.
- At distances in excess of 500 m, the negative impact significance will be low for all structures in the area other than houses.
- At distances in excess of 500 m, the negative impact significance will be none for potential damage to the sands in the primary fresh water aquifer system. The non-permeable boundary between the fresh water and the saline water will be able to withstand much higher vibration than 75 mm/s, but it will be necessary to drill a maximum diameter of 250 mm holes for the overburden blasting in the northern portion of the opencast mine to ensure protection of the boundary at all times. Vibration measurements, as outlined in the mitigation requirements, may dictate holes of less than 250 mm in diameter in the extreme north of the property.

Air Blast

- Over-charging of blastholes, poor stemming performance or lack of stemming material and under-burdened holes contribute to high air blast levels. These levels will be aggravated by cloud cover, and will always be higher in the down-wind direction. The predominant wind direction is from east to west, and people living on the west side of the opencast operation will be more negatively impacted than other people around the mine. As most of the people living in the area are located to the west of the mine, mitigation measures will need to be strictly applied to prevent discontent in the area.
- Very effective mitigation measures are available to contain air blast thus making the negative impact significance low to none with these measures in place. To achieve a low negative impact significance, air blast needs to be kept below 125 dB at any point of concern for all blasting operations.

Fly Rock

- Uncontrolled fly rock from blasting can travel hundreds of metres, with known cases up to 1000 m. This range is for extreme cases where very little blasting control is applied, and is due to over-charging of holes or under-burdening of holes.
- The negative impact of fly rock will be most severe for structures and people within 1000 m from blasting, but with mitigating measures in place, the negative impact significance will be none at distances further than 500 m and low at distances between 100 m and 500 m from blasting.

Dust and Fumes

- Dust and fumes from blasting will be carried downwind from the blasting areas. With the dominant wind direction being from east to west, the blasting dust and fumes will be carried towards the people and farms on the west side of the opencast mine. Fine coal dust particles from blasting are the most undesirable and the presence of this dust downwind will impact people negatively. Where it lands on water, it will remain in suspension for some time, with the sulphides creating increased acidity in the water.
- Excessive blast-related dust is caused by insufficient or ineffective stemming material in each hole. The negative impact significance will be reduced to low with effective stemming controls in place. With effective stemming control, atmospheric dust is mostly contained to within about 200 m of blasting.
- Poisonous fumes from blasting are caused by incomplete detonation. Blasting normally generates water, carbon dioxide, nitrogen and some solids. However, incomplete detonation, which is caused by poorly formulated explosives or unfavourable ground conditions, can result in poisonous fumes, these mainly being Nitrous oxides (red in colour) and carbon monoxide. Both of these disperse very quickly into the atmosphere, and will not pose a risk to people or animals at distances greater than 1000 m. However, they are undesirable as there is risk to people accidentally breathing in these gases, and mitigating measures will be needed to keep the negative impact significance low.

Water Pollution

- When ammonium nitrate dry explosives (usually referred to as ANFO) are used for blasting, their solubility poses a risk to the water resources in the area. ANFO dissolves very easily and can enter the water system through spillages and charging into wet holes. This will elevate the nitrates in solution in the water system.
- With the application of waterproof explosives, and mitigating measures to control spillage, the negative impact significance will be low.

Mitigation measures to reduce the impact of blasting:

- A detailed blasting procedure will be developed for Vele Colliery by the blasting contractor, in line with the recommendations made by the blasting specialist.
- For safety, it will be necessary to remove all people and animals during the blast to the minimum distance legally required and/or stipulated by the Inspectorate.
- Vibration and air blast monitoring will be needed for all blasts to make sure that the limits are being achieved and to provide an indication of when modifications are needed to the blasting method to correct for increased vibration and air blast levels.
- It will be important to carry out a thorough pre-blast crack survey of each house or permanent building that is located closer than 2000 m from the proposed blasting. It may be necessary to repeat this survey at annual or bi-annual intervals to track the changes in cracks and other damage with time.

<u>Visual impact</u>

The results of the viewshed analyses for the East and West Pits are presented in Figures 2.2.6.2(c) and (d) respectively. The coloured shades of each map reveal particular patterns of possible visual exposure. The probability of exposure is indicated by shades of yellow to red. Yellow indicate a low level of exposure and red indicate a high level of exposure.

It is evident from these maps that the Eastern Pit is less visible in comparison with the Western Pit. The first will impact directly south and north of the opencast area, with the highest impact expected upon residents across the border (Nottingham). The latter will impact a considerably larger area to the north and the west, including Mapungubwe National Park.

By integrating the viewshed data with the roads, a more realistic picture of potential visibility of the Western Pit is given (Figure 2.2.6.2(e)). Within Mapungubwe views of the mine will occur from the roads and 4x4 tracks in the eastern part of Mapungubwe, especially the section of road going downhill in an eastern direction from where the west pit might be exposed. It must be taken into account, though, that this is between 12 to 15km from the western boundary of the west pit, with an associated impact degree of medium. Any visibility of the east pit will be of a low degree being more than 20km away.

The high degree of visibility from the section of the Weipe road close to the Limpopo River must be noted. This section falls outside of Mapungubwe. The high degree of visibility is contributed to the removal of natural vegetation for agricultural purposes.

Mitigation measures that will be implemented:

- Introducing landscaping measures such as vegetating berms and permanent stockpiles.
- Avoid the unnecessary removal of vegetation during the operational phase.
- Rehabilitation and revegetation will be performed concurrent to mining, within 5 strips or 300m of active mining.

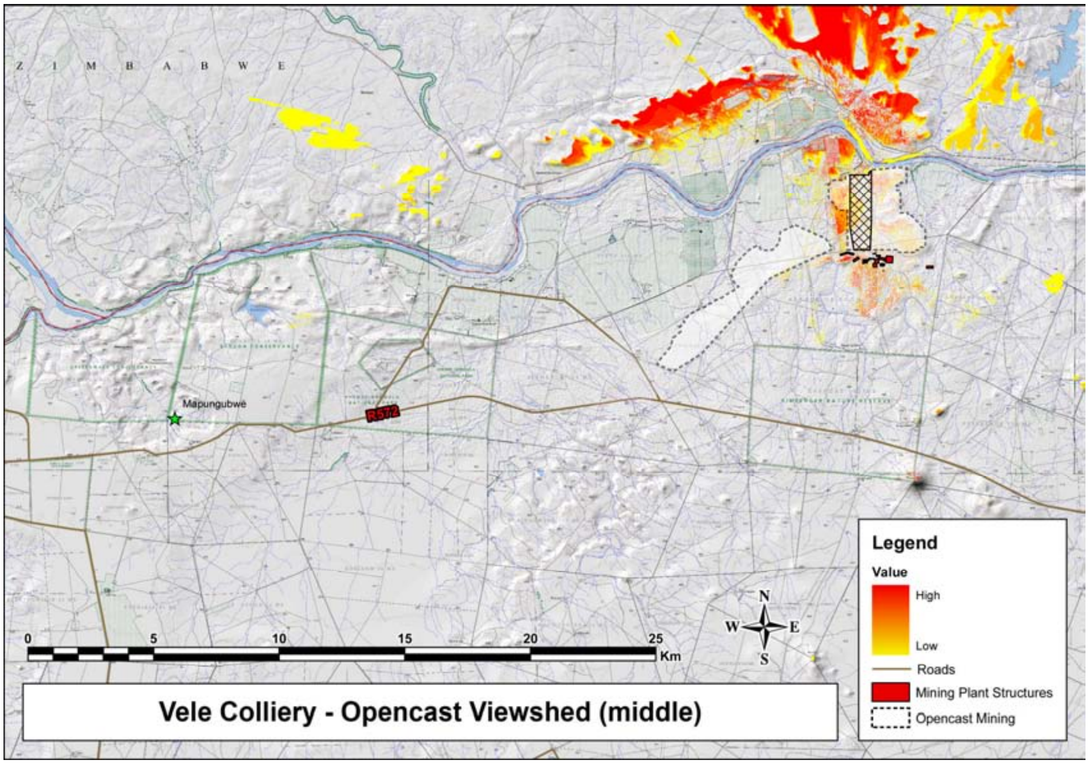


Figure 2.2.6.2(c): Viewshed analyses for the East Pit (towards end of pit life)

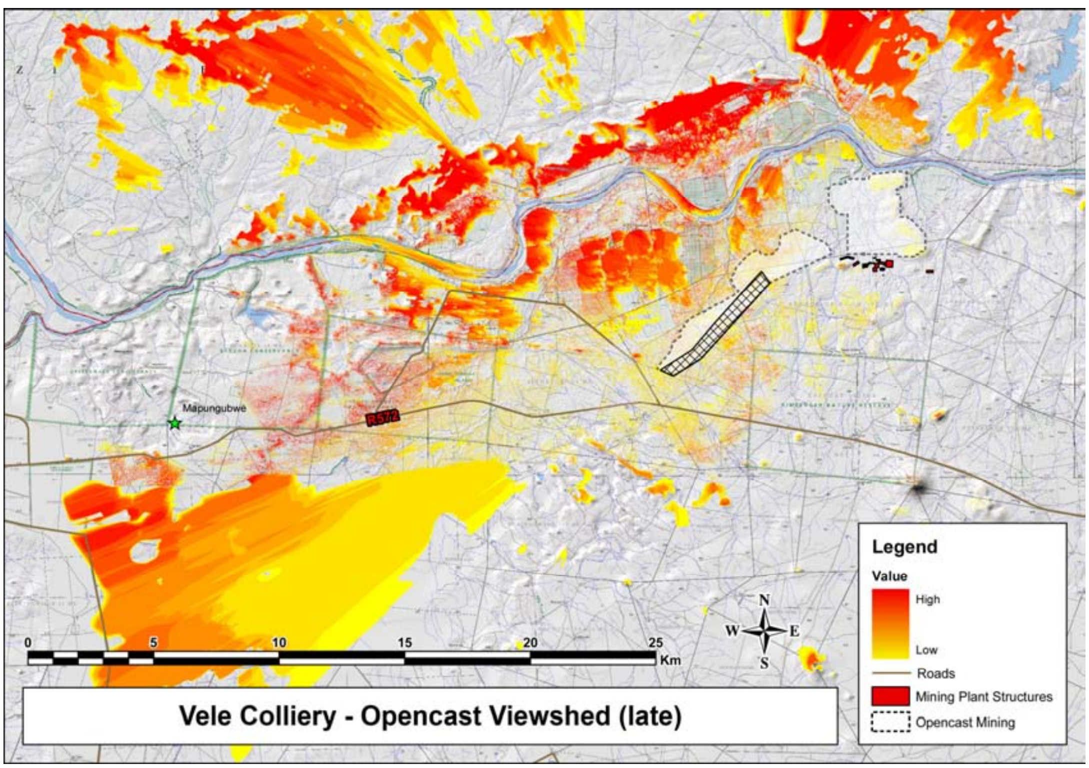


Figure 2.2.6.2(d): Viewshed analyses for the West Pit (towards end of LOM)

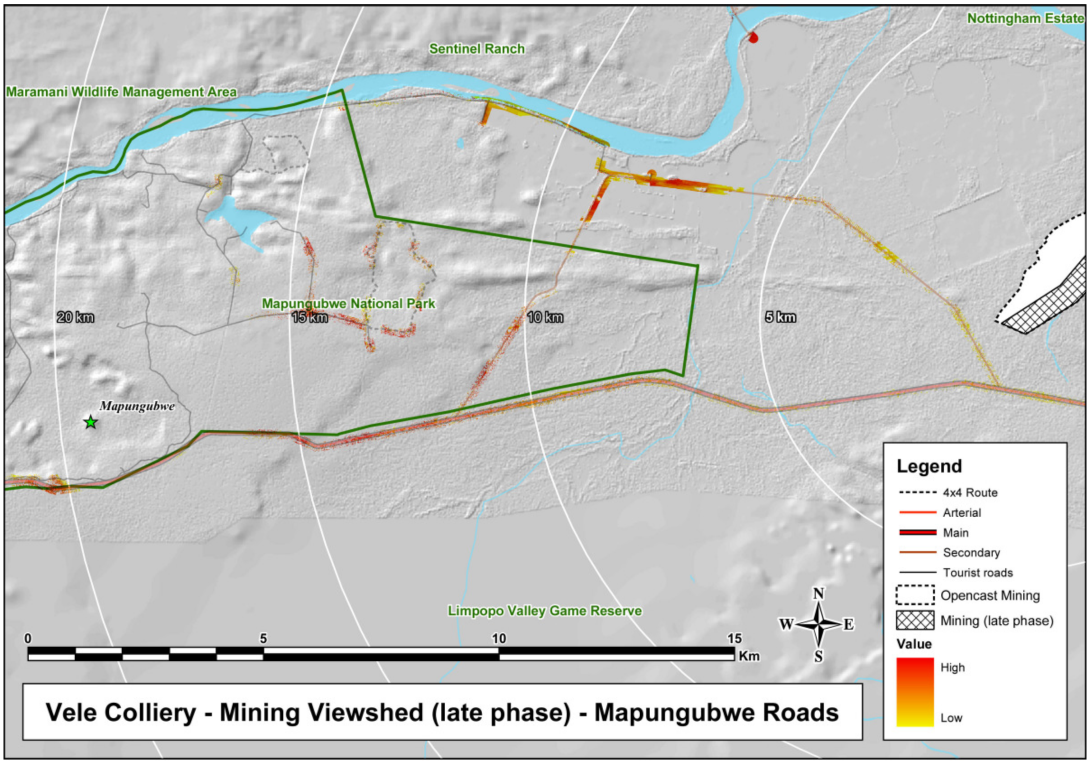


Figure 2.2.6.2(e): Viewshed analyses for the West Pit, with focus on the Mapungubwe National Park roads

No additional impacts have been identified during the **closure phase**.

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

After mine closure it is estimated that water levels in the mine area would take about 50 years to recover to the pre-mining levels. Some decant (total maximum 1 200 m^3/day) can then be expected at the lowest points around the eastern and western opencast areas. Sulphate concentrations of leachate will rise to 1750 mg/l due to the oxidation of pyrite, but when mixed with groundwater inflows, will peak at just below 1200 mg/l but due to reduced leachate volumes being produced will drop off to about 885 mg/l in the longer term.

Due to the neutralization potential (buffer capacity) of the overburden rock, it is not expected that the decant would turn acid.

Potential decant must be contained and one of the following measures implemented:

- Treat to an acceptable level before released into the environment
- Store and evaporate
- Use for irrigation of crops and rehabilitated areas

These options must be evaluated during the life of mine and included as part of the mine closure plan.

