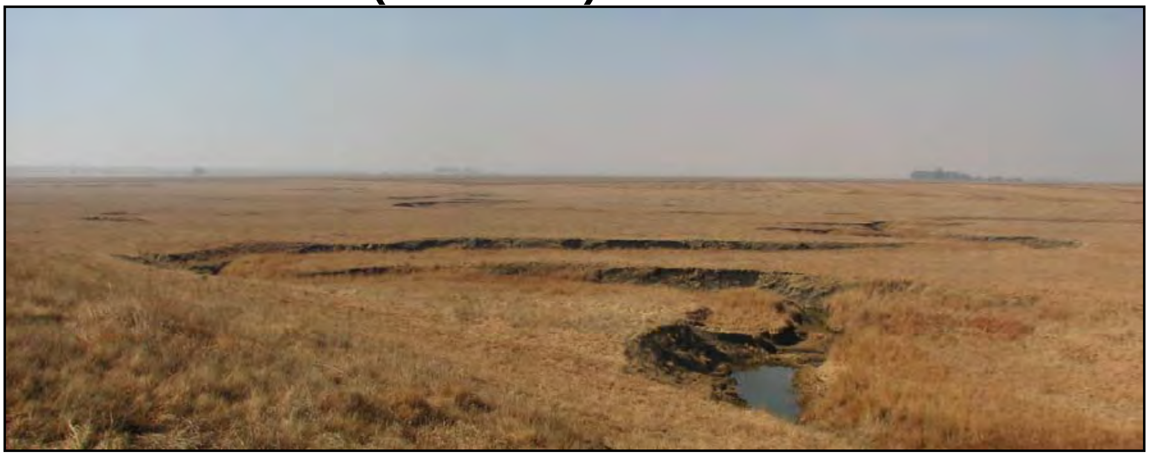
APPENDIX 5.10(A)

SPECIALIST REPORT
AQUATIC WETLANDS

PHASE 1: WETLAND DELINEATION AND ASSESSMENT FOR THE SASOL MINING MIDDELBULT (BLOCK 8) SHONDONI PROJECT



For:

JMA Consulting (Pty) Ltd
Jasper Müller
P O Box 883
Delmas, 2210
Tel: +27 13 665 1788
Fax: +27 13 665 2364

By:

Wetland Consulting Services (Pty) Ltd

Wetland Consulting Services (Pty.) Ltd.
PO Box 72295
Lynnwood Ridge
Pretoria
0040

Tel: 012 349 2699
Fax: 012 349 2993
Email: info@wetcs.co.za

Reference: 596/2010

APPROVAL

COMPILED BY:	CHECKED BY:	APPROVED BY:
NAME: Dieter Kassier	NAME: Dieter Kassier	NAME: Allan Batchelor
DATE: July 2010	DATE: July 2010	DATE: August 2010

DISTRIBUTION LIST

AGENCY, ORGANISATION OR PERSON	NO. OF COPIES
JMA Consulting (Pty) Ltd	1

REVISION

DATE	No.	DESCRIPTION OF REVISION OR AMENDMENT	INITIAL

DOCUMENT SUMMARY DATA

PROJECT:	**Phase 1: Wetland Delineation and Assessment for the Sasol Mining Middelbult (Block 8) Shondoni Project**
CLIENT:	**JMA Consulting (Pty) Ltd**
CONTACT DETAILS:	**Jasper Müller** **P O Box 883** **Delmas, 2210** **Tel: +27 13 665 1788** **Fax: +27 13 665 2364**
CONSULTANT:	**Wetland Consulting Services, (Pty) Ltd.**
CONTACT DETAILS:	**Allan Batchelor** **PO Box 72295** **Lynnwood Ridge** **0040** **Telephone number: (012) 349 2699** **Fax number: (012) 349 2993** **E-mail:** allanb@wetcs.co.za

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

INDEMNITY AND CONDITIONS RELATING TO THIS REPORT

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and Wetland Consulting Services (Pty.) Ltd. and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

Although Wetland Consulting Services (Pty.) Ltd. exercises due care and diligence in rendering services and preparing documents, Wetland Consulting Services (Pty.) Ltd. accepts no liability, and the client, by receiving this document, indemnifies Wetland Consulting Services (Pty.) Ltd. and its directors, managers, agents and employees against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by Wetland Consulting Services (Pty.) Ltd. and by the use of the information contained in this document.

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

1. BACKGROUND INFORMATION

Wetland Consulting Services (Pty) Ltd was appointed by JMA Consulting (Pty) Ltd to undertake a wetland delineation and assessment of three additional areas associated with the Sasol Mining Middelbult (Block 8) Shondoni Project, and to incorporate the findings of this study into the existing wetland study available for the area. The three additional areas surveyed as part of this report (indicated in Figure 1 below) are as follows:

- Northern Reserve
- Springbokdraai Reserve
- Leeupan Reserve

The existing wetland study for the area was also undertaken by Wetland Consulting Services (Pty) Ltd, with the report dated July 2002 (hereafter referred to as the 2002 Report). The study was undertaken under appointment of Oryx Environmental. The investigation formed part of the Middelbult Block 8 EMPR for Sasol Coal. The study provided a baseline report on the wetland areas that fall within the extent of the proposed underground mining areas.

The purpose of this new report is to extend the baseline information contained within the 2002 Report to include the three additional areas, and then to compile one single report to cover the entire Sasol Mining Middelbult (Block 8) Shondoni Project study area (referred to as the study area hereafter). Field work during the current study was only undertaken for the additional areas; no additional field work was undertaken in the area covered by the 2002 Report. As such, this report draws extensively from the 2002 Report, and is in many respects a duplication of the 2002 Report with some added information. The entire 2002 report is included for reference in Appendix 3.

2. TERMS OF REFERENCE

To extend the baseline information contained within the 2002 Report to include the three additional areas: Northern Reserve, Springbokdraai Reserve and Leeupan Reserve. For this purpose, the following activities were undertaken:

- Initial desktop delineation of suspected wetland areas in the additional areas;
- Groundtruthing of the additional areas to verify extent of delineated wetland areas;
- Assessment of the current condition (PES) of the wetlands;
- Functional assessment of the wetlands;
- Compilation of a detailed wetland assessment report incorporating the findings of the 2002 report.

3. LIMITATIONS

The initial wetland assessment was based on information collected during a number of field visits undertaken during March, April and early May 2002, while the additional areas were surveyed during several site visits in June 2010. Every attempt was made to collect the types of information necessary to assist in the assessment of the status of the wetlands on site. The baseline information on the wetlands was collected using a rapid assessment technique and the wetland boundaries were field delineated to an accuracy of approximately 30m. An assessment of key determinants of wetland maintenance and functioning was made using soil augering, anecdotal evidence and indicators of hydric conditions. It is likely that additional plant species occur in the wetlands on site and that these were not recorded during sampling for whatever reason, including time constraints, the methods used, and the season during which sampling was undertaken. This baseline study was based on a once-off assessment of the wetland habitats and thus does not depict the seasonal variations in plant species composition and richness that may occur.

4. STUDY AREA

The 2002 Report study area is approximately 19 300 ha in extent and is situated to the northeast and east of Secunda and south of Kinross. It includes the area surrounding Evander and the farms, or portions of the farms, Driefontein 137 IS, Kinross 133 IS, Winkelhaak 135IS, Witkleifontein 131 IS, Leeuwspruit 134 IS, Zandfontein 130 IS, Ruigtekuilen 129 IS, Kromdraai 128 IS, Brakspruit 359 IR, Springbokdraai 377 IS, Rietkuil 531 IR, and Leeuwpan 532 IR (Figure 1). The area lies between 26024’ and 26036’S and 28056’ and 29011’E and is located on portions of the topographic map sheets 2628BD Leandra, 2628DB Willemsdal, 2629AC Evander and 2629CA Secunda (Published by the Chief Directorate: Surveys and Land Information, Mowbray).

The three areas added to the study area during the current survey constitute an additional approximately 4 000ha, bringing the total size of the study area to 23 300ha

The site consists of a series of drainage lines running predominantly from north to south, intersecting an undulating landscape of grassland mixed with commercial agricultural lands, mines, mine villages, and homesteads. The drainage lines and floodplains in the area form part of the Waterval River system, which is a tributary of the Vaal River.

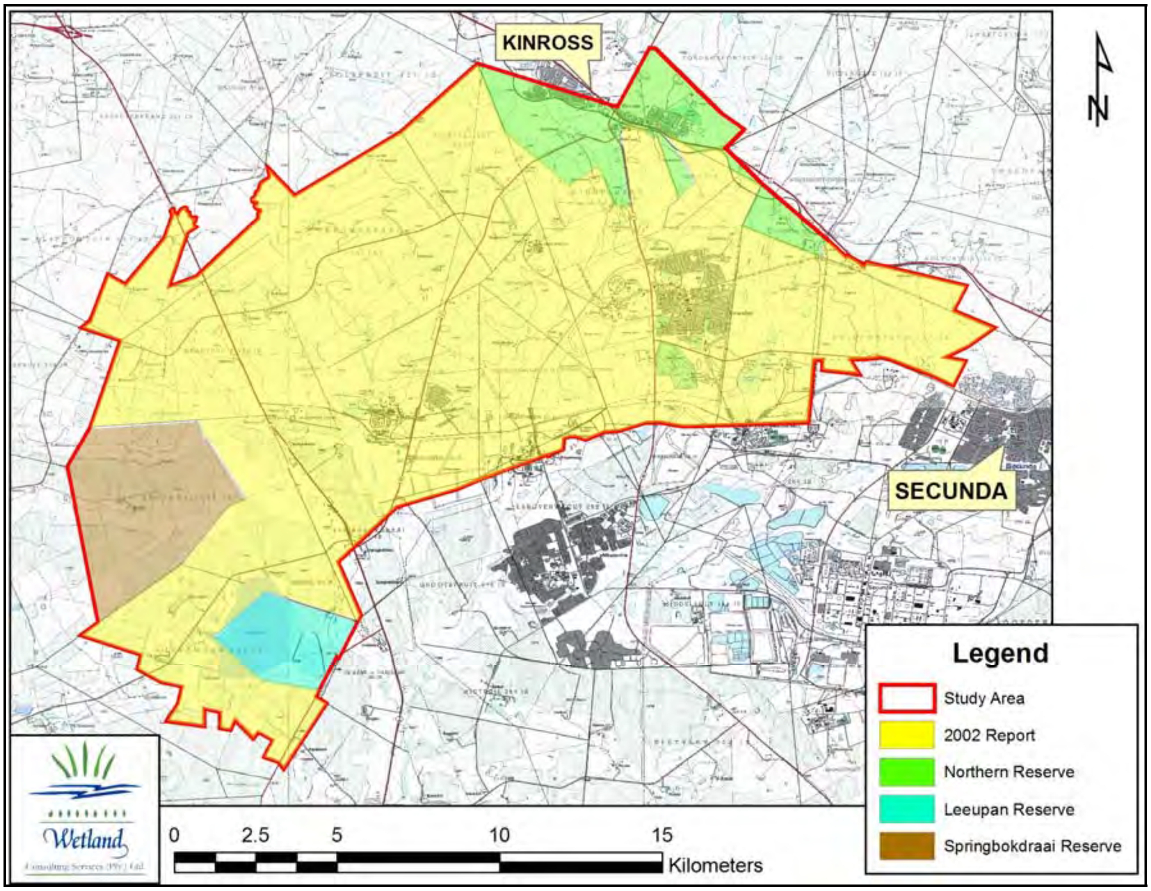


Figure 1. Map showing the extent and location of the study area. The area covered by the 2002 Report is shaded yellow, while the additional areas surveyed during the current study are shaded green, brown and blue respectively.