2.2.6.3 Impacts - Activity 2 (Underground mining)

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

- Surface disturbance – refer to Section 2.2.6.1
- Dust generation – refer to Section 2.2.6.1
- Noise generation – refer to Section 2.2.6.1

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

- Noise generation
- Visual impact
- Impact on surface water resources
- Impact on groundwater resources
- Subsidence
- Underground flooding

Noise

Certain of the sounds generated by the new complex will be continuous (over 24-hours) while others will be intermittent. The loudest of the continuous noise sources will be from the ventilation extractor fans, conveyor system drive-houses and overland conveyor system.

There is a potential for certain noise sensitive receptors to be impacted by the mining operation noise from both ventilation shafts specifically during the night-time period as reflected in Figure 2.2.6.3(a) below.

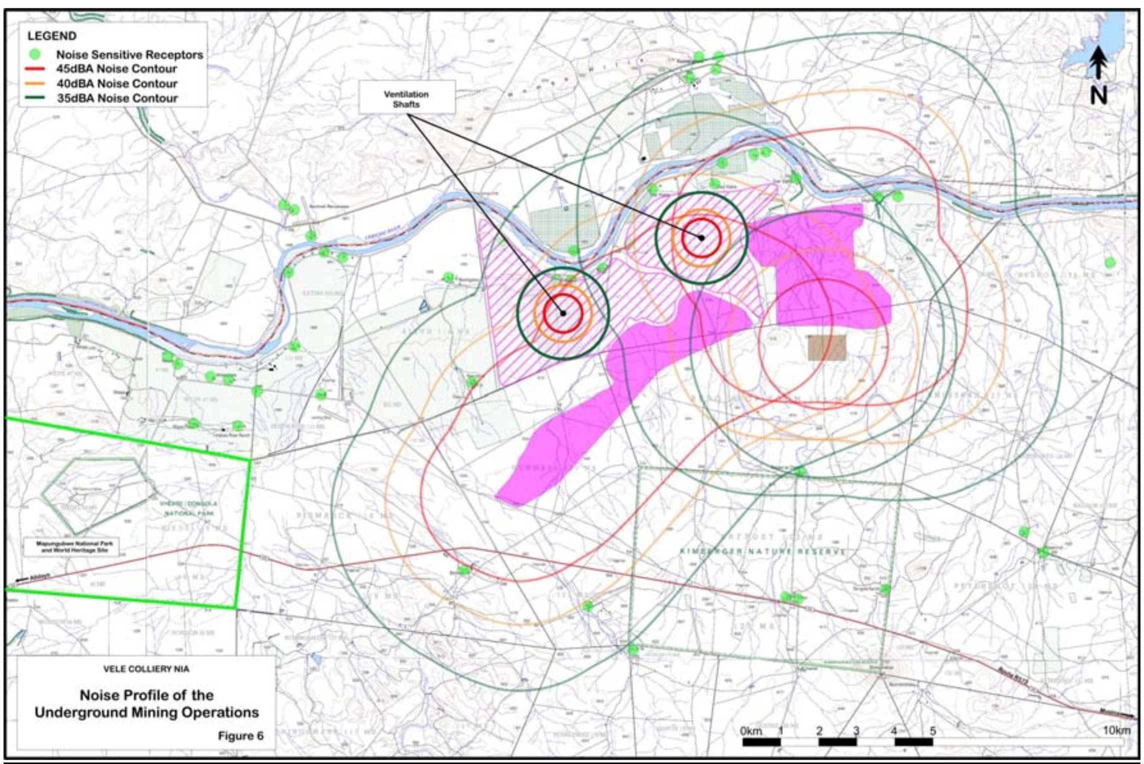


Figure 2.2.6.3(a): Noise profile for the Vele underground workings

Proposed mitigation measures include:

- Noise baffles to be placed on fans
- Use of low noise fans at ventilation shafts – tender requirement
- Cladding of generator sets / low noise generator sets will be used
- Rubber vulcanised belt – less noisy / vibration
- All plant, equipment and vehicles to be kept in good repair

Visual impact

The visual impact associated with the underground mining operation is limited to the ventilation shafts and the miners camp. Impact will be confined to the site and limited mitigation measures are proposed:

- Avoid the use of highly reflective material in construction.
- Metal surfaces should be painted in natural soft colours that would blend in with the environment.
- Using directional or cut-off type luminaries that focus the beam downward to mitigate light pollution.

Impact on surface water resources

The miners camp and rock dump area is regarded as a dirty water area to be provided with upstream diversion berms and downstream collection berms to feed water to a dirty water pond. This dirty water pond can also be used to receive water from the underground mine and would be sized to tie in with the dewatering storage requirements. The conceptual layout is shown in Figure 1.3.4(c).

The approaching upstream clean water flow is in the form of sheet flow and special measures are required at the outlet of the diversion drains to spread out the flow to achieve natural sheet flow conditions, thereby preventing scour.

The sewage treatment works, a package plant to treat water to DWAF's effluent quality standards, would be situated downhill of the office block and change rooms. The effluent would be discharged into the dirty water pond for re-use.

Impact on groundwater resources

The dewatering volumes were determined in the geohydrological model on an annual average flow basis, assuming the Limpopo River and its alluvial sandbed is a steady source. The projected maximum dewatering quantity would be reached by 2016 when an average flow rate of 5 167 m^3/day is reached. The water will be pumped from underground to surface holding dams, from where it will be piped to the processing plant for use in the beneficiation process.

Present day water levels in the upper aquifer layer vary from 480-510 mamsl over the mine workings. Water levels in 2023, in the period of peak losses from the Limpopo range from 460-510 mamsl. However, water levels in the alluvial aquifer remain stable at about 480 mamsl due to the influence of inflow from the Limpopo River, hence irrigation boreholes are unlikely to be affected.

The area of influence is not expected to extend beyond the ENE striking fault which bisects Erfrust and clips the SE corner of Bergen op Zoom in the south and the Limpopo River in the north. The radius of influence is thus not expected to be more than 5kms around the mine.

Due to the low recharge rates and low groundwater flow rates, water level recovery in the secondary aquifers is expected to be slow. After mine closure it is estimated that water levels in the mine area would take about 50 years to recover to the pre-mining levels.

Mitigation:

- Sufficient pumping and holding capacity must be made available to manage the dewatering of the underground workings to prevent the flooding of the underground.

Subsidence

Pillar failure could lead to surface subsidence, which in turn will impact on the primary aquifer and existing land use. No secondary extraction including pillar extraction has been designed for Vele Colliery due to the high likelihood of this resulting in surface subsidence.

Mitigation:

- The underground mine will be designed with safety factors which will prevent pillar failure and subsequent subsidence of the surface.

Methane

Whilst the potential exist for the coal to emit methane during the mining operation, it is considered very low due to the shallow nature of the coal seams.

Mitigation:

- Regular methane monitoring to be conducted.

No additional impacts have been identified during the **closure phase**.

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

Spontaneous combustion could lead to increased pillar failure and impact on air quality

Mitigation:

- Sealing of abandoned areas underground during the operational phase.
- Proper sealing of all shafts and boreholes.
- Continuous monitoring of sealed areas for early detection.

2.2.6.4 Impacts - Activity 3 (Coal Processing)

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

- Surface disturbance – refer to Section 2.2.6.1
- Dust generation – refer to Section 2.2.6.1
- Noise generation – refer to Section 2.2.6.1

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

- Impact of water use on the Limpopo River and primary aquifer
- Quality of surface water resource
- Noise levels
- Visual impact

Water use

The total operational water requirement at full production is estimated at 4 667 m³/day. Total inflows in to mine workings will peak at 5 Ml/day, which could provide a large portion of the mine water requirements. Most of the inflows are expected to occur in the Underground east workings due to its depth of up to 150 m below surface. The impact of mining on river losses varies over the life of the mine. Initially, most inflows into mine works will originate from releases of aquifer storage. River losses peak at under 4 Ml/day towards 2024.

To determine the worst case scenario for estimating the maximum quantity of make-up water that may be required, the effective, usable dewatering quantity was taken as 50% of the theoretical value. This was done to compensate for evaporation losses in the lined ponds to be used as temporary storage and to allow for the impact of long dry spells on the quantity of seepage into the mine, which will reduce the dewatering quantities.

The maximum shortfall occurs in the early period of the mine before the underground workings and the pits have reached the deeper levels and progressed to the areas closer to the river. The worst case shortfall can be taken as 3 400 m³/day, or 1.241 million m³/a, projected to occur in 2011. Thereafter the steady state shortfall (with 50% losses in the dewatering quantity) varies between 2 000 m³/day and 3 000 m³/day, or 0.73 million m³/a to 1.1 million m³/a. This shortfall, or make-up water, would be supplied from surface water sources (abstraction from the Limpopo River during high flood periods).

The Mine would probably have a legal right to 5.64 million m³/annum (15 450 m³/day), albeit at a low level of assurance. At this stage it can be assumed that 3.3 million m³/annum (9 040 m³/day) may be available at a higher level of assurance. Net river losses of 84.5 Ml/day prior to mining are not exceeded if abstraction for irrigation is reduced by 7 Ml/day due to the transfer of water rights to the mining company. Losses from the Limpopo are reduced to between 79-81 Ml/day, hence are less than pre mining conditions.

The volume of water required by the mine in low flow periods was calculated as 750 000 m³, to supply in the mine's average make-up water requirement of 2 500 m³/day over a period of 10 months. However, it is estimated that a dam with a volume of at least 1 million m³ is required to provide a safe operating margin. The proposed position of the clean water dam is shown on Figure 1.3.4(a).

Surface water quality

Unless proper measures are taken, polluted runoff from the plant area may affect the streams and the Limpopo River. However, runoff from the plant area will be collected in a dirty water dam for re-use and the impact will be limited to a very slight reduction in runoff, which is negligible.

The quality of surface water runoff in the plant area will deteriorate to worse levels if rainwater leaching out as surface flows or flows in streams are in contact with man-made occurrences of coaliferous material, petro-chemical products and over-doses of fertilizer and organic compounds used in agriculture.

As is evident from the sample taken at the fountain at Bergen op Zoom and from the water quality data of the boreholes as shown in the groundwater report, the present (background) water quality is poor. High levels occur of, amongst others, chloride, sulfate and sodium, due to the natural salinity in the groundwater which is a feature of dry climates with low surface water recharge.

The proposed mitigation measures are shown in Figure 1.3.4(a) and are briefly described below.

- It involves the diversion of clean runoff around the 'dirty' plant area, including the proposed railway loop. As indicated, the natural catchment area boundary is utilised as far as possible as the boundary of the area, thereby reducing the need for man-made berms. This lessens the impact on vegetation, soils and visual quality. If a railway is not constructed, the deemed dirty water area will be substantially reduced.
- At the upstream, southern end of the area, low diversion berms are required to direct some of the surface flow, in the form of unconcentrated sheetflow, away from the area. Being close to the natural top end of the watershed, the quantity of water to be diverted is small.
- Further downstream on the western side of the area, the railway line is used as the stream diversion, thereby obviating the need for an additional berm, since railway lines are normally elevated above natural ground level. No cross drainage culverts are to be installed over this length of the line. Initially though (until a final decision is taken regarding the railway line) a diversion berm will need to be constructed for this purpose.
- On the lower eastern side, a berm is required to reroute a small drainage line towards the east to tie in with the drainage system around the East Pit.
- The northern boundary of the dirty water area is formed by the haul road, which will be constructed above natural ground level. Upstream of the haul road, dirty water will be conveyed in drains towards the dirty water dam. The dirty water dam is constructed in the stream which naturally drains the dirty water area.
- The dirty water dam is to be lined and must contain the 1:50-year flood volume. It should have a spillway to discharge floods larger than the 50-year flood with a minimum freeboard of 800 mm above the full supply level, as prescribed in GN 704. The final design would depend on the excavatable depth and availability of suitable material for construction of the dam wall.
- Apart from the spillway, dam outlets should be provided in order for water to be abstracted for re-use. After major flood events the re-use of water from this dam should be first priority so as to keep the water level as low as possible.
- Other smaller, deep lined ponds are to be provided close to the plant which would receive water pumped from the workings and from the dirty water dam for use in the plant. At least two days' plant water demand should be stored here as back-up in the event of pump failures, i.e. at least 10 000 m^3. Excess water received in the ponds

would spill (through pipes) to the dirty water dam.

- The sewage treatment works, a package plant to treat water to DWAF's effluent quality standards, would be situated downhill of the office block and change rooms. The effluent would be discharged into the dirty water dam for re-use.
- At the workshop area, all fuel storage tanks should be installed on concrete floor slabs and bunded to contain spillages. Used oil should be collected in containers for recycling. The floor of the workshop area should drain towards an oil trap to prevent any ingress of contaminated water into the soil.

Noise

The main noise sources will be crushers, washing plants, screening operations, cyclones and conveyor systems. Only one noise sensitive receptor is likely to be impacted by the operational noise from this complex alone – refer to Figure 2.2.6.4(a). However, intermittent loud noises are likely to be heard further a field than the position of the 35dBA contour.

Noise from the sections of the overland conveyor system between drive houses is predicted to be relatively low; that is the noise levels from the belt section should not exceed 35dBA at an offset of 60 metres from the conveyor.