4.1 CATCHMENTS

The study area is located predominantly in primary catchment C, the Vaal River catchment, though with the northern most reaches of the site extending marginally into primary catchment B, the Vaal River catchment. The affected quarternary catchments include catchments C12D, in which the majority of the study area falls, and C12F, both of which are drained by the Waterval River, as well as catchment B11D, which is drained by the Steenkoolspruit. More details on the affected catchments is provided below.

Table 1. Table showing the mean annual precipitation, run-off and potential evaporation per quaternary catchment (Middleton, B.J., Midgley, D.C and Pitman, W.V., 1990).

Quaternary Catchment	Catchment Surface Area (ha)	Mean Annual Rainfall (MAP) in mm	Mean Annual Run-off (MAR) in mm	MAR as a % of MAP	Study area as % of catchment
C12D	81 343	666.9	59.3	8.9 %	29 %
C12F	75 655	634.9	49.1	7.7 %	> 0.5 %
B11D	49 812	671.5	30.1	4.5 %	1 %

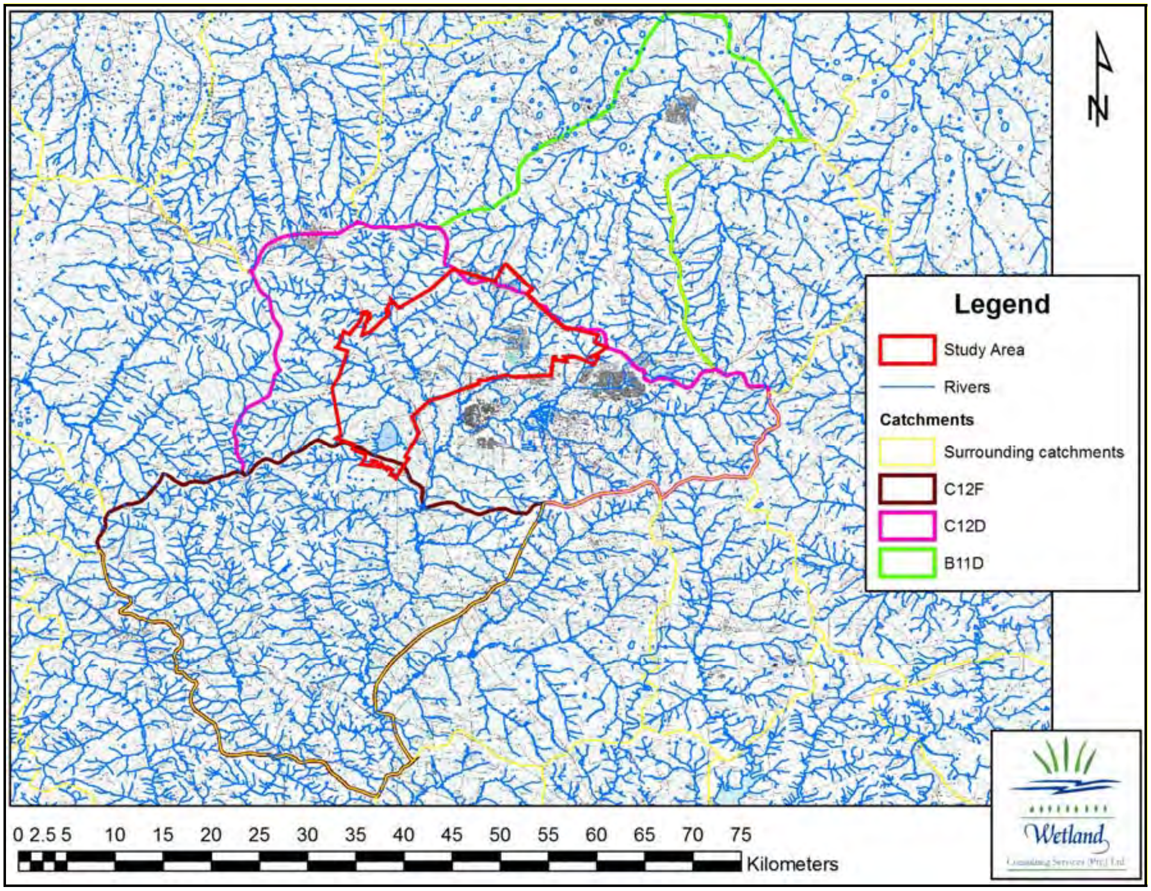


Figure 2. Map showing the Shondoni Project study area in relation to the quaternary catchments.

Of interest is the relatively high percentage of mean annual precipitation that ends up as run-off out of catchment C12D, being almost 9 %. Typically values further north on the highveld towards Witbank range from around 4-6 % (see catchment B11D). This higher run-off value is as a result of the geology of the area (see below) and indicates that wetlands in this area are more reliant on surface flows than sub-surface flows. It is therefore expected that wetland types such as floodplains and valley bottom wetlands would dominate in this area, with hillslope seepage wetlands being rather less common. The opposite applies to catchments further north on the highveld where infiltration of rainfall rather than run-off is the dominant driving process.

4.2 GEOLOGY

The geology of the study area is for the most part dominated by underlying dolerites, while extensive alluvial deposits occur along the floodplains associated with the larger rivers. Sandstone underlies the remaining areas of the study site, and is most common in the south west around Leeupan and the southern reaches of the study area.

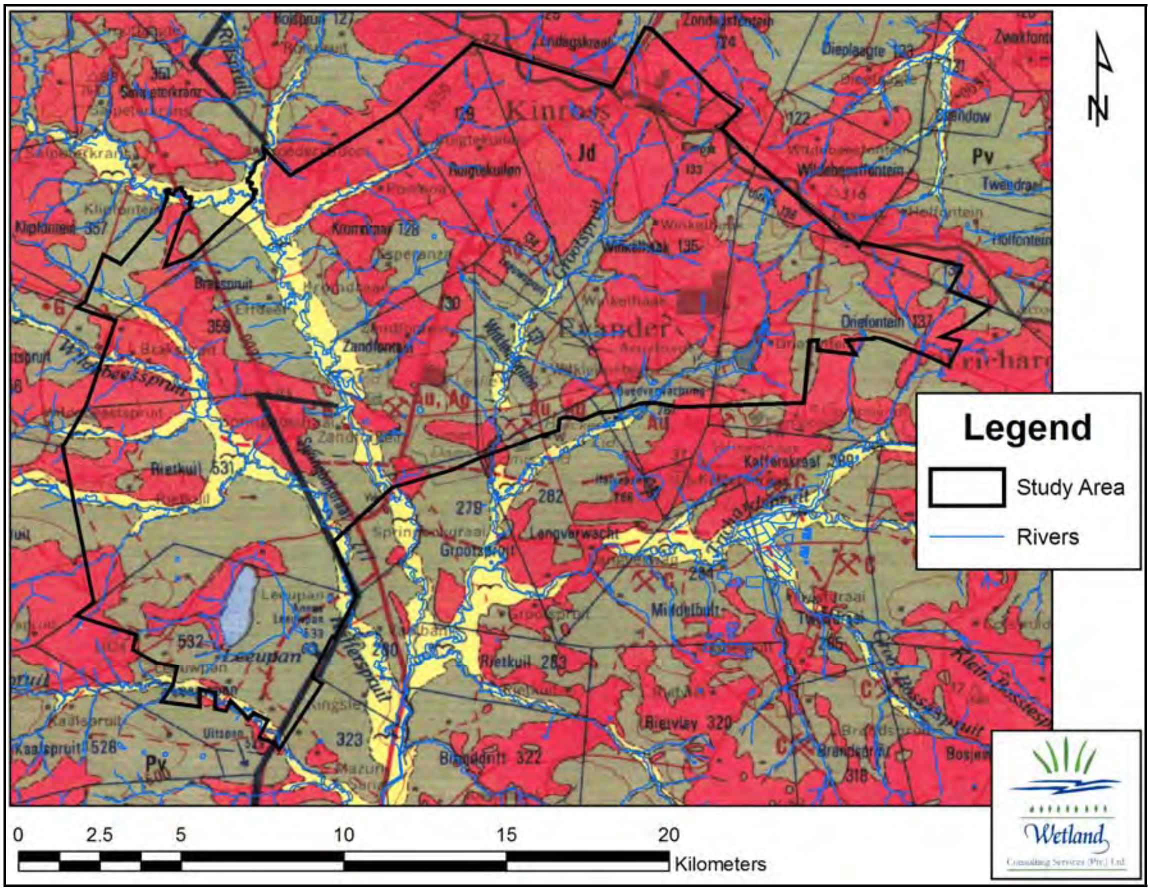


Figure 3. Map of the underlying geology – pink indicates dolerite, yellow shows alluvial deposits, and brown represents sandstone.

Dolerite typically weathers to form clay rich soils, with vertic, black soils being most common in the study area. These soils are highly expansive, showing cracking on the surface when dry, and become nearly impermeable to water when wet, resulting in a large percentage of rainfall ending up as run-off, as seen in Table 1 above. These soils dominate the study area, with typical soils forms including:

Arcadia

In the Arcadia soil form, a vertic A horizon occurs deep into the soil profile. The A horizon has strongly developed structure and clearly visible, regularly occurring slickensides in some part of the horizon. These soils have high clay content, a dark colour, and a predominance of smectic clay minerals and possess the capacity to swell and shrink markedly in response to moisture changes. This swell-shrink potential is manifested typically by the formation of vertical cracks in the dry state and the presence at depth of slickensides (polished surface planes produced by internal movement).

Katspruit

In the Katspruit soil form an orthic A horizon overlies a G horizon which is typical moist with grey matrix colours. Mottling may or may not occur down to a depth of 50 cm. Many of the Katspruit soils associated with the floodplains in the area are not characteristically saturated at depth. This is largely the result of incision of the stream channel, which serves to drain these areas and also reduces the likelihood of overbank topping during flooding rainfall and thus reduces the frequency of flooding. The soil profile thus dries out. The G horizon may be calcareous or non calcareous.

Kroonstad
In areas where the Kroonstad soil form occurs, an orthic A horizon overlies a typical greyish E horizon with a grey matrix which in places is shallower than 50 cm. The E horizon may contain mottling or streaking with a higher chroma than that of the matrix as a result of the periodic saturation with water. Below this a typically gleyed G horizon occurs. The orthic A horizon can also range from damp in some areas to dry in others.

Rensburg
The vertic A horizon of the Rensburg soil form has clearly visible slickensides in the transition to the lower layers and is characteristically cracked when dry. The vertic A horizon ranges from moist to dry depending on the frequency and duration of wetting when the soils are flooded. The underlying G horizon is often saturated unless the system has been drained and has typical grey matrix colours often with blue or green tint with or without mottling. In places in the study area, this form was calcareous in the upper G horizon.

Figure 4. Photographs showing a typical Arcadia soil profile on the left and a Rensburg soil profile on the right – both photographs were taken in the Secunda area during field work conducted in June 2010.

4.3 VEGETATION

According to the Vegetation of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006) the study area is located within the Grassland Biome and the Mesic Highveld Grassland Bioregion. Three specific vegetation types occur on site, of which Soweto Highveld Grassland is dominant. Eastern Temperate Freshwater Wetland vegetation is only associated with Leeupan on site, while a small patch of Eastern Highveld Grassland is indicated as occurring in the extreme northern reaches of the study area, to the north of Kinross.

Soweto Highveld Grassland, as described by Mucina and Rutherford (2006), is found mostly in the Mpumalanga and Gauteng Provinces on the gently to moderately undulating landscape of the highveld. Intrusive dolerites feature strongly in this area. The vegetation is typically a short to medium-high, dense, tufted grassland dominated by *Themeda triandra*. This vegetation type is considered *Endangered*, with almost 50 % already transformed by cultivation, mining, urban sprawl and building of road infrastructure.

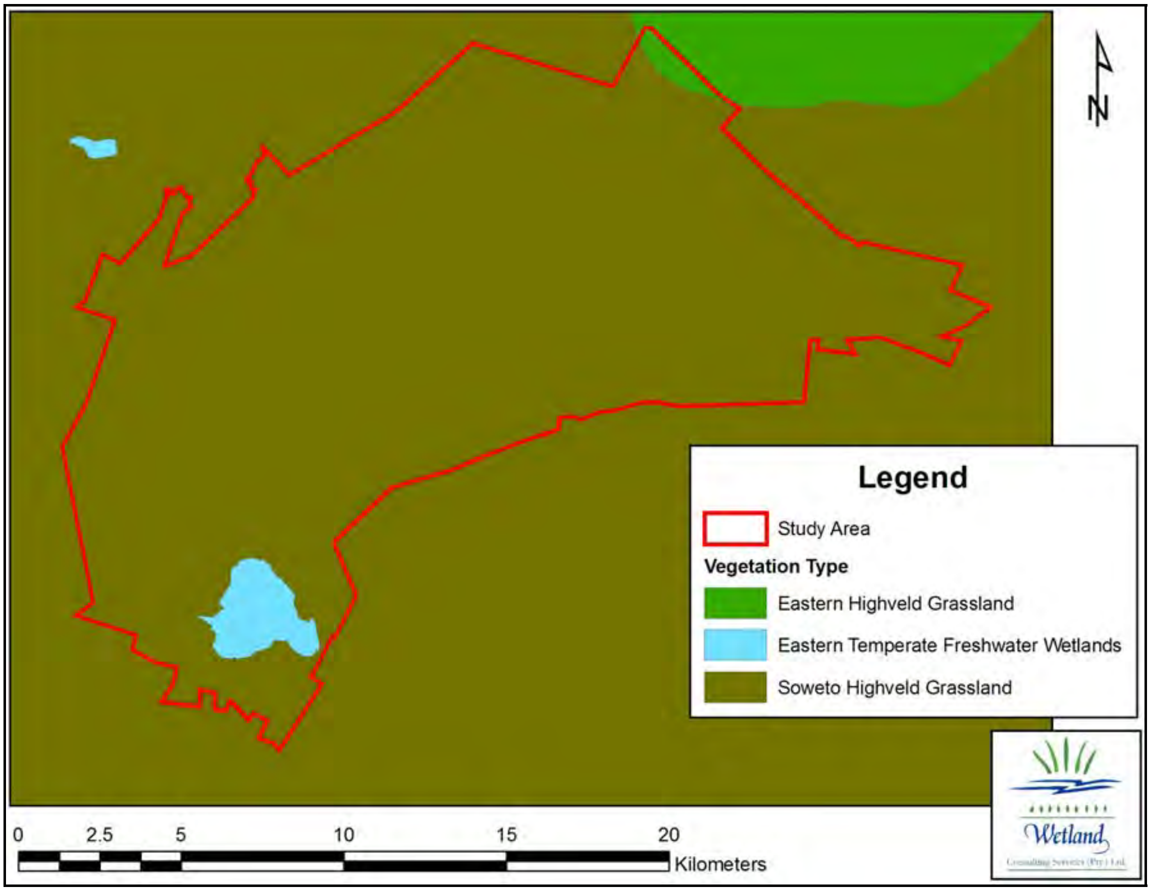


Figure 5. Vegetation map of the study area indicating the different vegetation types occurring on site (Mucina & Rutherford, 2006).

5. APPROACH

The National Water Act, Act 36 of 1998, defines wetlands as:

> **Wetlands** - *"Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."*

5.1 WETLAND DELINEATION AND CLASSIFICATION

Use was made of 1:50 000 topographic maps, geo-referenced Google Earth images and aerial photographs to generate digital base maps of the study area onto which the wetland boundaries were delineated using ArcView 9.1. The method described in Thompson et al (2002) was used to delineate wetlands at a desktop level, based on wetness signatures (darker or greenish areas) on satellite imagery and aerial photographs. All identified potential wetlands were then verified in the field.

During the current survey, wetlands were delineated according to the delineation procedure given in "*A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas*" (DWAF 2005). Indirect indicators of prolonged saturation, namely wetland plants (hydrophytes) and wetland soils (hydromorphic soils) were used to identify wetland areas. Hydromorphic soils must display signs of wetness (mottling and gleying) within 50cm of the soil surface for an area to be classified as a wetland. The study area was sub-divided into transects and the soil profile was examined for signs of wetness within 50 cm of the surface using a hand augur along transects. The wetland boundaries were then determined by the positions of augured holes that showed signs of wetness as well as by the presence or absence of hydrophilic vegetation.

The wetlands were subsequently classified according to their hydro-geomorphic determinants based on the system proposed in the National Wetland Classification System (SANBI, 2010) (in the case of the delineation undertaken in 2002, the classification of the wetlands was updated to align with the recently developed National Wetland Classification System – systems classified as "drainage lines" in the 2002 Report were reclassified as either channelled or unchannelled valley bottom wetlands). The presence of wetlands in the landscape can be linked to the presence of both surface water and perched groundwater. Wetland types are differentiated based on their hydro-geomorphic (HGM) characteristics; i.e. on the position of the wetland in the landscape, as well as the way in which water moves into, through and out of the wetland systems. A schematic diagram of how these wetland systems are positioned in the landscape is given in Figure 3 below.

6. FINDINGS

6.1 General Wetland Description & Classification

Five main types of natural wetland systems occur within the study area totalling an area of 3 186 ha (13.8% of the total study area). This figure includes all the natural wetland areas, but excludes dams and water-filled quarries. The recorded wetland types are:

- Floodplain
- Channelled Valley Bottom
- Unchannelled Valley Bottom
- Depression/Pans
- Hillslope Seepage

Together with Leeupan (which has been classified as a pan, but currently functions more as a dam), dams form the main artificial wetland type within the study area. There are approximately 100 dams within the study area with a total area of approximately 150 ha. Of these, Evander Dam is the largest with an inundated area of approximately 45 ha. The remaining dams are mostly farm dams with a total area of 55 ha.

The large pan in the south-western part of the study area (Leeupan), while once a natural and much smaller pan, is now artificially maintained by "waste water" inputs from Harmony Gold Mine. It is approximately 578 ha in extent. All the wetlands occur on clayey substrates and there is a distinct lack of sandy soils and thus hillslope seepage wetlands within the study area. Most of the seepage wetlands were located within the Leeupan area. All the natural wetlands and dams are maintained by surface runoff from the associated catchments and down the respective drainage lines. Pools of standing water are restricted to pans and depressions in the drainage lines and oxbows within the floodplains. The former occur where the local relief is flat enough to allow surface water to accumulate in small depressions while the latter have developed as a result of historical natural floodplain processes.

The position and boundaries of each of these main wetland types found on site are given in Figure 7. A schematic diagram of how these systems are positioned in the landscape is given in Figure 6. The areas covered by the various wetland types are given in Table 2 below.