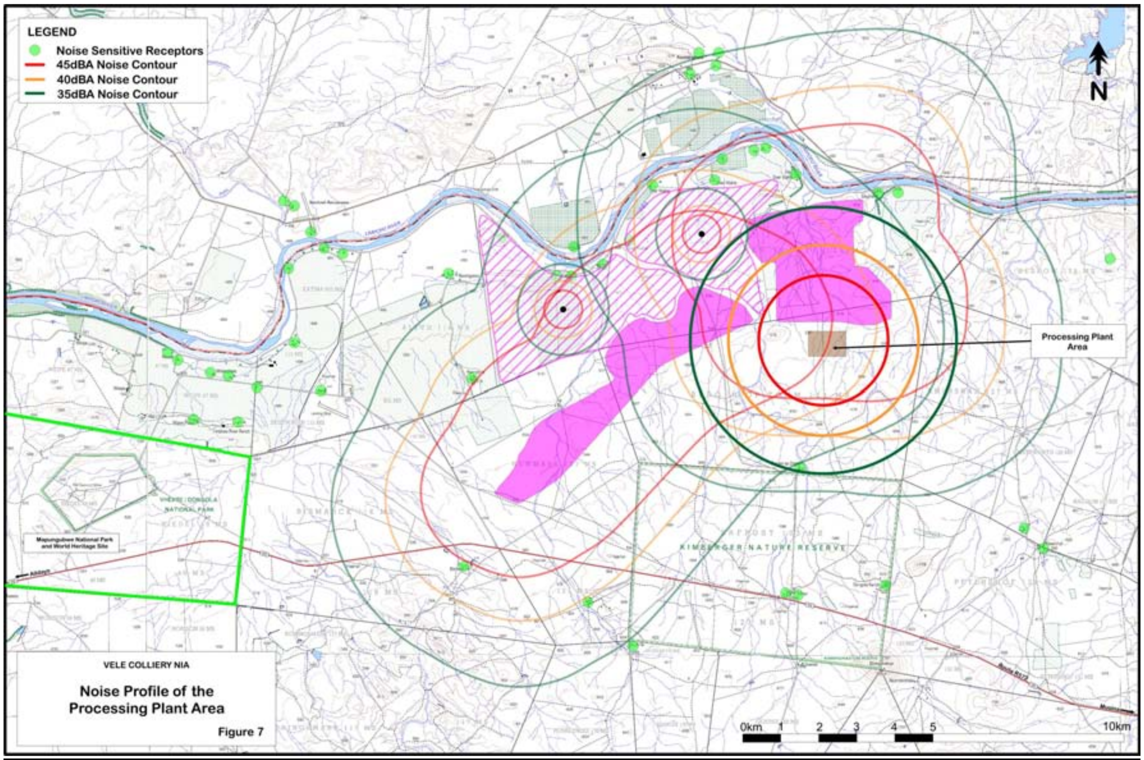


Figure 2.2.6.4(a): Noise profile for the Vele processing plant

Proposed mitigation measures include:

- Tree screening around plant area to reduce noise levels
- Noise suppression devices on heavy-duty vehicles – contract requirement
- Cladding of generator sets / low noise generator sets will be used
- Rubber vulcanised belt – less noisy / vibration
- All plant, equipment and vehicles to be kept in good repair

Visual impact

The results of the viewshed analyses for the Processing Plant are presented in Figure 2.2.6.4(b).

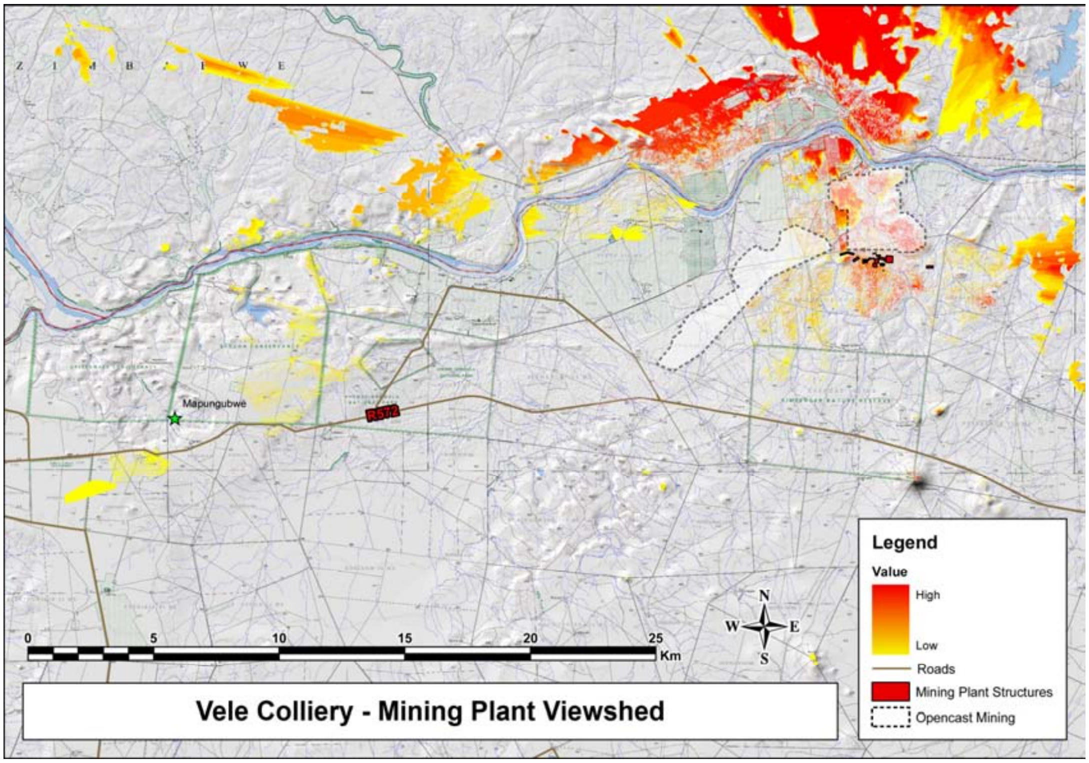


Figure 2.2.6.4(b): Viewshed analyses for the Vele processing plant

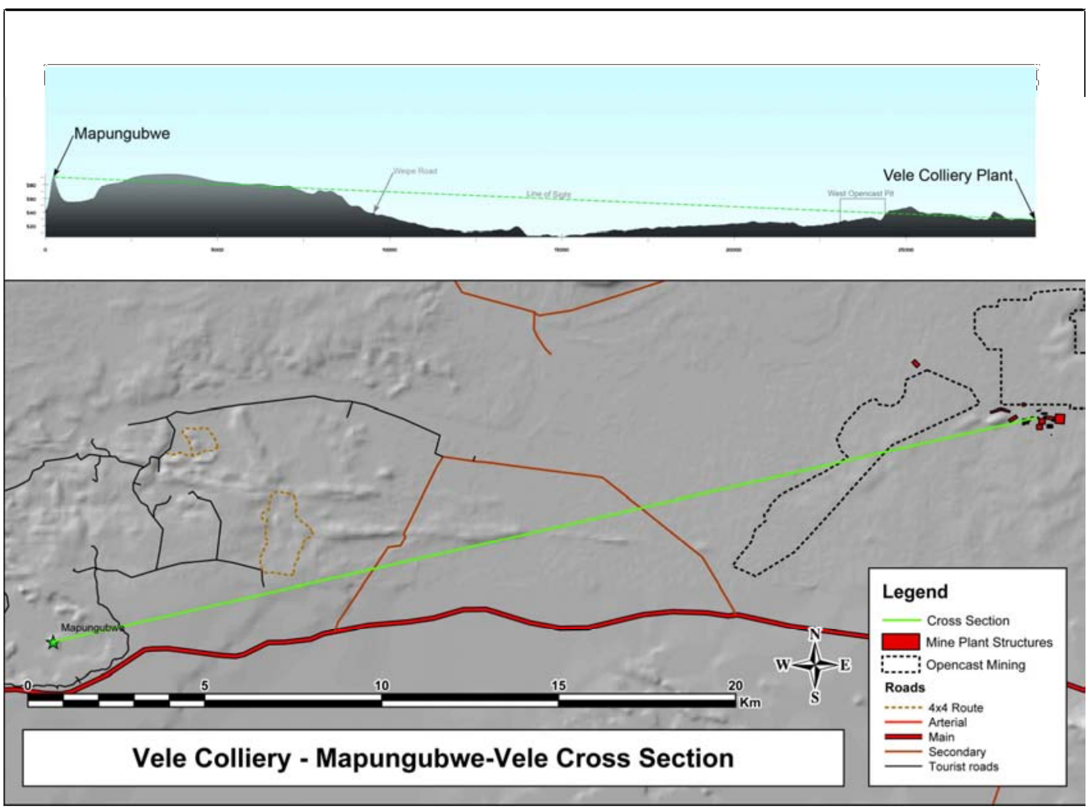


Figure 2.2.6.4(c): Mapungubwe-Vele Colliery cross section

The plant infrastructure will impact directly south and north of the site, with the highest impact expected upon residents across the border (Nottingham). Limited visibility is expected within the Mapungubwe National Park. Visibility from Mapungubwe Hill is obstructed by high ground east of the hill. The cross section (Figure 2.2.6.4(c)) also confirms the results of the viewshed analysis which indicate the eastern part of Mapungubwe as having the most likelihood of exposure to the plant.

Of concern however is the exposure from the processing plant during night time, especially if lighting sources are directed horizontally towards viewers.

Mitigation:

- Keeping infrastructure at minimum heights – maximum height of any structure instructed to be 20m.
- Avoid the use of highly reflective material in construction.
- Metal surfaces should be painted in natural soft colours that would blend in with the environment.
- Using directional or cut-off type luminaries that focus the beam downward to mitigate light pollution. Luminaries will be directed away from the Mapungubwe National Park.
- The use of outdoor fixtures high up on tall structures should be limited or avoided. In this instance good use should be made of the low elevation of the plant area and the visual absorption effect of the topography.
- Vegetation screens along western footprint of the processing plant area – a number of the Baobab trees to be relocated from the opencast areas could be utilised for this purpose, provided that the habitat is suitable.

No additional impacts have been identified during the **closure phase**.

No **post closure phase** associated with this activity.

2.2.6.5 Impacts - Activity 4 (Coal Transport)

No **construction phase** associated with Activity 4.

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

- Increased noise levels
- Increased traffic
- Spillages
- Dust generation

The current traffic on R572 is on average (per day) approximately 250 light vehicles and 103 heavy vehicles. On full production, approximately 250 60ton truck loads will be required to transport the coal product to Musina Siding. In addition, it is estimated that the increase in other vehicles (busses, light vehicles) will peak at 156 per day, with delivery (heavy vehicles) estimated in the order of 20 per day. Thus traffic on the R572 could potentially double.

This would pose a safety threat to local residents and local traffic. The coal transport trucks present a noise and a dust impact and are likely to further degrade the already degraded local roads. Spillage of coal may also occur from these trucks.

The predicted normal colliery traffic will increase the traffic generated noise level on Route R572 east of the colliery by approximately 2.0dBA (without coal trucks) and with an additional 4.1dBA if the coal trucks are routed along this road.

The following mitigation measures are proposed:

- Adhering to all road regulations, *e.g.* speed limits. Maximum speed limit of 80km/h for coal trucks.
- Ensuring headlights are on all the time to increase visibility.
- Ensuring coal is covered with a tarpaulin when travelling on R572.
- Ensuring the coal trucks use only the designated routes.
- Cleaning up of any spillages that may have occurred.
- Upgrading of transport routes as required.
- Ensuring a system of road maintenance is in place.
- Noise suppression devices on heavy-duty vehicles – contract requirement
- All plant, equipment and vehicles to be kept in good repair

No **closure** or **post closure phases** associated with Activity 4.

2.2.7 Potential Physical Impacts raised by IAPs and State Departments

Refer to **Sections 2.2.5** and **2.2.6**. In these sections the proposed mitigation measures are also discussed and the significance rating of the impacts are shown in **Table 2.2.9**.

2.2.8 Classification of Impacts in terms of Respective Phases

Refer to **Section 2.2.6** as well as to **Tables 2.2.3** and **2.2.9.**

2.2.9 Assessment of Potential Impacts

The classification of all environmental impacts identified will be assessed in terms of: -

- their duration,
- their extent,
- their probability,
- their severity.

The above will be used to determine the significance impact without any mitigation, as well as with mitigation.

Environmental risk and impact assessment criteria

DURATION		
Short term	6 months	1
Construction	36 months	2
Life of project	29 years	3
Post rehabilitation	Time for re-establishment of natural systems	4
Residual	Beyond the project life	5
EXTENT		
Site specific	Site of the proposed development	1
Local	Farm and surrounding farms	2
District	Musina Municipal district	3
Regional	Vhembe region	4
Provincial	Limpopo Province	5
National	Republic of South Africa	6
International	Beyond RSA borders	7

PROBABILITY		
Almost Certain	100% probability of occurrence – is expected to occur	5
Likely	99% - 60% probability of occurrence – will probably occur in most circumstances	4
Possible	59% - 16% chance of occurrence – might occur at some time	3
Unlikely	15% - 6% probability of occurrence – could occur at some time	2
Rare	<5% probability of occurrence – may occur in exceptional circumstances	1
SEVERITY		
Catastrophic (critical)	Total change in area of direct impact, relocation not an option, death, toxic release off-site with detrimental effects, huge financial loss	5
Major (High)	> 50% change in area of direct impact, relocation required and possible, extensive injuries, long term loss in capabilities, off-site release with no detrimental effects, major financial implications	4
Moderate (medium)	20 – 49% change, medium term loss in capabilities, rehabilitation / restoration / treatment required, on-site release with outside assistance, high financial impact	3
Minor	10 – 19% change, short term impact that can be absorbed, on-site release, immediate contained, medium financial implications	2
Insignificant (low)	< 10 % change in the area of impact, low financial implications, localised impact, a small percentage of population	1

RISK ESTIMATION (Nel 2002)					
	SEVERITY				
PROBABILITY	Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Critical (5)
Almost certain (5)	H	H	**E**	**E**	**E**
Likely (4)	M	H	H	**E**	**E**
Possible (3)	L	M	H	**E**	**E**
Unlikely (2)	L	L	M	H	**E**
Rare (1)	L	L	M	H	H

E	Extreme risk – immediate action required, detail considerations required in planning by specialists – alternatives to be considered	4
H	High risk – specific management plans required by specialists in planning process to determine if risk can be reduced by design and management and auditing plans in planning process, taking into consideration capacity, capabilities and desirability – if cannot, alternatives to be considered, senior management responsibility	3
M	Moderate risk – management and monitoring plans required with responsibilities outlined for implementation, middle management responsibility	2
L	Low risk – management as part of routine requirements	1

IMPACT SIGNIFICANCE	
Negligible	The impact is non-existent or insubstantial, is of no or little importance to any stakeholder and can be ignored.
Low	The impact is limited in extent, even if the intensity is major; whatever its probability of occurrence, the impact will not have a significant impact considered in relation to the bigger picture; no major material effect on decisions and is unlikely to require management intervention bearing significant costs.
Moderate	The impact is significant to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.
High	The impact could render development options controversial or the entire project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in project decision-making.
Very high	Usually applies to potential benefits arising from projects.

Table 2.2.9: Significance Assessment of Impacts associated with all activities for all phases of the project, including heritage resources

Activity	Potential Impact	D	E	P	S	RE	Significance without mitigation	Mitigation measures	Significance with mitigation
All activities	Surface disturbance for the purpose of mining or infrastructure will lead to impacts on the soil, land use and land capability, natural vegetation and fauna	4	2	5	3	4	High	Detailed species rescue, relocation and re-introduction plan, Appoint qualified person to management rescue and relocation plan	Moderate
								Identify and rescue of as many as possible fauna and flora species prior to construction and mining for relocation to suitable areas. This should be repeated on an annual basis.	
								Develop detail plan for indigenous nursery	
								Establish indigenous nursery, Appoint qualified person to manage nursery	
								Develop rehabilitation plan, Appoint rehabilitation officer	
								Fencing of designated infrastructure & mining areas	
								Creation of animal corridors	
								Appointment of herpetologist	
	Dust impact	3	2	4	3	3	Moderate	Construction & tarring of access road	Low
								Application of dust suppression – main haul road	
								Water sprays at stockpiles & transfer points	
								Cladding of stockpiles	
								Develop air blast control measures	
								Vehicle speed on unpaved roads limited to prevent dust creation	
								Employ latest technology to reduce vehicle exhaust gas emissions	
	Construction noise	2	2	4	3	3	Moderate	Construction site yards, construction worker camp and other noisy fixed facilities will be located well away from noise sensitive areas adjacent to the development sites	Low
								All construction vehicles and equipment are to be kept in good repair	
								Construction activities, and particularly the noisy ones, are to be limited to reasonable hours during the day and early evening	
								Construction staff working in areas where the 8-hour ambient noise levels exceed 75dBA must wear ear protection equipment	
	Poor waste management	3	3	3	3	3	Moderate	Different waste streams will be segregated and disposed of in appropriate designated receptacles	Low
								Appoint an approved, registered waste contractor to manage the waste generation and safe disposal thereof	
	Impact on conservation value of the region	5	5	4	4	4	High	Biodiversity offset programmes	Moderate Offset programmes – High Positive
								Implementation of monitoring programme ○ Groundwater ○ Surface water ○ Air quality ○ Blasting	
								Develop environmental awareness & educational programmes	
								Biennial auditing and reporting	

Activity	Potential Impact	D	E	P	S	RE	Significance without mitigation	Mitigation measures	Significance with mitigation
Activity 1	Surface water runoff	3	7	4	1	2	Low	Clean water diversions around the mining area – flow back to the natural environment Flood protection berm along Limpopo River to prevent flooding Rehabilitation concurrent to mining – limit dirty footprint	Negligible
	Water quality impacts	3	7	4	3	3	Moderate	Rock overburden and mine residue (discard and slurry) at the site are to be backfilled into the open pits and rehabilitated while mining progresses, hence surface dumps will be avoided. ROM and product stockpile sites must be carefully selected away from possible groundwater conduits. Stockpile sites must be compacted to limit percolation and leachate volumes. Potential acid generating horizons will be placed at bottom of pit and submerged below the water table, thereby preventing oxidation. Rehabilitation will be concurrent with mining, minimising the potential for oxidation of sulphide bearing rocks and controlling the migration of high sulphate leachate. Exposed residue material will be minimised by direct placement of overburden and topsoil. Vegetation will be re-established as soon as possible after topsoiling to minimise infiltration of water through residue material. Clean storm water will be diverted around the open pits. Leachate formed in open pits will be pumped to the processing facility for re-use. Due to the potential high salinity associated of the leachate, the return water dams must be lined.	Low
	Long-term water quality impact due to decant	5	7	4	3	3	High	Potential decant must be contained and appropriate management measures implemented. Alternative options must be evaluated during the life of mine and included as part of the mine closure plan. Groundwater and geochemical models must be updated on a regular basis (every 5 years) to verify potential for decant	Moderate
	Noise	3	2	4	3	3	High	Noise suppression devices on heavy vehicles – contract requirement Low noise generator sets to be used – contract requirement Construct noise attenuation berms – part of operational cost Blasting limited on regular times, restricted to 08:00-16:00 All plant, equipment and vehicles to be kept in good repair	Moderate
	Blasting	3	7	4	3	3	High	A detailed blasting procedure will be developed for Vele Colliery by the blasting contractor, in line with the recommendations made by the blasting specialist. For safety, it will be necessary to remove all people and animals during the blast to the minimum distance legally required and/or stipulated by the Inspectorate.	Moderate

Activity	Potential Impact	D	E	P	S	RE	Significance without mitigation	Mitigation measures	Significance with mitigation
								Vibration and air blast monitoring will be needed for all blasts to make sure that the limits are being achieved and to provide an indication of when modifications are needed to the blasting method to correct for increased vibration and air blast levels.	
								It will be important to carry out a thorough pre-blast crack survey of each house or permanent building that is located closer than 2000 m from the proposed blasting. It may be necessary to repeat this survey at annual or bi-annual intervals to track the changes in cracks and other damage with time.	
	Visual	4	3	3	4	4	High	Introducing landscaping measures such as vegetating berms and permanent stockpiles.	Moderate
								Avoid the unnecessary removal of vegetation during the operational phase.	
								Rehabilitation and revegetation will be performed concurrent to mining, within 5 strips or 300m of active mining.	
Activity 2	Surface water resources	3	7	3	3	3	High	Stormwater management – include clean water drains around dirty area	Low Reduction in current water use – High Positive
								Dirty water dams to be lined	
	Groundwater resources	4	2	5	2	3	Moderate	Sufficient pumping and holding capacity must be made available to manage the dewatering of the underground workings to prevent the flooding of the underground.	Low
	Pillar failure leading to surface subsidence & impact on primary aquifer	5	6	3	5	4	High	The underground mine will be designed with safety factors which will prevent pillar failure and subsequent subsidence of the surface.	Low
	Spontaneous combustion could lead to increased pillar failure	5	6	2	5	4	High	Continuous monitoring of sealed areas for early detection.	Low
	Noise	3	1	4	3	3	Moderate	Noise baffles to be placed on fans	Negligible
								Use of low noise fans at ventilation shafts – tender requirement	
								Low noise generator sets will be used – tender requirements	
								Rubber vulcanised belt – less noisy / vibration – tender requirements	
								All plant, equipment and vehicles to be kept in good repair	
	Visual	3	1	3	3	3	Moderate	Avoid the use of highly reflective material in construction.	Low
								Metal surfaces should be painted in natural soft colours that would blend in with the environment.	
								Using directional or cut-off type luminaries that focus the beam downward to mitigate light pollution.	
	Methane emissions leading to air quality impacts	3	7	2	3	2	Moderate	Ongoing methane monitoring	Low
Activity 3	Water requirements not met	3	1	3	5	4	High	Construction of clean water dam	Moderate

Activity	Potential Impact	D	E	P	S	RE	Significance without mitigation	Mitigation measures	Significance with mitigation
	Surface water impact	3	7	3	4	4	High	Clean water diversion canals around dirty plant area Dirty water collected in dam in plant – recycled for reuse in plant All dams within plant area to be lined Plant holding dams - lining Clean water diversion canals	Low
	Noise impact	3	2	4	3	3	High	Noise suppression devices on heavy vehicles – contract requirement Low noise generator sets will be used – tender requirements Tree screening around the plant Rubber vulcanised belt – less noisy / vibration – tender requirements All plant, equipment and vehicles to be kept in good repair	Moderate
	Visual impact	3	3	4	4	4	High	Keeping infrastructure at minimum heights – maximum height of any structure instructed to be 20m. Avoid the use of highly reflective material in construction. Metal surfaces should be painted in natural soft colours that would blend in with the environment. Using directional or cut-off type luminaries that focus the beam downward to mitigate light pollution. Luminaries will be directed away from the Mapungubwe National Park. The use of outdoor fixtures high up on tall structures should be limited or avoided. In this instance good use should be made of the low elevation of the plant area and the visual absorption effect of the topography. Vegetation screens along western footprint of the processing plant area – a number of the Baobab trees to be relocated from the opencast areas could be utilised for this purpose, provided that the habitat is suitable.	Moderate
Activity 4	Increased traffic leading to safety risk to other road users	3	3	4	3	3	High	Tender requirements to include: ➢ Adhering to all road regulations, *e.g.* speed limits. Maximum speed limit of 80km/h for coal trucks. ➢ Ensuring headlights are on all the time to increase visibility. ➢ Ensuring coal is covered with a tarpaulin when travelling on R572. ➢ Ensuring the coal trucks use only the designated routes. ➢ Noise suppression devices on heavy-duty vehicles – contract requirement ➢ All plant, equipment and vehicles to be kept in good repair	Moderate
	Pollution due to spillages & accidents	3	3	3	3	4	Moderate	Cleaning up of any spillages that may have occurred.	Low
	Safety risk due to poor road conditions	3	3	4	3	3	High	Upgrading of transport routes as required. Ensuring a system of road maintenance is in place.	Low

Activity	Potential Impact	D	E	P	S	RE	Significance without mitigation	Mitigation measures	Significance with mitigation
Heritage Resources	Destruction of heritage resources / palaeontological artifacts	3	1	5	3	4	High	The Early and Middle Stone Age bearing gravel deposit will be assessed during the removal of the topsoil.	Moderate Excavation of unknown/unidentified sites – High Positive
								The affected Iron Age sites will be assessed by means of Phase 2 assessments, which will include archaeological excavations.	
								The presence of a grave at Site 6 will be verified by means of a social consultation process.	
								The ritual and spiritual significance of the fountains to any displaced community be assessed.	
								The historical structures and features should not be directly impacted on by the development, but should future development threaten any of these the correct legal process in terms of the NHRA (Section 34) be implemented.	
								National Heritage and Palaeontological issues will be included in the environmental awareness programme.	

2.2.10 Cumulative Impacts

The following potential cumulative impacts have been identified and are briefly discussed on a qualitative basis:

Water abstraction

The total operational water requirement at full production is estimated at 4 667 m^3/day. It is currently envisaged to transfer the existing surface water rights of Overvlakte 125 MS (Ptns 3, 4 and 5) for mining use and the quantities have been evaluated as shown below.

PORTION OF OVER-VLAKTE	REGISTERED WATER USE (million m^3/a)				IRRIGATED AREA (ha)	ESTIMATED CURRENT USAGE (million m^3/a)
	RIVER	BOREHOLES	TOTAL	STORAGE (m^3)		
5	1.1	3.0262	4.12	24 500	232	2.57
3	1.1	1.9	3	-	290	3.07
4	1.1	0.23	1.33	74 000		
TOTAL	**3.3**	**5.1526**	**8.45**	**98 500**		**5.64**

Total inflows in to mine workings will peak at 5 Ml/day, which could provide a large portion of the mine water requirements. The impact of mining on river losses varies over the life of the mine. Initially, most inflows into mine works will originate from releases of aquifer storage. River losses peak at under 4 Ml/day towards 2024.

Net river losses of 84.5 Ml/day prior to mining are not exceeded if abstraction for irrigation is reduced by 7 Ml/day due to the transfer of water rights to the mining company. Losses from the Limpopo are reduced to between 79-81 Ml/day, hence are less than pre mining conditions.

Also refer to Section 2.2.6.4.

Surface disturbance

Surface disturbance for the purpose of mining or infrastructure will lead to impacts on the soil, land use and land capability, natural vegetation and fauna. The estimated surface disturbance is as follow:

	Hectares
Opencast mining	1835
Plant infrastructure	62
Underground infrastructure	16
Other	60
TOTAL	**1973**

It is important to note that the revised mining plan, which is a combination of opencast and underground mining, has significantly reduced the area of surface disturbance. Subsequently the impact on existing land use, in specific agricultural activities, has reduced significantly and only approximately 8% of the total surface that will be disturbed impacts on agriculture.

Noise

The existing noise climate of the core study area is very quiet and is of a rural nature. The construction of the colliery will introduce a loud noise source into the area and the size of the control 35dBA noise footprint will be extensive relative to the mining area.

From a qualitative aspect, the development of the Vele Colliery will bring about a change in the noise character of the area. There will be noises from sections of the colliery that will be heard at times well beyond the indicated positions of the respective 35dBA contours.

Dust

Based on site visits, aerial photos and site descriptions of the area, the following sources of air pollution have been identified:

- Vehicle entrainment and exhaust gas emissions
- Veldt fires
- Agricultural activities
- Other mining activities across the Limpopo River on the Zimbabwe side

A qualitative discussion on each of these source types is provided in Section 2.1.1.11 to highlight the possible extent of cumulative impacts which may result due to the proposed operations.

Future developments

A number of prospecting rights for coal and other minerals have been granted in the area. It is unsure at this stage whether any or all of these rights will progress into mining developments and it is therefore not possible to determine any cumulative impacts.

Similarly there is a potential for the establishment of a power station close to the Vele Colliery. The impact assessment associated with such a power station is still in its infant stages and can thus not be commented on in terms of a cumulative impact. Furthermore, it is still very indefinite whether this project will go ahead.

2.2.11 Knowledge gaps

The knowledge gaps identified include the following:

- Sufficient historical baseline data in respect of surface water quality and flows, groundwater and air quality. The necessary monitoring requirements have been identified as reflected in Table 2.8. These will be implemented as soon as possible to address the knowledge gap.
- The potential for decant must still be verified. The groundwater flow model and geochemical model need to be updated with additional monitoring data. Allowance has been made for a review of these models after 2 years after commencement of mining. These models will thereafter be updated on at least a 5 yearly basis.

2.3 SECTION 39 (3) (B) (II) (SOCIO-ECONOMIC ISSUES)

2.3.1 Engagement of IAPs

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

2.3.2 Socio-Economic Issues raised by IAPs and State Departments

The main concerns raised have been described in **Section 2.2.5** of this document.

2.3.3 Assessment of Socio-Economic Impacts

A detailed socio-economic impact assessment was performed by Naledi Development and is not going to be repeated here – refer to Annexure L. Similarly the significance rating of the socio economic impacts was performed in detail for all phases of the mining project – refer to Section 5 of the specialist report.