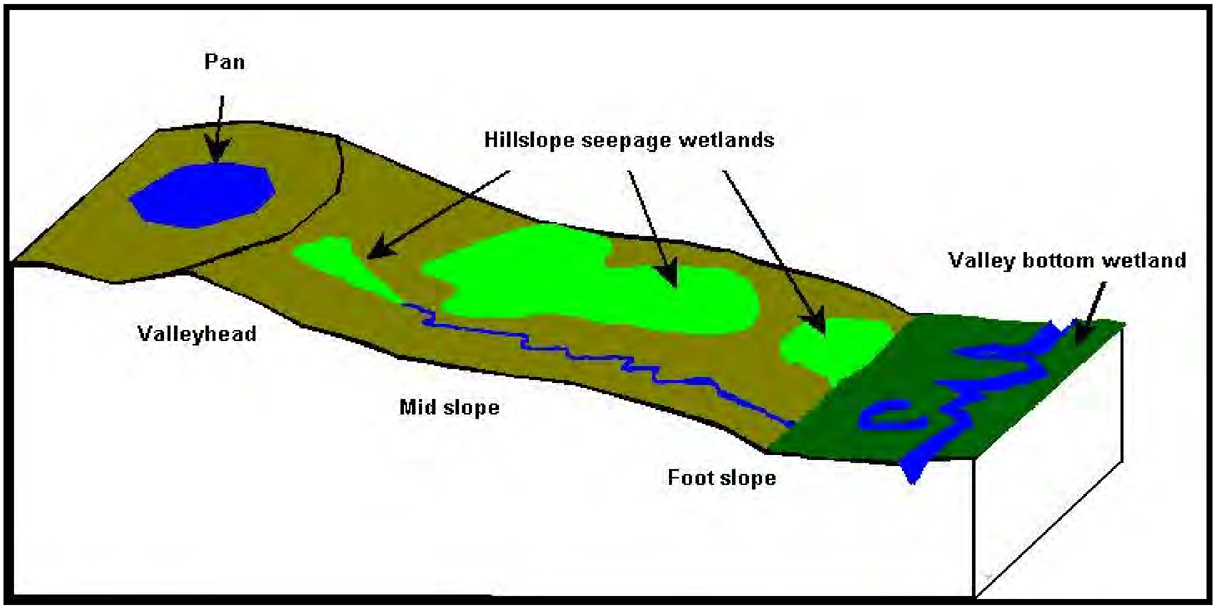


Figure 6. Schematic of the wetlands in the study area showing the general relationship to topography.

Table 2. Table showing the extent of each of the different wetland types identified on site.

Wetland Type	Area (ha)	% of wetland area
Channelled valley bottom	551.25	17.3%
Depression/Pan	586.61	18.4%
Floodplain	1914.57	60.1%
Hillslope seepage	120.22	3.8%
Unchannelled valley bottom	13.24	0.4%
TOTAL	3185.89	100.00%
Dams	124.70	n/a
Quarries	17.70	n/a

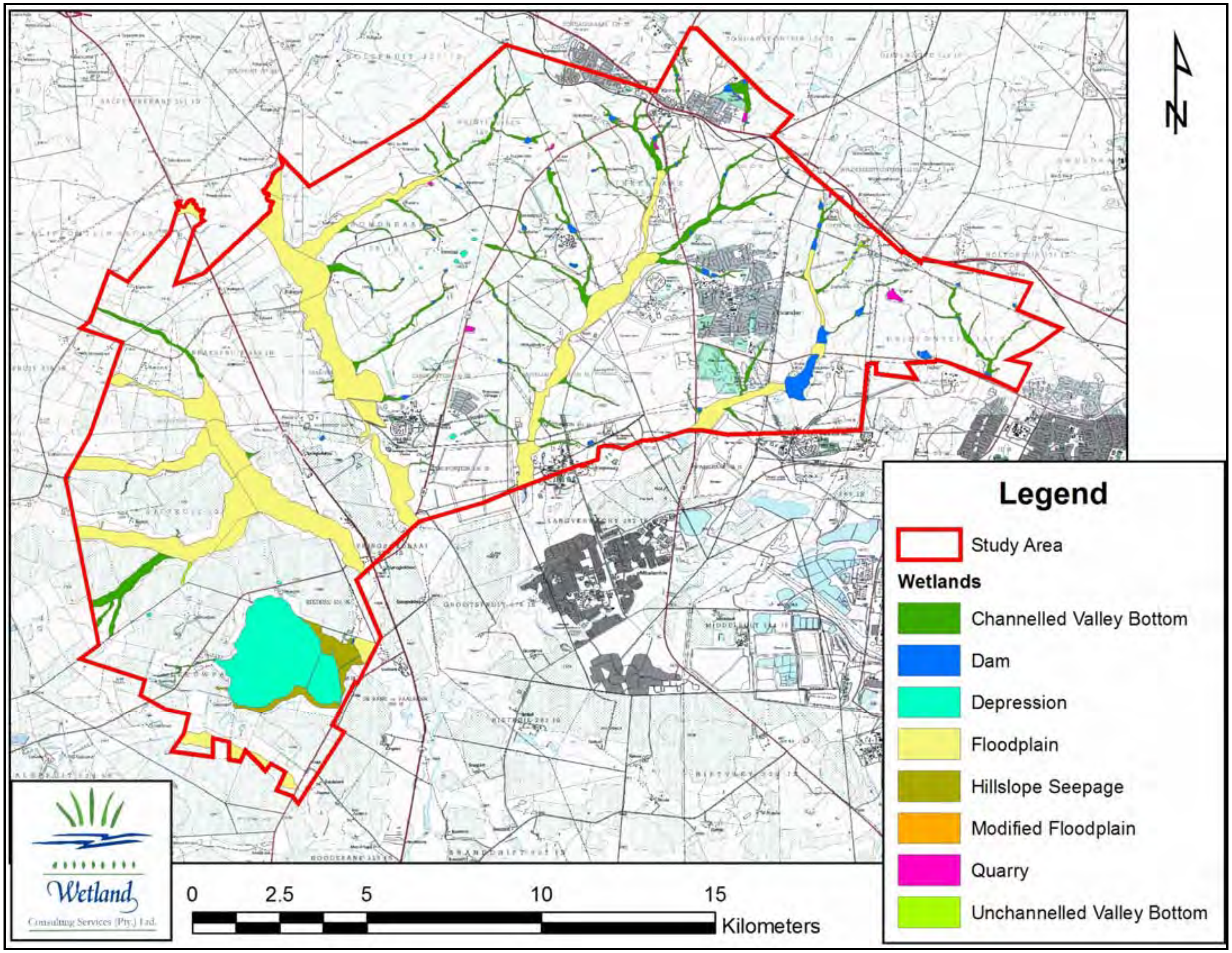


Figure 7. Map showing the delineated and classified wetlands on site.

The proposed conveyor route falls approximately half within the study area, with the southern half extending outside the study area. A total of 7 wetland crossings were identified along the conveyor route, consisting of the following wetland types:

- 5 Channelled Valley Bottom Wetlands
- 2 Floodplain Wetlands (including a crossing of the Trichardtspruit)

In addition, 1 water-filled quarry will be crossed, while 3 small farm dams located within the valley bottom wetlands and the southern most floodplain will potentially also be impacted. The wetlands along the proposed conveyor route are illustrated below.

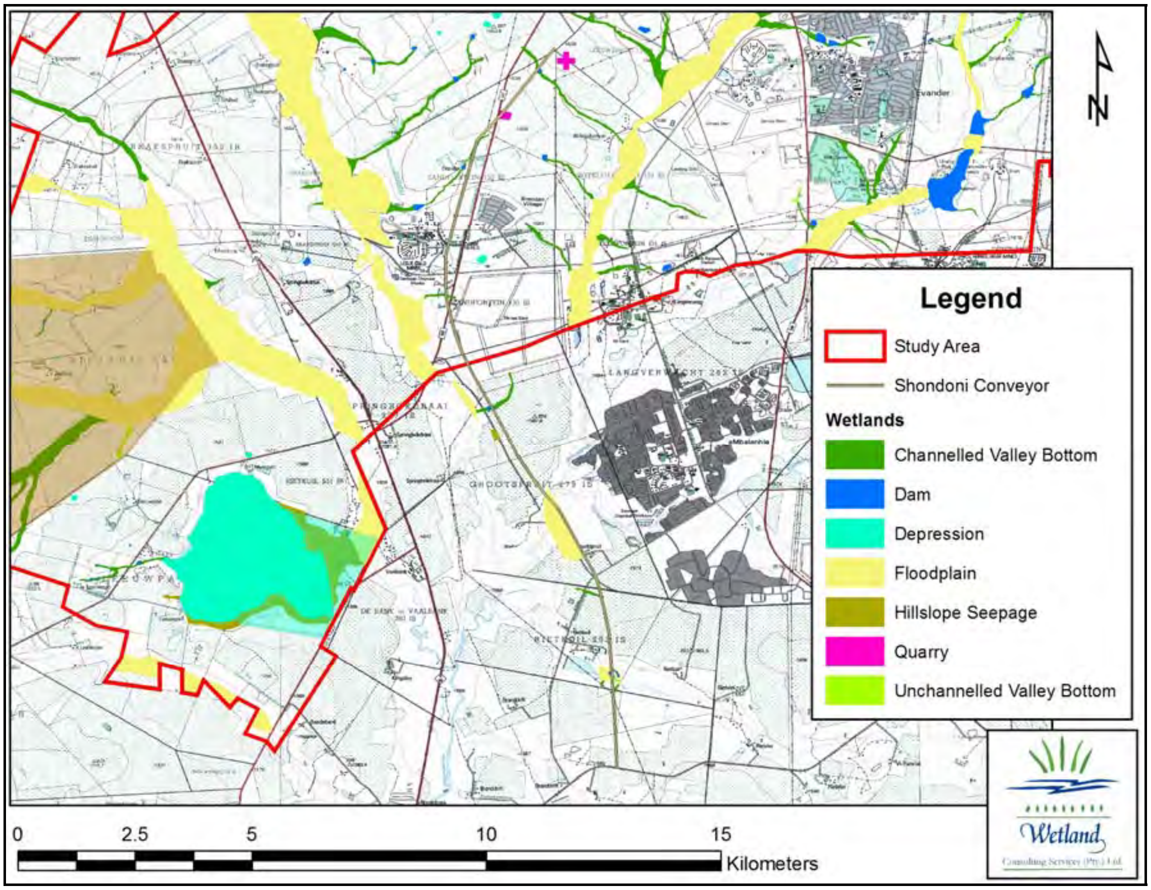


Figure 8. Wetlands identified along the proposed conveyor route. Wetlands were delineated up to approximately 200m upstream and downstream of each crossing point.

6.2 Description of the specific wetland types

For the purpose of this report, wetlands have been classified according to a hydro-geomorphic (HGM) classification system based on the Level 4a classification proposed by the National Wetland Classification System (SANBI, 2009). This system uses hydrological and geomorphological characteristics to distinguish primary wetland units, and is therefore based on factors that influence how wetlands function (SANBI, 2009).