The main socio-economic impacts include:

- Quality of Living Environment
  - Influx of job seekers
  - Increased strain on infrastructure
  - Impact on Housing availability
  - Impact of the quality of physical environment
  - Change processes and impacts related to daily movement patterns
  - Safety and Risk Exposure: Increase in crime, Infrastructure & Operational safety, Health Impacts
- Family and Community Impacts
  - Changes in the age, gender, racial or ethnic composition of the population
  - Conversion of land use and relocation of land owner individuals, families and labourers
  - Disruption of Social Networks
- Institutional, legal, political and equity impacts
  - Feelings in relation to the project
  - Capacity of government departments
  - Gender relations
  - Impact equity
- Sense of place

A number of mitigation measures have been identified by the socio-economic specialist, these include the following:

- Participation in regional structures
- Maximise local employment
- Provision of infrastructure and housing for construction workforce on site to alleviate the short term impact on Musina
- Support in the maintenance of the R572 road into Musina
- Implement programmes identified and included in the Social and Labour Plan (SLP)

- Facilitation with existing housing developments for external workforce
- Maximize employment of local people
- Establish a future forum to discuss downscaling and retrenchment
- Skill programmes to equip workforce (Mining-related and portable)
- Investigate and finalize alternative transport methods
- Issues and Grievance Procedure available
- Construction policy and procedures – control access, conduct and identification
- HIV/AIDS and health related awareness programmes
- Potential workforce skills & SMME database
- Make available bursary opportunities to build skill capital in the region
- Design and implement economic development programmes
- Minimize surface areas through planning of infrastructure lay-out and mine method alternatives
- Communication channel with direct adjacent land owners and key stakeholders to address impacts and grievances
- A transparent recruitment drive aimed at locals, including existing SMMEs and notably HDSAs
- A recruitment drive aimed at legitimate foreigners with scarce skills

Costs for the implementation of the socio-economic mitigation measures have been allowed for in the Social and Labour Plan (SLP) of the mine as summarized below. These costs have therefore not been included in the Environmental Management Plan (EMP) presented in this report – refer to Section 2.6.

PROGRAMMES	Y1	Y2	Y3	Y4	Y5	Total
Skills Development Plan	R1m	R2m	R6m	R8m	R8m	R25m
Career Progression Plan	R1m	R1m	R1m	R1m	R1m	R5m
Mentorship Plan	R2m	R2m	R2m	R2m	R2m	R10m
Internship & Bursary Plan	R4m	R7m	R7m	R6m	R6m	R30m
Infrastructure project	R1m	R8m	R8m	R5m	R2m	R24m
Community Service	R1m	R1m	R1m	R1m	R1m	R5m
Income Generating	R1m	R10m	R15m	R20m	R10m	R56m
Downscaling & Retrenchments	R1.0m	R1.0m	R1.0m	R1.0m	R1.0m	R5.0m
TOTAL	**R12m**	**R32m**	**R41m**	**R44m**	**R31m**	**R160m**

2.3.4 Comparative Assessment of Land Use and Development Alternatives

A macro-economic assessment was conducted by Conningarth Economist (Annexure M). The primary objective of this macroeconomic study has been to measure the nature and magnitude of the economic and socio-economic impacts that will result from the proposed coal mine. In the report options that were evaluated are: -

- coal mining
- agricultural production
- eco-tourism industry

The macro-economic impacts emanating from the proposed mine and rail activities have proven to be significant – refer to Annexure M.

The following is a brief summary of the most critical macroeconomic aggregates that have been measured in terms of their impact as a result of the coal mining. Table 2.3.4(a) shows the combined results (after deducting negative externalities) in order to arrive at annualised impacts. It was necessary to divide the total construction impacts by 20 years for this purpose.

Table 2.3.4(a): Summary of annual results [R millions, 2008 Prices]

	Total Construction and Operational Impact		
	Impact on Gross Domestic Product (GDP) [R millions, 2008 Prices]	**Impact on Capital formation [R millions, 2008 Prices]**	**Impact on Employment [numbers]**
Average Construction Phase	66	136	646
Nett Operational Phase	6981	12485	28255
Total Impact	7047	12622	28901

The above results are used to determine the economic effectiveness criteria associated with the construction and operation of the mine and relevant rail line that determine whether or not the project represents a more effective use of scarce economic resources. Since capital is a scarce resource in South Africa, the effectiveness criteria used in this study measure the use of capital in terms of employment and GDP creation, relative to averages for the total South African economy.

The effectiveness criteria measured for the relevant coal mining activities are provided in the Table 2.3.4(b) below. This table also reflects the average criteria for the South African economy as a whole.

Table 2.3.4(b): Economic Effectiveness Criteria for the Proposed Mine

	Total Vele Colliery Impact on South Africa	**Average South African Economy African**
GDP/Capital	0.56	0.31
Labour/Capital	2.29	4.47

The GDP/Capital ratio of the project is higher than the average criteria for the total South African economy. This demonstrates the high profitability of the project. The Labour/Capital ratio of the coal mine is lower (because of high capital intensity) than the relevant average of the South African economy, but it is still acceptable. This latter result highlights the positive impact the proposed Vele Colliery should have on employment creation in the Limpopo Province.

The major sectoral impacts are as follows:

- Mining and Quarrying 40.6%
- Manufacturing 12.8%
- Transport and communication 14.9%
- Finance, Real estate and business services 15.0%

With regard to the most severe impact analyses, it should be noted that when all agricultural activities of citrus would be eliminated together with the trebling (three times) of game farming and tourism inputs (as negative impacts) there could be a reduction of 4% in the

GDP forecast, but a 8% reduction in the employment forecast and a 12% reduction in the Capital formation.

Overall, however, the measured macro-economic impacts of the proposed Vele Coal mine activities exceed the relevant minimum macro-economic criteria for projects of this nature.

2.3.5 Knowledge gaps

The following knowledge gaps have been identified:

- Accurate and verifiable employment figures
- Accurate and verifiable information on the current capacity of infrastructure and services

The above would not significantly alter the findings of the macro-economic study or the significance ratings of the socio-economic impacts.

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

2.4.1 Engagement of IAPs

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

2.4.2 National Heritage Issues raised by IAPs and State Departments

The main concerns raised have been described in **Section 2.2.5** of this document.

2.4.3 Assessment of National Heritage Impacts

Refer to **Section 2.1.1.13** and **Figure 2.1.1.13**. Significance rating of the heritage impacts was done according to section 2.2.10 and is shown in **Table 2.2.9.**

***Graves* (Roodt, 2009 – Annexure H)**

There is one informal graveyard on Overvlakte and what appears to be an isolated grave on Bergen Op Zoom. The graveyard on Overvlakte will not be impacted by opencast mining and should not be affected by the development. The probable grave on Bergen Op Zoom must be verified through a social consultation process. Threatened graves will have to be re-located by means of a permit under section 36 of the National Heritage Resources Act or by authorisation in terms of the Human Tissues Act (1983) and regulation of the Provincial Department and Local Health Departments.

***Archaeology* (Roodt, 2009 – Annexure H)**

Subterranean gravel deposits containing Stone Age material will be impacted on by the mining. It is however, impractical to access such deposits before they are disturbed. Therefore it is recommended that a Stone Age specialist be allowed the opportunity to study this deposit when the topsoil is being removed to assess the significance of the material and if necessary, mitigate the further assessment required. The Late Stone Age site 20 will not be directly affected by the development.

The presence of Iron Age sites in the study area including elements of the Mapungubwe cultural landscape was confirmed by the specialist. At least 18 sites were recorded with pottery scatterings in other parts as well. These sites are what generally became known as commoner sites. Opencast mining in the study area will definitely destroy all evidence of the existence of these Iron Age sites. In addition, the probability of obscured Iron Age sites existing in the areas of intensive farming on the Limpopo River floodplain is extremely high as was found to the west where the archaeology had been studied in more depth. Most of the floodplain area will, however, be utilised for underground mining and no impact is predicted in these areas.

None of the recorded archaeological sites have been assigned a high significance rating and therefore their destruction may be mitigated by means of a permit application under Section 35 of the NHRA. Phase 2 assessments will be required at all the affected Iron Age sites. The specialist is of the opinion that the information gained from these assessments will add value and additional data to what is already known from work in the Mapungubwe core area and lead to a better understanding of the Mapungubwe cultural landscape.

Palaeontolgy (Durand, 209 – Annexure I)

From previous studies the presence of vertebrate fossils in the Tuli Block the Solitude, Klopperfontein and Clarens Formations contain vertebrate fossils. However, most of the fossiliferous layers are presently covered by alluvium and non-fossiliferous geological strata and will only be exposed during excavations during construction and the mining process.

Part of the mitigation will include the collection of fossils that are exposed during the excavation and construction phases. Due to their complexity, rarity and scientific importance, vertebrate fossils exposed during excavations have to be salvaged by means of excavations. It is essential that these fossils are excavated and taken to an approved fossil repository after exposure. The excavation and collection of fossils must be done by a trained palaeontologist registered with SACNASP.

For this reason it is important that a palaeontologist should visit the mine on a regular basis in order to salvage representative and scientifically important fossils exposed. It will be impossible to avoid encountering fossiliferous horizons during mining in a colliery because of the presence of plant fossils. It is foreseen that in most cases the plant fossils exposed during the construction and mining phases could be collected from the spoil heaps on a regular basis.

It is also suggested that a workshop be presented to the mining personnel and contractors who would be responsible for construction and mining on the palaeontology of the area and what fossils could be expected in the area. This will hopefully prevent the unnecessary destruction of fossils.

The following mitigation measures will be implemented during the life of mine:

- The Early and Middle Stone Age bearing gravel deposit will be assessed during the removal of the topsoil.
- The affected Iron Age sites will be assessed by means of Phase 2 assessments, which will include archaeological excavations.
- The presence of a grave at Site 6 will be verified by means of a social consultation process.
- The ritual and spiritual significance of the fountains to any displaced community be assessed.
- The historical structures and features should not be directly impacted on by the development, but should future development threaten any of these the correct legal process in terms of the NHRA (Section 34) be implemented.
- National Heritage and Palaeontological issues will be included in the environmental awareness programme.

2.4.4 Knowledge gaps

A number of knowledge gaps have been identified by the specialists and a budget has been allowed for to perform Phase 2 investigations on all the Iron Age sites, including archaeological excavations.

2.5 SECTION 39 (3) (C) ENVIRONMENTAL AWARENESS

Environmental awareness communication and reporting forms an integral part of an EMP. For this reason, a procedure will be developed that will describe the means by which the mine will communicate with its employees and with IAPs on environmental issues. The mine acknowledges the importance of effective internal communication of the Environmental Management System (EMS), as well as external communication of the EMS, and as such will maintain communication channels, both within the company and with the IAPs of the mine.

In general, the objective of this procedure will be to:

- Ensure that employees understand the Environmental Policy and objectives,
- Ensure that information regarding the environment is communicated effectively and is readily accessible to the relevant parties,
- Improve feedback of operational and environmental performance to management,
- Provide for the establishment of forums to discuss environmental issues, allocate resources and ensure that adequate measures are being taken to address the environmental problems,
- Provide guidelines for communication with outside organisations and IAPs,
- Ensure effective and constructive response with IAPs, and
- Ensure that records of environmental communication and interaction are documented and filed in an easily accessible storage system.

Internal communication and awareness campaign

Internal communication will be conducted on a monthly basis at the Mine as follows:

- Environmental induction – The mine will include environmental awareness in its induction programme for employees and contractors. Included in this will be the environmental requirements stipulated by this EMP. Special attention will be given to heritage and palaeontological aspects. Where required, specialists will be drawn in to assist with the training programme (e.g. archaeologist).
- EMS working group – The mine will identify appropriate employees, which will include members of the management team, to form an EMS working group which will discuss all relevant environmental issues on a monthly basis. Action plans will be drafted at each meeting, and followed up during each subsequent meeting.
- Management meetings – The mine will conduct monthly meetings where relevant Health, Safety, Environmental, Community (hereafter referred to as the HSEC) issues are discussed with the General Manager of the mine.
- Review meetings – The mine management team will provide feedback to the Operations Director on a monthly basis and all HSEC issues will be included in these meetings.

External communication and awareness campaign

External communication will be conducted as follow:

- Stakeholder Register – The Mine has a comprehensive Stakeholder Register as a result of the EMP process. The register contains a list of all stakeholders and includes the name of the stakeholder organisation, contact details of the IAPs, such as the address (both physical and postal), e-mail address, telephone number, cell phone number and fax number. This register will be maintained by the Mine's Environmental Department and updated on an annual basis.

- Stakeholder Reports – HSEC reports will be prepared annually and distributed to all the major stakeholders. To encourage feedback and facilitate stakeholder participation, each report will contain a feedback sheet, which will allow the stakeholders to change their contact details, if necessary, and to comment on or enquire as to HSEC matters. Any feedback sheets received will be managed according to fixed operating procedures and any actions taken will be recorded for reference purposes.
- Public Forums – Annual public meetings will be held with major stakeholders to present and discuss HSEC issues. A register of attendees will be completed and minutes taken during the proceedings, which will be distributed to all the major stakeholders for information purposes, whether they attended the meeting or not. To encourage feedback and facilitate stakeholder participation, feedback sheets will be handed to each stakeholder upon registration and collected after the forum. This will allow the stakeholders to change their contact details, if necessary, and to comment on or enquire as to HSEC matters. Any feedback sheets received will be managed according to fixed operating procedures and any actions taken will be recorded for reference purposes.
- External Complaints Register – An HSEC external complaints register will be stationed at the office of the Mine's Environmental Manager. If a complaint and/or concern are raised, a formal Incident Investigation will be opened, managed and investigated in accordance with the appropriate EMS operating procedure. A central complaints register will be kept by the Environmental Department and updated and monitored on a monthly basis. Records will be kept of the external complaints, as well as the follow-up investigation and actions taken. Regular contact will be kept with the complainant until the complaint has been suitably addressed.

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

Mitigation measures were identified already in sections 2.2, 2.3 and 2.4 and a significance rating for each impact was done (refer to Tables 2.2.9, 2.3 and 2.4). In some cases impacts are similar of nature and therefore measures to either modify, remedy, control or stop any actions, activities, processes leading to, or causes of pollution or degradation are discussed per specific impact and not per activity. Also the implementation of some management measures actually acts as mitigation measure for more than one impact. Therefore, in order to prevent double accounting of costs duplication of management measures will not be done in this section. If a specific management measure has been discussed and the cost determined it will not be repeated unless it occurs in different phase of the project. In this section the focus will be on all the mitigation measures that will be required as well as the cost to implement those measures. Refer to **Tables 2.6(a) – (e).**

The management action plan to implement the mitigation measures are provided in **Table 2.6(f).** Also refer to the monitoring programme provided in **Table 2.8**.

Table 2.6(a): Summary of Impacts, mitigation measures and costs per impact for construction phase activities

Activity	Impact	Mitigation	Year 1-4
ALL ACTIVITIES	Surface disturbance for the purpose of mining or infrastructure will lead to impacts on the soil, land use and land capability, natural vegetation and fauna	Detailed species rescue, relocation and re-introduction plan	R250,000
		Identify and rescue of as many as possible fauna and flora species prior to construction and mining for relocation to suitable areas	R3.6 million
		Develop detail plan for indigenous nursery	R100,000
		Establish indigenous nursery	R500,000
		Develop rehabilitation plan	R500,000
		Fencing of designated infrastructure & mining areas	R9.9 million
		Creation of animal corridors	R1.3 million
		Implementation of monitoring programme ○ Groundwater ○ Surface water ○ Air quality ○ Blasting ○ Weather Station	 R680,000 R100,000 R250,000 R300,000 R250,000
		Environmental audits / reporting	R250,000
		Develop environmental awareness & educational programmes	R250,000
	Dust impact	Construction & tarring of access road	R20 million
		Application of dust suppression – main haul road	R3 million
		Water sprays at stockpiles & transfer points	*Best Practice*
		Cladding of stockpiles	R35 million
		Develop air blast control measures	*Best Practice*
	Construction noise	Construction site yards, construction worker camp and other noisy fixed facilities will be located well away from noise sensitive areas adjacent to the development sites	*No cost*
		All construction vehicles and equipment are to be kept in good repair	*Best Practice*
		Construction activities, and particularly the noisy ones, are to be limited to reasonable hours during the day and early evening	*Best Practice*
		Construction staff working in areas where the 8-hour ambient noise levels exceed 75dBA must wear ear protection equipment	*Best Practice*
	Waste management	Different waste streams will be segregated and disposed of in appropriate designated receptacles	*Best Practice*
		Appoint an approved, registered waste contractor to manage the waste generation and safe disposal thereof	*Best Practice*
ACTIVITY 1	Flooding of opencast	Flood protection berm	R11.3 million
ACTIVITY 2	Noise	Noise baffles to be placed on fans	*Tender requirements*
		Use of low noise fans at ventilation shafts	*Tender requirements*

Activity	Impact	Mitigation	Year 1-4
		Low noise generator sets will be used	*Tender requirements*
		Rubber vulcanised belt – less noisy / vibration	*Tender requirements*
		All plant, equipment and vehicles to be kept in good repair	*Best Practice*
	Visual	Avoid the use of highly reflective material in construction.	*Tender requirements*
		Metal surfaces should be painted in natural soft colours that would blend in with the environment.	*Best Practice*
		Using directional or cut-off type luminaries that focus the beam downward to mitigate light pollution.	*Best Practice*
	Impact on surface water resources	Miners camp dams - construction	R1.9 million
		Miners camp dams - lining	R2 million
	Impact on groundwater resources	Sufficient pumping and holding capacity must be made available to manage the dewatering of the underground workings to prevent the flooding of the underground.	R1.7 million
ACTIVITY 3	Water requirements	Construction of clean water dam	R6.4 million
		Abstraction - piping	R2.5 million
		Abstraction - pumps	R500,000
	Surface water quality	Dirty water dam in plant – construction	R1.5 million
		Dirty water dam in plant - lining	R2.1 million
		Plant holding dams - construction	R1.4 million
		Plant holding dams - lining	R1.9 million
		Clean water diversion canals	R1.2 million
	Noise	Noise suppression devices on heavy vehicles	*Tender requirements*
		Low noise generator sets will be used	*Tender requirements*
		Rubber vulcanised belt – less noisy / vibration	*Tender requirements*
		All plant, equipment and vehicles to be kept in good repair	*Tender requirements*
	Visual impact	Keeping infrastructure at minimum heights – maximum height of any structure instructed to be 20m.	*Plant design*
		Avoid the use of highly reflective material in construction.	*Tender requirements*
		Metal surfaces should be painted in natural soft colours that would blend in with the environment.	*Best Practice*
		Using directional or cut-off type luminaries that focus the beam downward to mitigate light pollution. Luminaries will be directed away from the Mapungubwe National Park.	*Best Practice*
		The use of outdoor fixtures high up on tall structures should be limited or avoided. In this instance good use should be made of the low elevation of the plant area and the visual absorption effect of the topography.	*Best Practice*

Activity	Impact	Mitigation	Year 1-4
		Vegetation screens along western footprint of the processing plant area – a number of the Baobab trees to be relocated from the opencast areas could be utilised for this purpose, provided that the habitat is suitable.	*Relocation of Baobabs*
ACTIVITY 4	Impact of increased traffic / safety risks	Upgrading of transport routes as required.	R15 million
		Ensuring a system of road maintenance is in place.	R1.8 million
			R127.43 million

Table 2.6(b): Summary of Impacts, mitigation measures and costs per impact for operational phase activities

Activity	Impact	Mitigation	Annual Cost
ALL ACTIVITIES	Surface disturbance for the purpose of mining or infrastructure will lead to impacts on the soil, land use and land capability, natural vegetation and fauna	Annual rescue operation	R500,000
		Appoint qualified person to management rescue and relocation plan	*Same as nursery*
		Appointment of herpetologist	R150,000
		Appoint qualified person to manage nursery	R600,000
		Appoint rehabilitation officer	R600,000
	Dust impact	Application of dust suppression – main haul road	R1.6 million
		Water sprays at stockpiles & transfer points	*Best Practice*
		Vehicle speed on unpaved roads limited to prevent dust creation	*Best Practice*
		Employ latest technology to reduce vehicle exhaust gas emissions	*Best Practice*
	Waste management	Different waste streams will be segregated and disposed of in appropriate designated receptacles	*Best Practice*
		Appoint an approved, registered waste contractor to manage the waste generation and safe disposal thereof	*Best Practice*
	Impact on conservation value of the region	Biodiversity offset programme	R5 million
	Monitoring programme	Ongoing monitoring	R640,000
		Environmental audits / reporting	R250,000
		Update groundwater & geochemical model	R100,000
ACTIVITY 1	Impact on drainage lines and surface runoff	Storm water management & drains - ongoing during operational phase	R900,000
	Impact on water quality	Rock overburden and mine residue (discard and slurry) at the site are to be backfilled into the open pits and rehabilitated while mining progresses, hence surface dumps will be avoided.	*Operational cost*
		ROM and product stockpile sites must be carefully selected away from possible groundwater conduits. Stockpile sites must be	*Operational cost*

Activity	Impact	Mitigation	Annual Cost
		compacted to limit percolation and leachate volumes.	
		Potential acid generating horizons will be placed at bottom of pit and submerged below the water table, thereby preventing oxidation.	*Operational cost*
		Rehabilitation will be concurrent with mining, minimising the potential for oxidation of sulphide bearing rocks and controlling the migration of high sulphate leachate.	R4.65 million
		Exposed residue material will be minimised by direct placement of overburden and topsoil.	*Operational cost*
		Vegetation will be re-established as soon as possible after topsoiling to minimise infiltration of water through residue material.	R1.4 million
		Clean storm water will be diverted around the open pits.	*See above*
		Leachate formed in open pits will be pumped to the processing facility for re-use.	*See Act 3*
		Due to the potential high salinity associated of the leachate, the return water dams must be lined.	*See Act 3*
	Noise impact	Noise suppression devices on heavy vehicles	*Tender requirements*
		Low noise generator sets to be used	*Tender requirements*
		Construct noise attenuation berms – part of operational cost	*Operational cost*
		Blasting limited on regular times, restricted to 08:00-16:00	*Best Practice*
		All plant, equipment and vehicles to be kept in good repair	*Best Practice*
	Blasting	A detailed blasting procedure will be developed for Vele Colliery by the blasting contractor, in line with the recommendations made by the blasting specialist.	*Tender requirements*
		For safety, it will be necessary to remove all people and animals during the blast to the minimum distance legally required and/or stipulated by the Inspectorate.	*Best Practice*
		Vibration and air blast monitoring will be needed for all blasts to make sure that the limits are being achieved and to provide an indication of when modifications are needed to the blasting method to correct for increased vibration and air blast levels.	*See monitoring programme*
		It will be important to carry out a thorough pre-blast crack survey of each house or permanent building that is located closer than 2000 m from the proposed blasting. It may be necessary to repeat this survey at annual or bi-annual intervals to track the changes in cracks and other damage with time.	R150,000
	Visual impact	Introducing landscaping measures such as vegetating berms and permanent stockpiles.	R100,000

Activity	Impact	Mitigation	Annual Cost
		Avoid the unnecessary removal of vegetation during the operational phase.	*Best Practice*
		Rehabilitation and revegetation will be performed concurrent to mining, within 5 strips or 300m of active mining.	*Best Practice*
ACTIVITY 2	Impact on surface water resources	Maintenance of storm water management & drains – miners camp	R25,000
	Impact on groundwater resources	Maintenance of pumping and holding capacity to manage the dewatering of the underground workings to prevent the flooding of the underground.	R165,000
	Subsidence	The underground mine will be designed with safety factors which will prevent pillar failure and subsequent subsidence of the surface.	*Best Practice*
	Methane	Ongoing methane monitoring	*Operational cost*
ACTIVITY 3	Noise impact	Noise suppression devices on heavy vehicles	*Tender requirements*
		Low noise generator sets will be used	*Tender requirements*
		Tree screening around the plant	*Baobab relocation*
		Rubber vulcanised belt – less noisy / vibration	*Tender requirements*
		All plant, equipment and vehicles to be kept in good repair	*Best Practice*
	Visual impact	Avoid the use of highly reflective material in construction.	*Tender requirements*
		Metal surfaces should be painted in natural soft colours that would blend in with the environment.	*Tender requirements*
		Using directional or cut-off type luminaries that focus the beam downward to mitigate light pollution. Luminaries will be directed away from the Mapungubwe National Park.	*Best Practice*
		The use of outdoor fixtures high up on tall structures should be limited or avoided. In this instance good use should be made of the low elevation of the plant area and the visual absorption effect of the topography.	*Best Practice*
		Vegetation screens along western footprint of the processing plant area – a number of the Baobab trees to be relocated from the opencast areas could be utilised for this purpose, provided that the habitat is suitable.	*Baobab relocation*
ACTIVITY 4	Road safety	Tender requirements to include: ➢ Adhering to all road regulations, *e.g.* speed limits. Maximum speed limit of 80km/h for coal trucks. ➢ Ensuring headlights are on all the time to increase visibility. ➢ Ensuring coal is covered with a tarpaulin when travelling on R572.	*Best Practice / Tender Requirements*

Activity	Impact	Mitigation	Annual Cost
		➢ Ensuring the coal trucks use only the designated routes. ➢ Noise suppression devices on heavy-duty vehicles – contract requirement ➢ All plant, equipment and vehicles to be kept in good repair	
		Ensuring a system of road maintenance is in place.	R1.8 million
	Spillages	Cleaning up of any spillages that may have occurred	R100,000
			R18.73 million

Table 2.6(c): Summary of Impacts, mitigation measures and costs per impact for decommissioning activities

Activity	Impact	Mitigation	Annual Cost	Closure cost
ACTIVITY 1	Rehabilitation of surface disturbance	Final rehabilitation of surface areas (230ha)		R17.1 million
		Revegetation (230 ha)		R4.6 million
		Dismantling of infrastructure		R570,000
ACTIVITY 2	Rehabilitation of surface disturbance	Dismantling of infrastructure		R3.1 million
		Rehabilitation of dams and stormwater drainage		R700,000
	Spontaneous combustion	Proper sealing of all shafts and boreholes		R11.4 million
ACTIVITY 3	Rehabilitation of surface disturbance	Dismantling of infrastructure		R4.2 million
		Rehabilitation of surface area		R3.85 million
		Rehabilitation of dams and stormwater drainage		R240,000
ACTIVITY 4	Rehabilitation of surface disturbance	Rehabilitation of access road		R1.56 million
	Monitoring programme	Ongoing monitoring	R640,000	
		Environmental audits / reporting	R250,000	
		Revise groundwater & geochemical model	R220,000	
			R860,000	**R47.32 million**

Table 2.6(d): Summary of Impacts, mitigation measures and costs per impact for post-closure phase activities

Activity	Impact	Mitigation	Annual Cost
ALL ACTIVITIES	Monitoring programme	Ongoing monitoring	R640,000
		After-care & maintenance	R4 million
ACTIVITY 1	Long-term water impacts	Potential decant must be contained and one of the following measures implemented: ➢ Treat to an acceptable level before released into the environment ➢ Store and evaporate ➢ Use for irrigation of crops and rehabilitated areas	*To be determined over LOM*
ACTIVITY 2	Spontaneous combustion could lead to increased pillar failure and impact on air quality	Continuous monitoring of sealed areas for early detection.	*Include in monitoring programme – no additional cost*
			R4.64 million

Table 2.6(e): National Heritage Impacts Summary of Impacts, mitigation measures and costs per impact

Activity	Impact	Mitigation	Year 1-4	Annual Cost
ALL ACTIVITIES	Surface disturbance leading to an impact on national heritage and palaeontological artifacts	Appointment of archaeologist	-	R250,000
		Appointment of palaeontologist	-	R150,000
		Awareness programmes	-	Part of Induction
	Impact on Iron Age / Mapungubwe	Phase 2 investigations of Iron Age sites	R500,000	-
			R500,000	**R400,000**

Table 2.6(f): Management action plan to implement mitigation measures

Activity	Implementation Phase	Review/Repeat Frequency	Responsibility
Develop & implement Rescue & Relocation Plan	Prior to mining	Annual rescue operation for areas to be disturbed in the next 12 months	Specialist to be appointed
Develop & implement Biodiversity Management Plan, including avifaunal plan	Within one year of mining	Annual review	Specialist to be appointed
Develop Rehabilitation Plan / Land Use Management Plan	Construction Phase	Annual review or if major change in scheduling	Mining Dept
Establish indigenous nursery	Commencement of mining	Ongoing review and improvement	Manager to be appointed
Reporting of rehabilitation plan ➢ Areas disturbed ➢ Areas levelled ➢ Areas topsoiled ➢ Areas vegetated	Construction Phase	Monthly	Rehabilitation Officer
Initiate alien vegetation programme	Construction Phase	Annual review	Environmental Officer
Phase 2 heritage study	Prior to mining	As required	Specialist to be appointed
Heritage monitoring	Construction phase	Monthly	Archaeologist to be appointed
Palaeontology monitoring	Construction Phase	Monthly	Palaeontologist to be appointed
Identify off-set programmes	Construction Phase	Annual review	Environmental specialist in conjunction with relevant stakeholders
Revision of groundwater flow & geochemical model	Within 2 years of mining	Revise every 5 years	Specialist to be appointed
Develop detail blasting procedure in line with specialist advise	Prior to opencast mining	Ongoing review based on monitoring data	Blasting contractor
Stipulate best practice requirements in tender documentation i.r.o. emissions, noise, equipment, transport, etc.	Prior to appointment of contractors	Ongoing review as new technology becomes available	Procurement Dept
Implement environmental awareness programme	Construction Phase	Ongoing review Include in annual induction programme	Environmental Officer Human Resources
Herpetology monitoring	Construction Phase	Monthly	Specialist to be appointed
Maintenance of clean & dirty water system	Construction Phase	Weekly	Engineering Dept
Dam safety inspections of clean water dam	Construction Phase	Annually	Specialist to be appointed
Initiate agreement with Roads Agency Limpopo re road maintenance	Prior to mining	Ongoing discussions and auditing of road conditions	Engineering Dept