The 2002 Report classified wetlands based on a much simplified HGM classification system, and only recognised three different wetland types, namely floodplain, drainage lines and pans. To align the 2002 data with the SANBI (2009) classification system, the “drainage lines” were re-classified as either channelled or unchannelled valley bottom wetlands for the purposes of this report. The re-classification was done based on aerial photography and the presence or absence of a visible channel; no additional groundtruthing was done of these areas.

6.2.1 Channelled valley bottom wetlands

Channelled valley bottom wetlands make up more than 17 % of the wetland area on site. The channelled valley bottom wetlands on site occur generally high up in the catchments and form tributaries of the larger floodplain wetlands. They are separated from the main floodplains in the study area based on slope and the absence of characteristic floodplain alluvial features. In most cases however, the transition from floodplain to drainage line is not as abrupt as depicted in Figure 1. In addition, many of the larger valley bottom wetlands function very similarly to floodplains in terms of hydrology. However, the steeper slope and the narrower valleys result in sediment export and the erosion of a channel through the wetland being the dominant processes in these systems, rather than the depositional process that dominates on typical floodplains.

Within the study area, the soils of these wetlands are charaterised by vertic black clays; soils that do not display typical wetland indicators (e.g. mottling) very clearly and provide some difficulty to accurate delineation and identification of wetlands. Plant species too comprise predominantly upland species, but the presence of some facultative and facultative wetland species suggests that these areas are at least temporarily wetted. As such, it is very difficult to accurately delineate the extent of the temporarily wet zones and the boundaries of the valley bottom wetlands. Nevertheless it is felt that the delineation contained in this report represents best scientific judgement. In addition to the valley bottom wetlands, several minor preferential flow paths feeding into these wetlands also occur on site, though these do not display wetland characteristics and cannot be delineated as such. Given the clayey nature of the soils in the area and the high run-off percentage generated by these soils, it is clear that most of the valley bottom systems on site a driven by surface run-off.

Typical of all these types of systems on site, a tall emergent plant community zone dominates the lower elevations (areas that remain inundated or wet for longest). Dominant plants in the tall emergent zone include obligate hydrophytic plants such as the sedge *Cyperus fastigiatus*. The bulrush *Typha capensis* is noticeably absent from many of these systems (with the exception of areas associated directly with dams), probably due to the highly seasonal nature of these systems. Shorter mixed grass/sedge meadows occur immediately adjacent to the tall emergent zone and the dominant plant species here include the grass *Leersia hexandra* and the sedges *Juncus oxycarpus* and *Fimbristylis complanata*. There is generally a rapid transition from the mixed grass/sedge zone of these more seasonally wet habitats to the more temporarily wet habitat associated with the adjacent marginally wet grasslands. These areas comprise a mixture of grasses, the dominant species being the upland grass *Themeda triandra*. Facultative wetland and facultative indicator category species such as *Eragrostis plana* and *Setaria sphacelata* respectively are co-dominant in many places providing evidence of temporary wetting.

6.2.2 Unchannelled valley bottoms

Unchannelled valley bottom wetlands make up less than 0.5 % of the wetland area on site. Within the study area these wetland systems do not differ significantly from the channelled valley bottom wetlands, but represent systems were the flow velocities and volumes are not sufficient to erode a channel through the length of the wetland.

6.2.3 Floodplains

Floodplains are the most extensive wetland systems on site and make up 60 % of the wetland area. Surface hydrological forces typically dominate the processes operating on floodplains. Typical floodplain features such as meandering channels and oxbows are associated with all the floodplains on site. This is as a result of the depositional history and the associated topography. As the name implies, floodplains receive water during periods of high rainfall, where the volume of water flowing down a watercourse exceeds the capacity of the channel, and spills out onto marginal areas. Once the black vertic clays are saturated, the floodwaters flow horizontally over the surface. With sufficient flooding, oxbows and depressions fill up prior to draw down. The floodplain grasslands on site are all temporarily inundated meaning that they only remain inundated for short periods following flooding during high flow periods. Inundation does not occur every year. These floodplain grasslands dominate the wetland area on site with a total area of 1 877 ha (Table 2). This area is made up of ten systems associated with each of the main river systems on site as shown in Figure 7. The impervious nature of the clays ensures that oxbows and depressions remain inundated for a period longer than the adjacent floodplain grasslands. These areas together with depressions, pools and areas within the active channels represent the only seasonally wet wetland habitats in these floodplain systems.

It is however also assumed that groundwater plays an important role in the functioning of the floodplain wetlands on site, with water (derived from upslope sources) moving along the interface between the soil and the underlying parent rock also contributing to saturating the soils within the floodplains and inundating the oxbows (the soils are assumed to fill up from the bottom). Given the eroded, incised condition of many of the floodplain channels and the resultant reduced regularity of overtopping, the importance of this subsurface contribution is magnified.

Three different types of oxbows/cut-off meanders were idenitifed on site, differentiated based on the duration of inundation. The duration of inundation is influenced by flooding of the river, the shape and size of the oxbow, as well as the substrate. In general, those areas that were inundated for longest (at least a few months during the summer rainfall season) by the time of the site visits had the highest habitat diversity while those that were inundated for shorter periods had the lowest, Oxbows are however naturally variable and in a reference type floodplain, a continuum of types is expected depending on the extent and duration of recent flooding.

Typical of all the types of oxbows on site, a tall emergent plant community zone dominates the lower elevations of the wetter oxbows. Plants in the tall emergent zone include obligate hydrophytic plants such as the sedge *Cyperus fastigiatus*. In the inundated oxbows, a floating leaved and submerged plant community comprising only obligate wetland indicator plants may also occur. The floating leaved and submerged pondweeds *Potamogeton thunbergii* and *Potamogeton pectinatus* respectively were the common species in this zone. Shorter mixed grass/sedge meadows occur immediately adjacent to the tall emergent zone and in the seasonally saturated zones of all the oxbows and the dominant plant species here include the grass *Leersia hexandra* and the sedges *Eleocharis dregeana*.

As is the case with the depressions and pools in the drainage lines, there is generally a rapid transition from the mixed grass/sedge zone of these more seasonally wet habitats to the more temporarily wet habitat associated with the adjacent marginally wet grasslands. These floodplain grasslands comprise a mixture of grasses, the dominant species being the upland grass *Themeda triandra*. Facultative wetland and facultative indicator category species such as *Eragrostis plana* and *Setaria sphacelata* respectively are co-dominant in many places providing evidence of temporary wetting.

6.2.4 Depressions (Pans)

Ten natural pans occur within the study area. One additional pan, Leeupan has been artificially enlarged by the construction of two weirs and is now by far the largest open water body in the area. It has a surface area of 578 ha. Leeupan also receives waste water inputs from Harmony Gold Mine. Given these modifications, Leeupan functions more as a dam than a pan in its current, modified condition. The presence of Red Data listed bird species (Greater and Lesser Flamingo) does however reveal that the Leeupan is still important in terms of biodiversity support.

Table 3. Summary of water quality data for Leeupan (Year 2000) and from 10 highveld pans sampled in September 2001.

Determinant	Leeupan		10 Highveld pans	
	Mean	Range	Mean	Range
pH	8.24	8.8 - 4.48	8.05	8.96 - 6.73
Electrical conductivity	623.56	788 – 360	819.09	3200 - 92.00
Chloride	1603.09	1800 - 168.5	156.36	729 – 7
Sulphate	715.60	1100 – 517	61.55	157 – 2
Sodium	1015.16	1279.96 - 875.5	172.62	656 -10.8
Magnesium	54.63	72.9 - 48.6	9.12	15.3 - 3.44
Calcium	136.19	160 - 119.7	9.57	20.8 - 3.82
Potassium	67.09	94.4 - 52.7	20.99	89.4 - 3.37

The 2002 Report analysed numerous water samples taken from pans in the area and compared these to the quality of Leeupan (not sampled in the 2010 study). Water samples have been collected and analysed from Leeupan since 1993. A comparison of these early records with more recent ones, suggest that the concentrations of the major cations and anions sampled have not changed over time. In order to try and get an idea of the status of Leeupan, the water quality data was compared with that from 10 highveld pans not influenced by mining activities.

As can be seen from the results presented in Table 3, there was considerable inter pan variation in the concentrations of most of the determinants measured. Despite this between pan variability, none of the highest recorded concentrations of any of the determinants, (with the exception of electrical conductivity), approached even the average concentrations of the determinants measured in Leeupan. The most notable differences are the high concentrations of sodium, calcium, magnesium, and sulphate in Leeupan water when compared to the "natural range". This could reflect the consequences of mining activities. Mine waters associated with coal mining activities in the region are known to contribute these elements to surface waters, but they could conceivably reflect the underlying geology and natural weathering processes.

In addition to Leeupan, numerous smaller pans with a total surface area of 6.14 ha were also identified within the study area. The pans are not fed by groundwater or adjacent seepage wetlands as is the case with many pans in the region. Water loss is through evapotranspiration and seepage deeper into the soil. Changes in water chemistry as a result of the concentrating and precipitation of elements due to evaporative concentration would thus be expected to have a marked influence on the composition of the water quality in these systems as a whole, and probably also exerts an influence on the faunal and floristic components of these systems.

Typically, the pans are relatively floristically poor but some variation between the systems is evident based on the duration of inundation. Some of the pans hold water for shorter periods than others and thus lack the tall emergent, floating leaved and submerged hydrophytic communities associated with the open water in pans. These pans are therefore dominated more by mixed grass/sedge meadows of *Leersia hexandra/Setaria sphacelata* and *Eleocharis dregeana/Fimbristylis complanata* throughout.

The mixed grass/sedge meadows of *Leersia hexandra/Setaria sphacelata* and *Eleocharis dregeana/Fimbristylis complanata* also occur in more permanent pans, but these are restricted to the periphery where seasonal root zone wetting occurs. In contrast to the temporary pans, towards the centre of the more permanent pan, longer inundation produces longer-term saturation possibly extending over seasons. As such, plants like the common bulrush, *Typha capensis*, that can survive in the conditions imposed by more semi-permanent root-zone saturation occur. Submerged hydrophytes like the fennel-leaved pondweed *Potamogeton pectinatus* and the broad-leaved pondweed *Potamogeton thunbergii* occur in the open water. The transitional zone (between the centre and edge of the pan) is characterised by seasonal inundation and extensive floating mats of the hydrophytic grass *Leersia hexandra* occur.

Indications are that the other pans are probably only inundated for short periods during the summer rainfall season following local rainfall events and then fairly rapidly draw down to empty. In the lowest lying areas, shallow water may stand for longer but for most of the year the pans do not contain surface water.