Activity	Implementation Phase	Review/Repeat Frequency	Responsibility
Identify & clean-up of any spillages along R572	Construction Phase	Weekly	Engineering Dept
Identify & report any road maintenance issues	Construction Phase	Ongoing	Engineering Dept Roads Agency Limpopo
Implement aftercare & maintenance programme for rehabilitated areas	Within 2 years of mining	Ongoing implementation as per specialist recommendations	Rehabilitation Officer
Implement monitoring programme – refer Table 2.8	Prior to mining	Annual review of monitoring programme or if major change in scheduling	Environmental Officer
Review and analyses of monitoring data for: ➢ Surface water ➢ Groundwater ➢ Mine water balance ➢ Land use management ➢ Air quality ➢ Environmental noise ➢ Blasting ➢ Natural resources, including riverine forest ➢ Waste management	Commencement of mining	Monthly	Environmental Officer HSEC Committee
Internal review of EMP compliance, conformance to environmental objectives and strategies and the implementation thereof	Commencement of mining	Bi-annually	Environmental Officer HSEC Committee
EMP performance assessment to determine conformance with the Vele EMP amendment, including effectiveness and appropriateness of EMP	Within first 2 years of mining	Annually	External appointment
Vegetation audit to determine effectiveness of land use management plan and long-term sustainability of vegetated areas	Within first 2 years of mining	Annually	External appointment
Environmental legal compliance audit	Commencement of mining	Annually	External appointment
Revision of closure cost assessment	Commencement of mining	Annually	Engineering Dept
HSEC stakeholder meeting	Commencement of mining	Annually	Mine Management

2.7 ENVIRONMENTAL EMERGENCIES AND REMEDIATION

An environmental incident is defined as "*an unexpected sudden occurrence, including a major emission, fire or explosion leading to serious danger to the public or potentially serious pollution of or detriment to the environment, whether immediate or delayed*".

Some environmental emergencies have been identified that could occur during the project, in the event of which immediate remedial action must be undertaken, namely:

- Occurrence of surface fires, including veld fires.
- Compromising of dirty water management structures such as berms.
- Hydrocarbon spills or leaks from machinery on the surface.
- Flooding of opencast and underground workings

2.7.1 Surface Fires

In the event of a fire, the procedure to be followed is provided in Section 18 of the National Veld and Forest Fires Act, 1998 (Act 101 of 1998). The said Act provides for the notification of relevant affected parties, access to land on which a fire is burning for the purpose of extinguishing it, and requires that the fire protection officer of the area be informed, as well as those of surrounding areas to which the fire may spread. An emergency procedure will be developed in conjunction with the landowners and the local fire department to ensure in the event of a surface fire, the requirements of the National Veld and Forest Fires Act will be met.

2.7.2 Compromising of Surface or Groundwater Protection Measures

All compromised berms and other surface or groundwater protection measures will immediately be repaired and stabilised to avoid further contamination of clean areas with dirty water and the impacts associated therewith. Also refer to ***Spill Management Procedure*** in section 2.7.4.4.

2.7.3 Hydrocarbon Spills or Leaks from Machinery

All areas affected by spills of hydrocarbons will be remedied immediately. Soil rehabilitation by land farming, or other means will be initiated immediately, and the necessary measures will be taken to ensure that pollution of surface water and groundwater does not occur. Also refer to ***Spill Management Procedure*** in section 2.7.4.4.

2.7.4 Environmental Procedures

2.7.4.1 Handling, use and storage of materials

The Contractor will ensure that any delivery drivers are informed of all procedures and restrictions (including "no go" areas) that need to be complied with on site. The Contractor will ensure that these delivery drivers are supervised during off-loading by someone with an adequate understanding of the requirements of the site procedures.

Materials will be appropriately secured to ensure safe passage between destinations. Loads including, but not limited to sand, stone chip, fine vegetation, refuse, paper and cement, will have appropriate cover to prevent them spilling from the vehicle during transit. The Contractor will be responsible for any clean-up resulting from the failure by his employees or suppliers to properly secure transported materials.

All manufactured material will be stored within the Contractor's camp, and out of the rain. All lay down areas outside of the construction camp will be subject to the Site Engineer's approval.

Hazardous chemical substances used during construction will be stored in secondary containers. The relevant Material Safety Data Sheets (MSDS) will be available on Site. Procedures detailed in the MSDS will be followed in the event of an emergency situation. For potentially hazardous substances that are to be stored on site, the Contractor will provide a Method Statement detailing the substances/materials to be used, together with the storage, handling and disposal procedures of the materials.

2.7.4.2 Hydrocarbon management

Hydrocarbons (petrol, diesel, oils/lubricants) must be managed in the following manner:

- All oil and other petroleum products must be stored in a bunded area with a containment capacity of the product being stored plus 10%.
- Decanting facilities must be available for decanting purposes at all times. Decanting facilities must be bunded appropriately to prevent spillages. Decanting must be done in such a way that no spillages occur whilst filling or emptying any containers. All portable diesel bowsers shall be used, filled, pumped, emptied, decanted and transported in such a way to prevent spillages of any kind.
- The maintenance of any petroleum liquid (e.g. oil, petrol and diesel) and grease supply pipes must be done in such a manner as to prevent any spillages to the environment.
- All machines, equipment and tanks (including mobile compressors and diesel bowsers) that have got the potential to leak oil shall be inspected and kept in good condition at all times. Leaking equipment will be repaired immediately or removed from the Site. .
- Drip trays will be provided for stationary plant (such as compressors) and for "parked" plant (such as diesel bowsers, vehicles).
- The handling of drip trays and management of volume of oil levels in drip trays will be such that they will not overflow into the environment. If any spillages of oil did occur, it shall be cleaned immediately after the spillage occurred. Also refer to ***Spill Management Procedure*** in section 2.7.4.4.
- The relevant Material Safety Data Sheets (MSDS) will be available on Site. Procedures detailed in the MSDS will be followed in the event of an emergency situation.
- The Contractor shall ensure that proper spillage kits is implemented and maintained for cleaning of any spills. Any leaks or spillages will be cleaned up as soon as possible and reported to the Site Manager immediately. Also refer to ***Spill Management Procedure*** in section 2.7.4.4.
- Oil contaminated rags and other cleaning material used for cleaning of spillages shall be disposed into allocated hazardous waste bin and removed by a certified waste removal company. Also refer to ***Waste Management Procedure*** in section 7.3.3.
- Under no circumstances will the selling of empty drums for other uses be allowed.

2.7.4.3 Waste management

Colour-coded waste bins for the disposal of different types of waste will be introduced at the site, as listed below:

- Domestic waste – green bins
- Hazardous waste – black bins with red band

- Fluorescent tubes – black bins with blue band
- Scrap metal – blue bins
- Used oil/diesel – suitable oil drums, clearly marked
- Building rubble (demolition activities)

The general and hazardous waste streams will be segregated and disposed of in appropriate designated receptacles. All waste will be disposed off-site at approved landfill sites.

General principles for the management of waste include:

- Domestic waste generated on the mine site will be disposed of in a variety of green waste bins placed at dedicated positions. Smaller waste bins will be placed around the premises, which will be emptied into the larger bins placed at dedicated positions for collection by the domestic waste contractor. The mine will appoint a suitable waste contractor(s) to remove and dispose of the domestic waste at an authorised landfill site.
- Hazardous waste generated on the contractor site will be disposed of in bins clearly marked 'hazardous waste' bins (black with red band) supplied by a registered waste contractor. Smaller colour-coded waste bins may be placed around the premises, which will be emptied into the larger bins placed at dedicated positions for collection by the waste contractor. Hazardous waste may only be removed by the approved waste contractor, who must be appointed by the mine for the removal and disposal of hazardous waste.
- Fluorescent tubes will be crushed and placed in the dedicated drums (black with blue band). Full fluorescent tube drums must be removed by the said waste contractor for safe disposal.
- Scrap metal must be placed in dedicated bins (blue) or for larger material, within the site camp. Smaller waste bins may be placed around the construction site, which must be emptied into the larger bins placed at dedicated positions for collection by the waste contractor.
- Waste must be recycled as much as possible, e.g. paper, ink cartridges, used oils.
- Waste must be removed from site on an on-going basis and bins will not be allowed to become overfull. The waste may be temporarily stored at the contractor site in an area that is weatherproof and scavenger-proof, and which the Site Engineer has approved. No waste bins shall be accumulated and/or stored in a waste yard for more than 90 days without being emptied. The waste contractor will ensure that the waste bins are disposed within the required time limit of not more than 90 days.
- Used oil/diesel must be stored in suitable, clearly marked drums stored in a demarcated, concrete lined bunded area. In case of removal by a certified oil removal/recycling company, the necessary safe disposal or recycling certificates should be obtained from the contractor.
- Any chemicals shall be disposed of as stipulated in the particular product's MSDS. This includes the destruction of containers if prescribed.
- No building rubbles will be disposed of on the mine premises. All building rubbles will be removed from site when required by the appointed demolishing contractor as agreed by the Site Engineer. The building rubbles will be collected by the appointed contractor, removed from site and disposed of at an authorised landfill site.
- No medical waste may be disposed of into domestic waste bins. Medical waste must be deposited in an appropriate container and sent to the Mine Clinic, who is responsible for the removal and safe disposal thereof.

- A detailed waste inventory must be kept by the mine in terms of volume of waste removed, waste types (detail of specific items where applicable), landfill/waste sites used for disposal, certificates of disposal, etc. The format of the waste inventory will be agreed to between the mine and the contractor(s) upon appointment.
- The waste inventory will be submitted to the responsible party on a monthly basis, together with the monthly invoice. The waste inventory should be copied to the Environmental Manager, who will maintain a central database for auditing purposes. No payment will be approved prior to receipt of the waste inventory.
- No on-site burying, dumping or burning of any waste materials, vegetation litter or refuse shall occur.

2.7.4.4 Spill management

Definitions

- *Minor Risk Incident* - Minor spills are those which can be controlled, contained and cleaned up with the help of the people on site. Minor effects on biological or physical environment. Minor short to medium term damage to small area of limited significance.
- *Major Risk Incident* - Significant spills are those in which human hazard is evident, the spill cannot be contained and /or has led to contamination of a water resource and / or other sensitive location e.g. drain. Moderate short to medium term damage, widespread with some impairment of ecosystem function, possible fire hazard, explosion or danger to health.
- *Emergency* - Means an accidental situation involving the release or imminent release of dangerous goods or other substances that could result in serious adverse effects to the health and/or safety of persons or the environment. An emergency may be the result of human cause or natural occurrences including, but not limited to, process upsets, controlled reaction, fires, explosions, threats, structural failures, floods, storms, etc.
- *Dangerous Goods* - Means goods that include explosives, compressed and liquefied gasses, flammable and combustible materials, as well as radioactive materials.
- *Hazardous Substance* - Includes any toxic, harmful, corrosive, irritant or asphyxiate substance, or mixture of such substance for which an occupational exposure limit is prescribed, or which could create a hazard to human health or the environment.
- *MSDS* - Means Material Safety Data Sheet of the product or substance

Spill management procedure

Minor Risk Incident

- Assess the situation and determine the hazard and extent of the spill, taking into account the quantity of the spillage and the danger of the substance. Refer to MSDS of the substance spilled to identify hazard.
- Contact the Site Manager, detailing the substance, quantity, severity, location and possible environmental impact.
- Demarcate the area where the substance was spilled.
- Contain the spill with the correct control measures i.e. sand, spill-sorb, bunding, spill-kits, etc. Refer to the MSDS of the substance spilled for correct handling and control of the spill.
- The Site Manager must contact the relevant person(s) to attend to the situation.

Major Risk Incident or Emergency

- Assess the situation and determine the hazard and extent of the spill, taking into account the quantity of the spillage and the danger of the substance. Refer to MSDS of the substance spilled to identify hazard.
- Raise the alarm and evacuate the area.
- Contact the Site Manager, detailing the substance, quality, severity, location and possible environmental impact.
- Demarcate the area where the substance was spilled.
- If possible try to contain the spill with the correct control measures i.e. bunding, etc. Ensure not to endanger anyone or yourself by doing this. Refer to MSDS of the substance spilled for correct handling and control of the spill.
- The Site Manager must contact the relevant person(s) to attend to the situation.

2.7.4.5 Flooding of mine workings

A detailed Code of Practice for In-Rushes will be compiled for the opencast and underground mine workings as required in terms of the Mine Health and Safety Act.

2.8 MONITORING AND REPORTING

A comprehensive monitoring system was developed for Vele Colliery, which includes a detailed environmental monitoring system and an implementation, auditing and reporting protocol – refer to Table 2.8.

The objective of the environmental monitoring system is to:

- Prevent and/or minimize the environmental impact associated with the proposed mining operation
- Ensure that the environmental management system at Vele perform according to specifications
- Ensure conformance with the environmental objectives
- Ensure timeous implementation of the environmental strategies and implementation programme
- Act as a pollution early warning system
- Obtain the necessary data required to address knowledge gaps
- Check compliance with license requirements
- Ensure consistent auditing and reporting protocols

A proper data management system will be set up to facilitate trend analyses and preparation of reports. All the monitoring data will be collated and analysed on an annual basis and included in management reports.

It must be noted that the monitoring programme is a dynamic system changing over the different life cycle phases of the mine. The programme will be reviewed on an annual basis and revised if necessary.

In addition, EMP performance assessments, as required in terms of the MPRDA will be performed on a biennial basis and submitted to the Department of Minerals and Energy (DME) for distribution to other relevant authorities.