6.3 Fauna and Flora

6.3.1 Fauna

Small mammals such as mongoose, grey duiker and rodents naturally occur in the area. Yellow mongoose was seen on site and the presence of numerous Marsh owls (*Asio capensis*) in the wetlands suggest that rodents occur. Cape clawless otters (*Aonyx capensis*) and water mongoose (*Atilax paludinosus*) occur in the area and there was evidence of the presence of otters in the Wildebeestspruit and its tributaries in particular. They appeared to be targeting the large Potamonautes crabs that burrow into the *Eleocharis dregeana* and *Leersia hexandra* dominated oxbows and depressions that occur in these drainage lines and floodplains. For a more detailed assessment of the fauna occurring on site, refer to the terrestrial ecology report prepared for the Sasol Mining Middelbult (Block 8) Shondoni Project (Wetland Consulting Services, 2010).

The wetlands on site, especially the large floodplain wetlands with their numerous oxbows as well as the larger open water bodies on site (Leeupan and the farm dams) are expected to provide important habitat for waterfowl. The Red Data listed **African Grass Owl (*Tyto capensis*)**, listed as Vulnerable, was observed on site where it was flushed from its roost in a stand of *Imperata cylindrica* associated with the edge of the channel along a floodplain in the Springbokdraai Reserve area (-26.534313°S; 28.976503°E).

6.3.2 Flora

A total of 88 indigenous plant species were recorded in the wetlands of the study area. A total of 27 plant species were recorded in the riparian zones, 42 in the floodplain grasslands, 42 in the valley bottom wetlands, 29 in the floodplain and drainage line oxbows, pools and depressions, and 24 in the pans. A total of 18 exotic plant species were also recorded in the wetlands. All of the plant species recorded are common wetland and marginal wetland species.

The variability in species composition that was picked up within the floodplains and drainage lines is attributed to the differences in species composition between the marginally wet grasslands and the oxbows, pools and depressions. The presence of these features produces wetter habitats within the otherwise fairly dry, temporarily wet floodplain and drainage line grasslands that all had a similar plant species richness and composition throughout the study area. These grasslands for example, are dominated by more dryland species while the more seasonally wet habitats associated with the active channels, pools, depressions and oxbows are dominated by more facultative wetland (fw) and obligate wetland (ow) species.

There is also some variability between different oxbows, pools and depressions in terms of the abundance and composition of plant species. This is related to the extent and duration of wetting within and between these systems with those that are wettest for longest containing more of the obligate type species. Among these systems there is therefore a wet-dry continuum that further adds to the wetland diversity in the floodplain and drainage line systems. The plant species composition of the pans also appeared to reflect a response to a wet-dry continuum related to the variability and duration of inundation in the different pans.

When compared to the upper Olifants River catchment to the north of the study area however, the degree of variability in plant species composition and richness between the wetland types in the Middelbult area is low. This is probably attributable to the absence of seepage wetlands. This lack of seepage wetlands is in turn attributed to a general lack of sandy soils and groundwater influence in the study area.

A list of the plant species recorded in the main wetland types on site is given in Appendix 1.

Plant indicator categories

There is a fairly even spread of plant indicator categories within the wetland habitats in the study area. Approximately 57% of the plants that were recorded within the wetlands (Figure 5) can be regarded as wetland indicator species (in the ow and fw indicator classes). The remaining 43% comprise plant species equally likely to occur in wetland and non-wetland areas and plant species more likely to occur in non wetland areas. This is a further indication of the relatively dry conditions common in the majority of the wetland habitats within the study area during the field surveys.

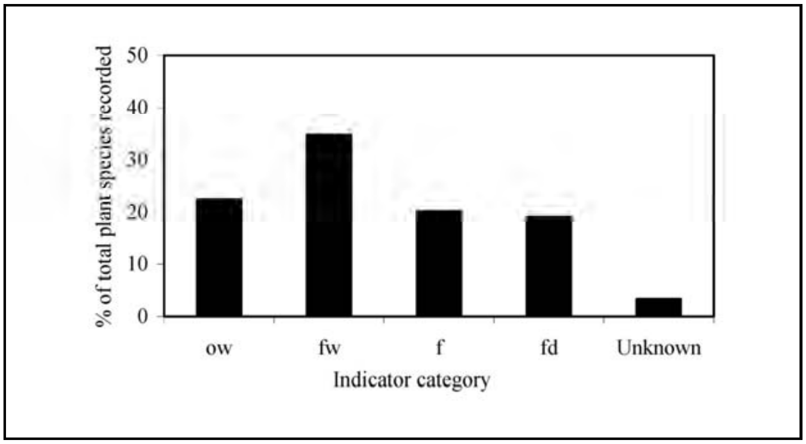


Figure 9. Percentage of plant species in the different indicator categories for all the wetlands in the study area at the time of the field surveys.

Within the riparian zones and floodplain grasslands there is a similar spread of plant indicator categories with very few (low percentage) of obligate wetland (ow) species and an even distribution of facultative wetland (fw) and more non wetland species (Figure 6).

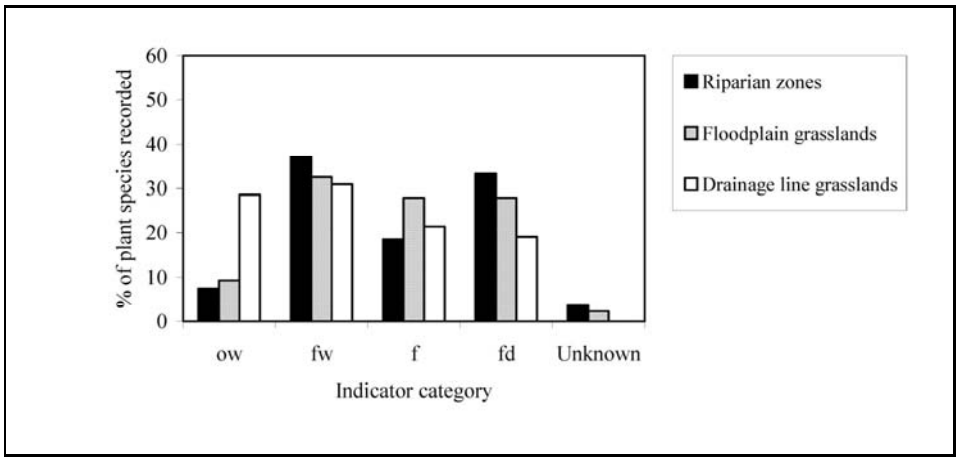


Figure 10. Percentage of plant species in the different indicator categories for the riparian zones, floodplain grasslands and drainage line grasslands at the time of the field surveys.

In contrast, the valley bottom grasslands have a higher percentage of obligate wetland (ow) species compared to the former systems. This can probably be attributed to the existence of more seasonally wet habitats in some of the drainage lines, particularly where there is little channel erosion and there is a gradual transition from pools and depressions to the adjacent grasslands as is the case in the drainage lines of the Wildebeestspruit.

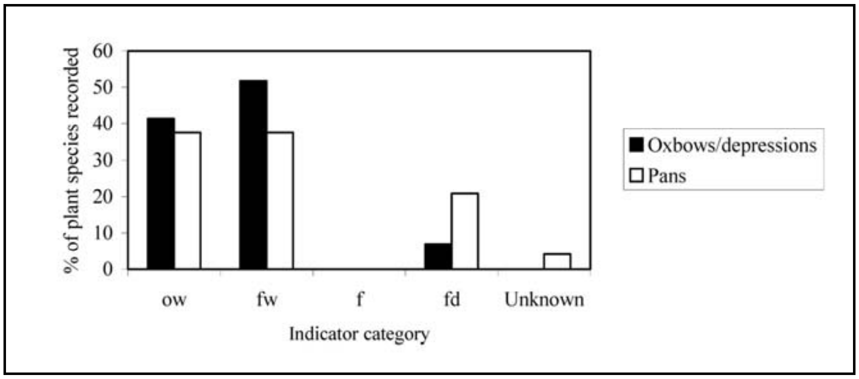


Figure 11. Percentage of plant species in the different indicator categories for the oxbows, pools and depressions and pans at the time of the field surveys.

In contrast to these systems, plant species occurring in the oxbows, depressions and pans comprise predominantly obligate wetland (ow) and facultative wetland (fw) species (Figure 7). This means these systems comprise almost exclusively wetland indicator species with a few facultative dryland (fd) species on the edges. As expected these systems therefore represent the wetter group of wetland habitats in the study area and to a large extent these are quite different to the more extensive yet drier marginally wet habitats associated with the floodplain and drainage line grasslands.

6.4 Functional Assessment

Despite the widely held notions about wetland functionality, extensive literature searches reveal that very few practitioners have actually quantified these benefits (Batchelor, 2002). Moreover, it appears that these functions are highly variable depending on the characteristics of the wetlands and the landscape. In the present study, it was not possible to perform the types of investigations necessary for determining functionality such as nutrient balance studies or flood attenuation quantifications. This was due both to the complexity of the task and the costs and time that would have been involved. It is therefore difficult to speculate on the functional values of the wetlands on site. Nevertheless, some general discussion is possible based on experience and other projects undertaken in the region. These are discussed for each of the main wetland types found within the study area.

Floodplains

Floodplains are commonly considered to be valuable in that they perform a number of beneficial functions to society. For example, due to the nature of the vegetation and the topography they occupy, they are considered important for flood attenuation. Their function in relation to enhancing water quality however is less clear. Since the dominant source of water on floodplains is the volume of water flowing over the surface of the floodplain area, the concentrations of nutrients are generally low due to dilution effects. This together with shorter retention times, reduces the chance of contact between the bulk of the water and the sediments and thus reduces the opportunity for the removal of certain nutrients.

One exception to this is suspended solids, the concentration of which may be high due to the ability of floodwaters to carry high suspended loads. Once flows overtop river banks, the velocity of the floodwaters reduces and permits the selective deposition of particles, with fine particles associated with slow flows and coarser sediments progressively higher flows. Some nutrient removal, for example phosphates and ammonia bound to clay minerals and soil particles, is likely to occur coincidentally with the deposition of sediments. Sedimentation will thus tend to reduce phosphate loads in the short term, which however are likely to be recycled through plant and animal uptake and possibly re released into the system. Re release may also occur if the sediments are submerged for periods long enough to result in the formation of anaerobic conditions, such as would occur in the depressions and oxbows.