Table 2.8: Environmental monitoring programme for Vele Colliery

Aspect	Issue	Purpose	Monitoring points	Frequency	Sampling method	Variables
Climate	Weather station	To obtain detail weather records for the LOM		Continuous	-	Wind speed & direction Temperature & rainfall Humidity & atmospheric pressure
Surface water	Surface water quality	Determine any deterioration in water quality as a result of the mining related activities	Limpopo River – u/s & d/s of site Two major site streams – u/s & d/s of proposed development	Monthly	Grab sampling	EC, pH, TDS, SS, Cl, SO_4, NO_3, Na, F, Fe, Al, Mn, Zn, Total Alkalinity, Ca, Mg, K, Total Hardness.
				Six monthly	Grab sampling	Analyses to 95% charge balance, including all metals and hydrocarbons.
	Potable water	Determine water quality of drinking water	Outflow of potable treatment facility	Weekly	Grab sampling	Turbidity and micro-biological constituents
	Sewage effluent	Determine water quality of sewage effluent	Outflow of sewage works	Weekly	Grab sampling	Turbidity and micro-biological constituents
	Clean water canals	Determine the sediment levels or any other contamination prior to discharge into the Limpopo River	Downstream points on clean water canals	Monthly	Grab sampling	EC, pH, TDS, SS, Cl, SO_4, NO_3, Na, F, Fe, Al, Mn, Zn, Total Alkalinity, Ca, Mg, K, Total Hardness, hydrocarbons.
	Water management infrastructure	Monitoring of condition, identifying areas that require maintenance	Along clean & dirty water canals, clean & dirty water dams	Quarterly After a big rain event.	Visual	Evidence of erosion, cracks, subsidence, overgrowth, etc.
	Dirty water systems	Determine the water quality and long-term chemical changes in the dirty water systems	Dirty water dams	Monthly	Grab sampling	EC, pH, TDS, SS, Cl, SO_4, NO_3, Na, F, Fe, Al, Mn, Zn, Total Alkalinity, Ca, Mg, K, Total Hardness.
	Haul road crossings	To identify and mitigate any spillages into the clean water system	All haul road crossings over clean water canals	Weekly	Visual inspection	Evidence of spillages
	Biomonitoring	Due to the ephemeral nature of the streams and even of the Limpopo River, biomonitoring will not be considered at this site.				
Groundwater	Groundwater quality	To determine any impact on the groundwater quality as a result of mining	Up & down gradient of mining area Along geological structures Alluvium & all other water bearing zones Neighbouring farms (Hydrocensus boreholes)	Quarterly	High integrity grab sampler (double valve), preferably made from PVC/Teflon	EC, pH, TDS, SS, Cl, SO_4, NO_3, Na, F, Fe, Al, Mn, Zn, Total Alkalinity, Ca, Mg, K, Total Hardness.
	Groundwater levels	To determine any impact on the groundwater levels as a result of mining	As above	Quarterly	As above	Water level

Aspect	Issue	Purpose	Monitoring points	Frequency	Sampling method	Variables
Mine water balance	Water levels in dams	To verify water balance and volume of water stored	Clean & dirty water dams	Monthly	Survey	Height (m)
	Dirty water recycled	To determine volume of dirty water abstracted & recycled for processing and dust suppression	Dewatering points in the open pits Underground mine water at the dewatering pumps	Monthly reading	Water meters	Volume (m^3)
	Clean water abstraction	To determine volume of clean water abstracted from the Limpopo River & primary aquifer	Surface water abstraction points at the Limpopo River Borehole abstraction points Neighbouring farms	Monthly reading	Water meters	Volume (m^3)
	Process flow	To determine accurate process water balance	Inflows & outflows Moisture content of the product & residue	Monthly	Water meters	Volume (m^3)
Land use management	Concurrent rehabilitation	To determine conformance with environmental objective for concurrent rehabilitation	Mining area	Monthly	Survey	Hectares disturbed Hectares levelled Hectares topsoiled Hectares revegetated
	Rehabilitation plan	To ensure conformance to final rehabilitation plan and free-draining standard	Rehabilitated areas	Monthly	Survey	Final level of rehabilitation
	Soil analysis	To determine any deficiencies in soil fertility prior to seeding	Topsoiled areas	Ongoing (prior to seeding)	Soil samples	As per specialist advise
	Vegetation audit	To determine effectiveness of land use management plan and long-term sustainability of vegetated areas	Vegetated areas	Annually	Field survey	As per specialist advise
	Riverine forest	To determine the impact on the riverine forest as a result of mining	Along Limpopo River	Bi-annually	Field survey	As per specialist advise
	Alien vegetation	To monitor conformance with alien vegetation programme	Total mining area, including rehabilitated areas	Monthly (during eradication programme)	Survey	Area (hectares)
Air quality	Dust outfall	To determine the levels of dust outfall as a result of the mining activities	As per specialist report	Continuous	Directional dust outfall buckets	Settleable particles ($mg/m^2/day$)
Environmental noise	Noise levels	To determine the noise levels within the communities and sensitive areas	Infrastructure areas Sensitive receptors within 35dBA noise isopleth	Monthly	To be determined	dBA
Blasting	Air blast and ground vibration	To determine the effectiveness of the blasting procedure	As per specialist report	Continuous	Vibration stations (seismograph)	Air blast Ground vibration
Waste	Waste generation &	To determine volume of waste generated	Site	Monthly	Contractor report	Waste types

Aspect	Issue	Purpose	Monitoring points	Frequency	Sampling method	Variables
	management	& disposed				
Heritage	Heritage/cultural resources	To capture all heritage/cultural resources exposed by mining	Site	Monthly	Archaeologist site visit	-
	Paleontology	To capture all palaeontological artifacts exposed by mining	Site	Monthly	Paleontologist site visit	

3 COMPLIANCE WITH SECTION 39 (4) (A) (II) – FINANCIAL PROVISION

3.1 CLOSURE COSTS

This section was compiled in terms of Section 39 (4) (a) (ii) of the Act, read together with Section 41(1). Refer to **Figure 1.3.3** and **Figure 1.3.1** showing the infrastructure and the mining layout respectively.

The mitigations, monitoring and reporting of the impacts have already been discussed in this document.

3.2 CALCULATION

The closure costs for Vele Colliery were assessed using the "Guideline Document for the Evaluation of the Closure-related Financial Provision Provided by a Mine – April 2004"). A rules-based approach was used and related back to the surface area of the various components included in the closure costs.

According to this calculation an amount of R62 million (excluding VAT) needs to be provided as guarantee.

Table 3.2: Closure cost calculation

No	Description	Unit	A Quantity	B Master Rate	C Multiplication factor	D Weighting Factor	E=A*B*C*D Amount Rands
1	Dismantling of processing plant and related structures (Including overland conveyors and power lines.)	m^3	122000	R 6.82	1	1.1	R 915,244.00
2(A)	Demolition of steel buildings and structures	m^2	10000	R 95.00	1	1.1	R 1,045,000.00
2(B)	Demolition of reinforced concrete building structures	m^2	14480	R 140.00	1	1.1	R 2,229,920.00
3	Rehabilitation of access roads	m^2	83200	R 17.00	1	1.1	R 1,555,840.00
5	Demolition of housing or administration facilities	m^2	15000	R 190.00	1	1.1	R 3,135,000.00
6	Opencast rehabilitation including final voids and ramps	ha	104	R 99,600.00	1	1.1	R 11,394,240.00
8(A)	Rehabilitation of overburden and spoils	ha	234	R 66,400.00	1	1.1	R 17,091,360.00
8(B)	Rehabilitation of processing waste deposits and evaporation ponds	ha	4	R 240,200.00	1	1.1	R 1,056,880.00
9	Rehabilitation of subsided areas	ha	3	R 55,600.00	1	1.1	R 183,480.00
10	General surface rehabilitation	ha	100	R 35,000.00	1	1.1	R 3,850,000.00
11	River Diversions				-		-
12	Fencing	ha	8600	R 60.00	1	1.1	R 567,600.00
13	Water management	ha	4	R 20,000.00	1	1.1	R 88,000.00
14	2 to 3 years maintenance and after care	ha	1502	R 7,000.00	1	1.1	R 11,565,400.00
15(A)	Specialist Study	Sum	5%				R 100,000.00
15(B)	Specialist Study	Sum	5%				R 855,090.50
				SUBTOTAL			**R 55,633,054.50**
				Preliminary and General		**0%**	**R 0.00**
				Contingencies		**10%**	**R 5,563,305.45**
				SUBTOTAL plus Contingencies			**R 61,196,359.95**
				VAT @14%			**R 8,567,490.39**
				GRAND TOTAL			**R 69,763,850.34**

4 COMPLIANCE WITH SECTION 39 (4) (A) (III) - CAPACITY TO MANAGE AND REHABILITATE THE ENVIRONMENT

4.1 FINANCIAL CAPACITY

In **Tables 2.6(a)-(e)** the costs to modify, remedy, control or manage any actions, activities and processes that could cause pollution or degradation was shown for each impact and activity. Also indicated in the tables are the phase in which the impact will occur. **Table 4.1** below indicates a summary of costs for environmental mitigation over the life of mine, indicating how the original budget presented in the Mining Work Programme was adapted as a result of the EIA performed for the proposed Vele Colliery.

4.2 RESOURCE CAPACITY

Refer to Table 2.6(f) for the management implementation action plan that shows the actions required, the frequency for review and the management responsibility.

Allowance has been made for the following environmental personnel (permanent employees) at the mine:

- HSEC Coordinator
- Environmental Officer
- Rehabilitation Officer
- Indigenous nursery manager

In addition, the following specialists will be appointed to assist with the development of the plans & programmes, and to perform the necessary monitoring:

- Qualified archaeologist
- Qualified palaeontologist
- Qualified soil scientist
- Qualified biodiversity specialist
- Qualified groundwater specialist
- Specialists required to assist with off-set programmes

Internal communication will be conducted on a monthly basis at the Mine as follows:

- Environmental induction – The mine will include environmental awareness in its induction programme for employees and contractors. Included in this will be the environmental requirements stipulated by this EMP. Special attention will be given to heritage and palaeontological aspects. Where required, specialists will be drawn in to assist with the training programme (e.g. archaeologist).
- EMS working group – The mine will identify appropriate employees, which will include members of the management team, to form an EMS working group which will discuss all relevant environmental issues on a monthly basis. Action plans will be drafted at each meeting, and followed up during each subsequent meeting.

- Management meetings – The mine will conduct monthly meetings where relevant Health, Safety, Environmental, Community (hereafter referred to as the HSEC) issues are discussed with the General Manager of the mine.
- Review meetings – The mine management team will provide feedback to the Operations Director on a monthly basis and all HSEC issues will be included in these meetings.

Table 4.1: Summary of Proposed Measures and Costs over the life of mine

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
RUN OF MINE PRODUCTION Mt	0.19	4.09	12.21	12.61	14.15	14.15	14.15	14.15	14.15	14.15
Environmental Monitoring	0.15	0.15	0.15	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Rehabilitation & Maintenance	0.10	0.10	0.10	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Future Closure Cost Provision	0.08	1.64	4.88	5.04	5.66	5.66	5.66	5.66	5.66	5.66
Total allowed for in MWP	**0.83**	**1.89**	**5.63**	**5.39**	**6.51**	**6.01**	**6.51**	**6.01**	**6.51**	**6.01**
Enviro costs Required by EMP	**19.75**	**19.75**	**19.75**	**19.75**	**18.73**	**18.73**	**18.73**	**18.73**	**18.73**	**18.73**
Revised Total	**20.58**	**21.64**	**25.38**	**25.14**	**25.24**	**24.74**	**25.24**	**24.74**	**25.24**	**24.74**
	Year 11	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Year 16**	**Year 17**	**Year 18**	**Year 19**	**Year 20**
RUN OF MINE PRODUCTION Mt	14.15	14.15	14.15	14.15	14.15	14.15	14.15	14.15	14.15	14.15
Environmental Monitoring	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Rehabilitation & Maintenance	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Future Closure Cost Provision	5.66	5.66	5.66	5.66	5.66	5.66	5.66	5.66	5.66	5.66
Total allowed for in MWP	**6.01**	**6.01**	**6.01**	**6.01**	**6.01**	**6.01**	**6.01**	**6.01**	**6.01**	**6.01**
Enviro costs Required by EMP	**18.73**	**18.73**	**18.73**	**18.73**	**18.73**	**18.73**	**18.73**	**18.73**	**18.73**	**18.73**
Revised Total	**24.74**	**24.74**	**24.74**	**24.74**	**24.74**	**24.74**	**24.74**	**24.74**	**24.74**	**24.74**
	Year 21	**Year 22**	**Year 23**	**Year 24**	**Year 25**	**Year 26**	**Year 27**	**Year 28**	**Year 29**	
RUN OF MINE PRODUCTION Mt	14.15	14.11	12.66	11.83	11.45	11.34	10.24	9.65	4.55	
Environmental Monitoring	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	
Rehabilitation & Maintenance	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	
Future Closure Cost Provision	5.66	5.64	5.06	4.73	4.58	4.54	4.09	3.86	1.82	
Total allowed for in MWP	**6.01**	**5.99**	**5.41**	**5.08**	**4.93**	**4.89**	**4.44**	**4.21**	**2.17**	
Enviro costs Required by EMP	**18.73**	**18.73**	**18.73**	**18.73**	**18.73**	**18.73**	**18.73**	**18.73**	**18.73**	
Revised Total	**24.74**	**24.72**	**24.14**	**23.81**	**23.66**	**23.62**	**23.17**	**22.94**	**20.90**	

5 UNDERTAKING

I, Baldwin Khosa, the undersigned and duly authorised thereto by Limpopo Coal Company (Pty) Ltd, have studied and understand the content of the environmental management programme and hereby duly undertake to adhere to the conditions as set out therein including any amendments approved by the Petroleum Agency SA, as well as the requirements of the Mineral and Petroleum Resources Development Act (No 28 of 2002) and the regulations thereto.

Signed at Polokwane on this 15th day of May 2009.

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SIGNATURE

Company Representative

ANNEXURES

A	Layout Plans & Maps	
B	Soil, Land Use & Land Capability	Red Earth, 2009
C	Biodiversity	Dubel, 2009
D	Surface Water	WSM Leshika, 2009
E	Geology & Groundwater	WSM Leshika, 2009
F	Air Quality	Bohlweki-SSI, 2009
G	Noise	JKA, 2009
H	Heritage	Roodt, 2009
I	Palaeontology	Durand, 2009
J	Visual	MetroGIS, 2009
K	Blasting	Rorke, 2009
L	Socio-Economic	Naledi, 2009
M	Macro-Economic	Conningarth, 2009
N	Public Participation Records	