During the drying out phase, similar processes to those documented in endorheic pans can be expected, with progressive concentrating of solutes until their solubility products are exceeded. The actual mass of these precipitates is however unlikely to represent a significant proportion of the mass of elements transported during the flood event. In addition to removal, flooding can also result in the release of salts and nutrients into the water column through mineral exchange. During the initial wetting phase for example, previously deposited salts and nutrients may be dissolved and leached from the sediments into the water column. Another effect that flooding has on sediments is a change in the redox potential. Typically the redox potential would decrease as a function of time after flooding. The change in redox increases the solubility of a number metals such as manganese and iron and can result in the release of these and previously bound phosphates. The converse also holds when the floodplain systems drain and the sediments become re aerated.

The oxbows within the floodplains retain water for longer (throughout the summer rainfall season in many cases) and therefore are major contributors to the biodiversity of the floodplains in that they create seasonally wet habitats within the temporarily wet floodplain grasslands in which they occur.

Valley bottom wetlands

The broad drainage lines within the study area are expected to perform similar functions to the floodplains, but at a smaller, and over different spatio-temporal scales. While retention times are expected to be shorter due to the steeper slopes in the drainage lines compared to the floodplains, there are some drainage lines where saturated conditions appear to persist for longer periods than in the floodplains due to local changes in slope and/or shallower channel incision. These areas act almost like seepage wetlands within the drainage lines and thus could be functioning in a similar manner to seepage wetlands. The longer retention times and anaerobic conditions in these systems is likely to facilitate the removal of excess nutrients and inorganic pollutants (Rogers, Rogers and Buzer, 1985; Gren, 1995; Ewel, 1997; Postel and Carpenter, 1997) that may be getting into the water courses associated with these drainage lines. In so doing they may be performing a purification service. The wetlands are not expected to be playing an important role in replenishing or recharging groundwater supplies, mainly because of their small size and fairly impervious clay base. They may however be helping to retain water for longer in sections of the drainage lines and thus in the catchment and they probably contribute towards the biodiversity of the catchment by creating seasonally wet patches in a landscape that is dominated by dry grassland and temporarily wet wetlands.

Pans

Water quality in pans is influenced by the pedology, geology, and local climate (Batchelor, 2002). This in turn, is likely to have a marked influence of the response of these systems to nutrient inputs. In systems like those on site that dry out completely at some stage, some of the accumulated salts and nutrients such as organic nitrogen, various phosphate and sulphate salts might be transported out of system by wind and be deposited on the surrounding slopes. Where deposited materials are not transported out of the system they may re-dissolve when waters enter the system after rainfall events.

Of the phosphate load entering a pan, some may enter absorbed to particulates including the soil, and the other fraction as soluble reactive phosphate. It is likely that the there will be transfer between these forms. When on the one hand pans fill, anaerobic/anoxic conditions will develop, leading to the solubilisation of a fraction of the sediment bound phosphate component. When the pans dry out, conditions favouring the precipitation of Phosphate bound to iron and aluminium and/or as calcium phosphate will result followed by diagenesis.

Another possible sink for phosphates are plants that occur in the pans, either as terrestrial plants when the pan is empty or as aquatic plants when flooded. Some of the phosphates will be taken up by macrophytes present within the system, but unless these are removed, either by grazing and or harvesting, they will not in the long term contribute to phosphate removal, but will be part of an internal recycling system.

Hillslope seepage wetlands

Hillslope seepage wetlands are rare within the study area and are mostly found in the south west of the study area around Leeupan where the soils are sandier, allowing easier infiltration of rainwater into the soils and the lateral movement of water through the soils as interflow.

As is the case of the other wetland types, hillslope seepage wetlands support plants in particular, and associated insects, birds and small mammals adapted to the seasonal moisture regime. In addition hill slope seeps support conditions that facilitate both sulphate and nitrate reduction as interflow emerges through the organically rich wetland soil profile, and they can thus play an important role in maintaining water quality. They typically represent low energy environments, and where soil moisture conditions remain high throughout the year can accumulate carbon. As hillslope seepage wetlands, for the most part, are dependent on the presence of an aquiclude, either a hard or soft plinthic horizon they are not generally regarded as significant sites for groundwater recharge (Parsons, 2004).

6.5 Present Ecological Status (PES) Assessment

While the 2002 Report did include an assessment of the present condition of the wetlands on site, the report did not contain a present ecological assessment as per the standard methodology proposed by "*Resource Directed Measures for Protection of Water Resources. Volume 4. Wetland Ecosystems*" (DWAF, 1999). For the purposes of this report a present ecological status assessment was carried out, with the results illustrated in the map below. The PES assessment for the area covered by the 2002 Report is based on the descriptions of the wetlands contained within the report, some limited field observation, as well as on changes in landuse within the wetlands catchment as visible from aerial imagery.

No pristine wetlands were found to occur within the study area, with all of the wetlands on site having undergone a degree of degradation due to changes in landuse and other anthropogenic activities.

All of the wetlands on site have been exposed to impacts associated with agricultural activities. Cultivation has had some direct impact on some of the smaller valley bottom wetlands and pans where cultivation has intruded into the wetlands. Further impacts from cultivation include an increase in sediment transported into the adjacent wetlands. All of the wetlands on site have however been affected by livestock grazing, with overgrazing resulting in decreased diversity as well as decreased cover, increasing the risk of erosion, while cattle paths and trampling by cattle further create erosion nick points. Incorrect burning regimes and too frequent burning exacerbate the problems caused by cattle. Building of farm dams has in some areas also had a significant impact on the wetlands through changing the hydrological regime of the wetlands and leading to flow concentration, resulting in erosion.

The impact of such agricultural activities on the wetlands has however been fairly limited, as witnessed by the result of the PES assessment that classes the wetlands in the west of the study area, those that have only been affected by agricultural activities and have not been directly affected by mining, urbanisation and associated activities, as being in the best condition.

Mining and urbanisation have impacted on the wetlands on site through deterioration in water quality (e.g. through the release of treated wastewater, stormwater and/or mine water), in impacting on the hydrology (e.g. increased flows, including storing of mine water in Leeupan), and in direct modification of the wetlands (e.g. river diversions and the weirs to increase storage capacity in Leeupan. Road crossings have further resulted in concentration of flows, resulting in erosion and channel incision.

All of the above impacts have resulted in the current condition of the wetlands on site departing significantly from the reference or unimpacted condition of the wetland. This is reflected in the results of the PES assessment which indicates that most of the wetlands are in a moderately modified condition (PES C) due to the various impacts discussed above. A significant percentage of the wetlands (16 %) is considered largely modified, mostly as a result of changes in hydrology and water quality due to urbanisation and infrastructure development, but also in some cases due to cultivation within the wetlands.

Table 4. Table showing the rating scale used for the PES assessment.

Mean*	Category	Explanation
Within generally acceptable range		
>4	A	Unmodified, or approximates natural condition
>3 and <=4	*B*	*Largely natural with few modifications, but with some loss of natural habitats*
>2.5 and <=3	*C*	*Moderately modified, but with some loss of natural habitats*
<=2.5 and >1.5	*D*	*Largely modified. A large loss of natural habitat and basic ecosystem function has occurred.*
Outside generally acceptable range		
>0 and <=1.5	E	Seriously modified. The losses of natural habitat and ecosystem functions are extensive
0	F	Critically modified. Modification has reached a critical level and the system has been modified completely with almost complete loss of natural habitat.

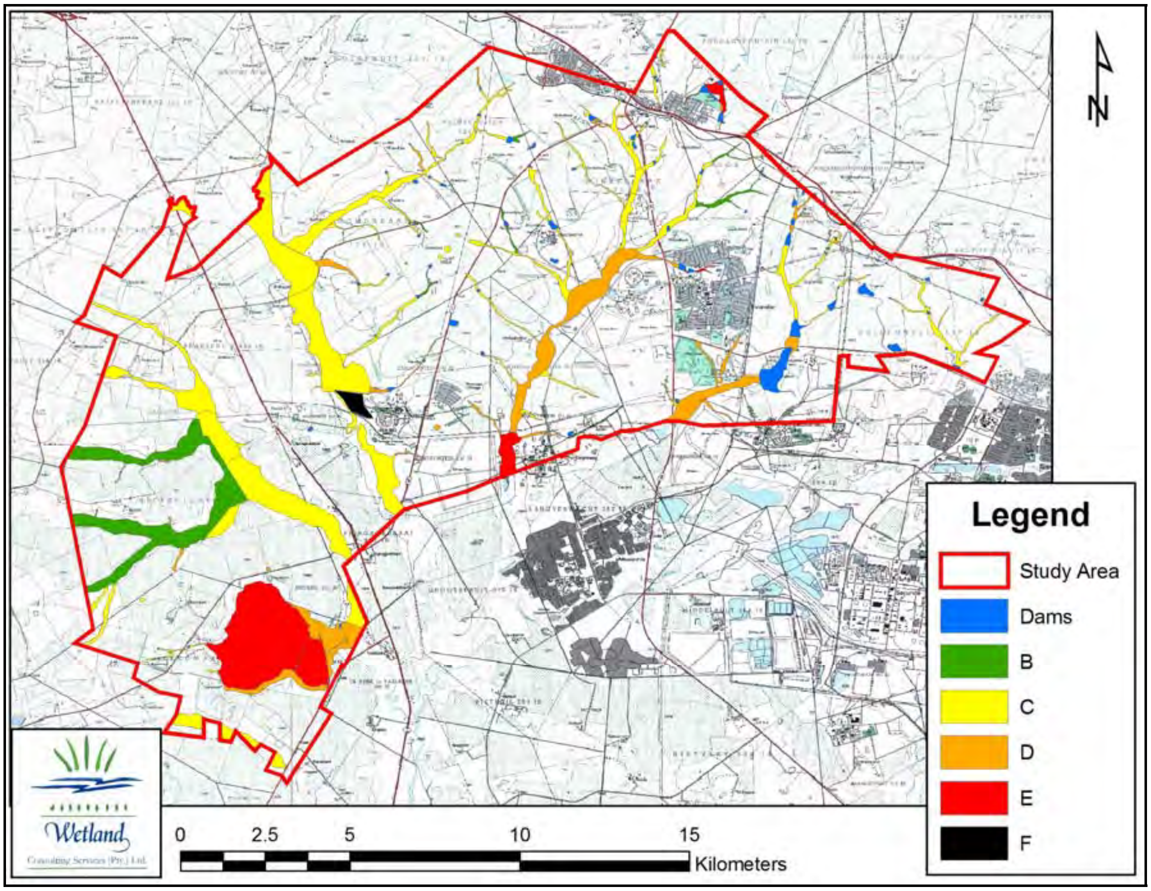


Figure 12. Map showing the results of the PES assessment.

Table 5. Results of the PES assessment

PES	Area (ha)	% of total wetlands
B	442.45	13.90%
C	1552.04	48.76%
D	508.97	15.99%
E	648.47	20.37%
F	31.40	0.99%
TOTAL	3185.89	100.00%

The results of the PES assessment for the wetlands along the conveyor route are illustrated below. The discussion provided above on the wetlands of the study area is also applicable to the wetlands along the conveyor route.

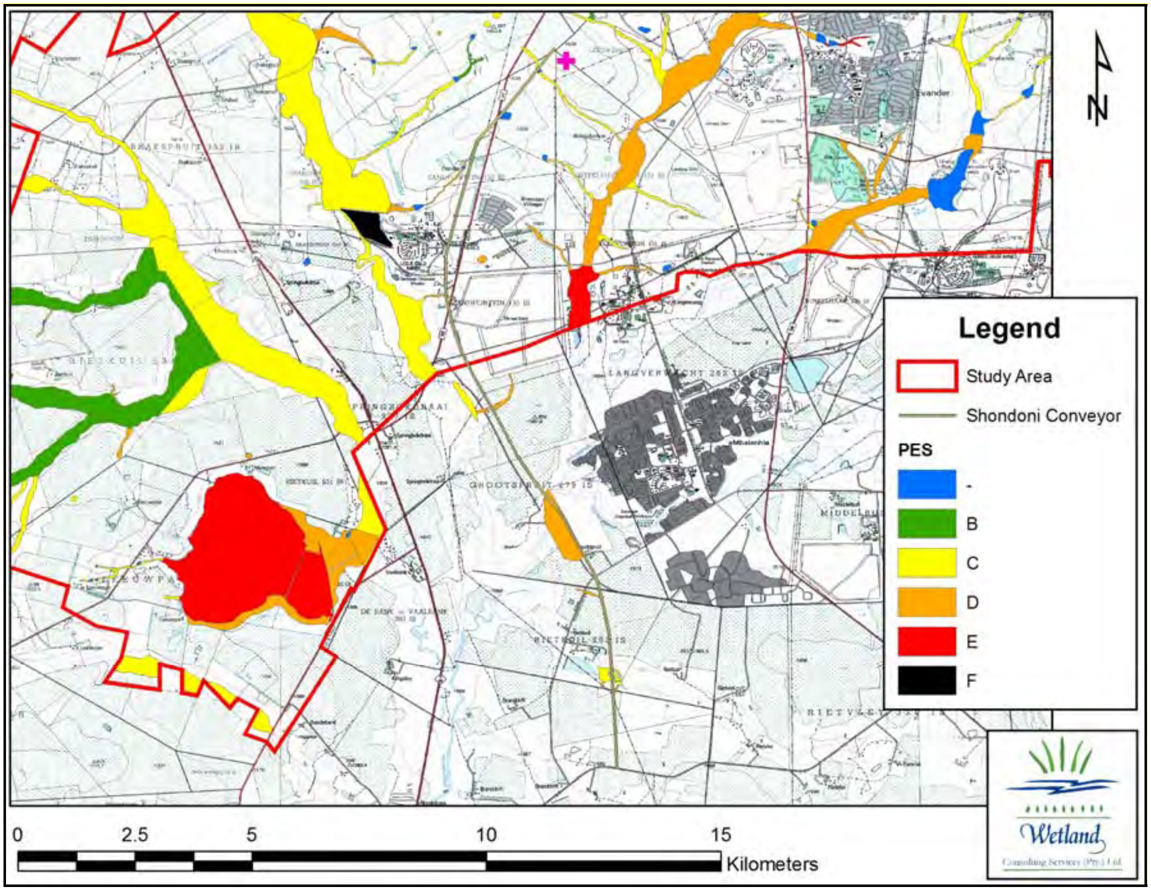


Figure 13. PES assessment results for the wetlands along the conveyor route.

6.6 Ecological Importance and Sensitivity

The site has no formal conservation status. However, based on the current level of understanding and available knowledge of the wetlands of the region, the following discussion is given in the 2002 Report, with some modifications based on findings during the current survey.

Considering the current degraded status of the floodplains within the study area, and the low diversity of plants associated with these, the presence of Red Data plant species in the floodplain grassland habitats is unlikely. It is more likely that if any Red Data plant species occur within the wetland habitats on site, these will be restricted to the few remaining intact riparian zones, either associated with the floodplains or the drainage lines. Given the types of pans on site as well as the lack of seepage areas around the pans, it is unlikely that they contain any Red Data plant species. However, *Kniphofia typhoides* was recorded on site within on of the smaller valley bottom wetlands on site, and is considered likely to occur in several of the valley bottom wetlands and floodplains on site.

Very few unimpacted floodplains remain in the region, probably for similar reasons to those given above. Despite this type of floodplain (temporarily inundated channelled valley bottom floodplains without footslope seepage wetlands) being numerous in the region, it is the cumulative effect of these high levels of degradation that is of concern, particularly from a hydrological viewpoint. As a result, it is speculated that a large part of the functionality of these systems in the catchment has been lost. Those floodplains that are still in largely natural condition are thus of elevated importance.

Despite the large number of pans in the region, it is the cumulative impact relating to threats that is significant. It is unclear as to how many pans have been lost in the region. For pans in particular, loss is not simply a measure of the loss of surface area, but includes loss as a result of other factors such as their use as evaporation features for waste water from mines, for example. Others include changes in wetting regimes and extent as a result of draining from undermining and water abstraction, while others occur as a result of changes of land-use or development of the basin or catchment area of the pan which is generally closely related to the footprint of the pan itself. For these reasons, it is difficult to speculate on this aspect other than to say that due to their limited distribution, pans in general in the region are under threat.

Based on the above discussion an ecological importance and sensitivity assessment was undertaken for the wetlands on site. Ecological Importance and Sensitivity is a concept introduced in the reserve methodology to evaluate a wetland in terms of:

- Ecological Importance;
- Hydrological Functions; and
- Direct Human Benefits

These scoring assessments for these three aspects of wetland importance and sensitivity have been based on the requirements of the NWA, the original Ecological Importance and Sensitivity assessments developed for riverine assessments (DWAF, 1999), and the work conducted by Kotze et al (2008) on the assessment of wetland ecological goods and services (the WET-EcoServices tool).

The results of the EIS assessment are illustrated below.

Most of the wetlands on site are considered to be of moderate importance and sensitivity, with only those wetlands that have undergone extensive degradation being considered of low importance. It is however important to point out that all wetlands, irrespective of their state of degradation, are considered as sensitive landscapes and reflect the movement of water through the landscape.

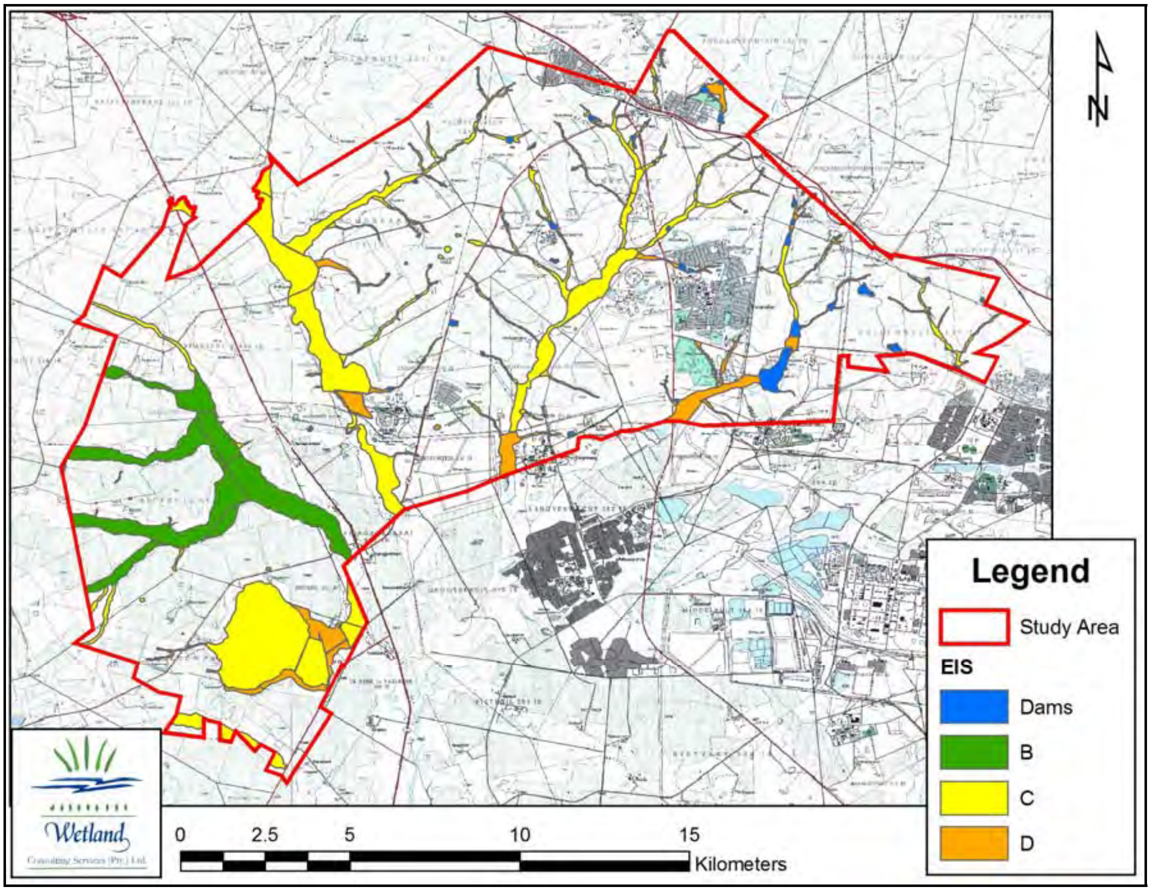


Figure 14. Map showing the results of the EIS assessment.

Table 6. Results of the EIS assessment.

EIS	Area (ha)	% of total wetlands
B	865.58	27.19%
C	1917.43	60.23%
D	400.32	12.58%
TOTAL	3185.89	100.00%

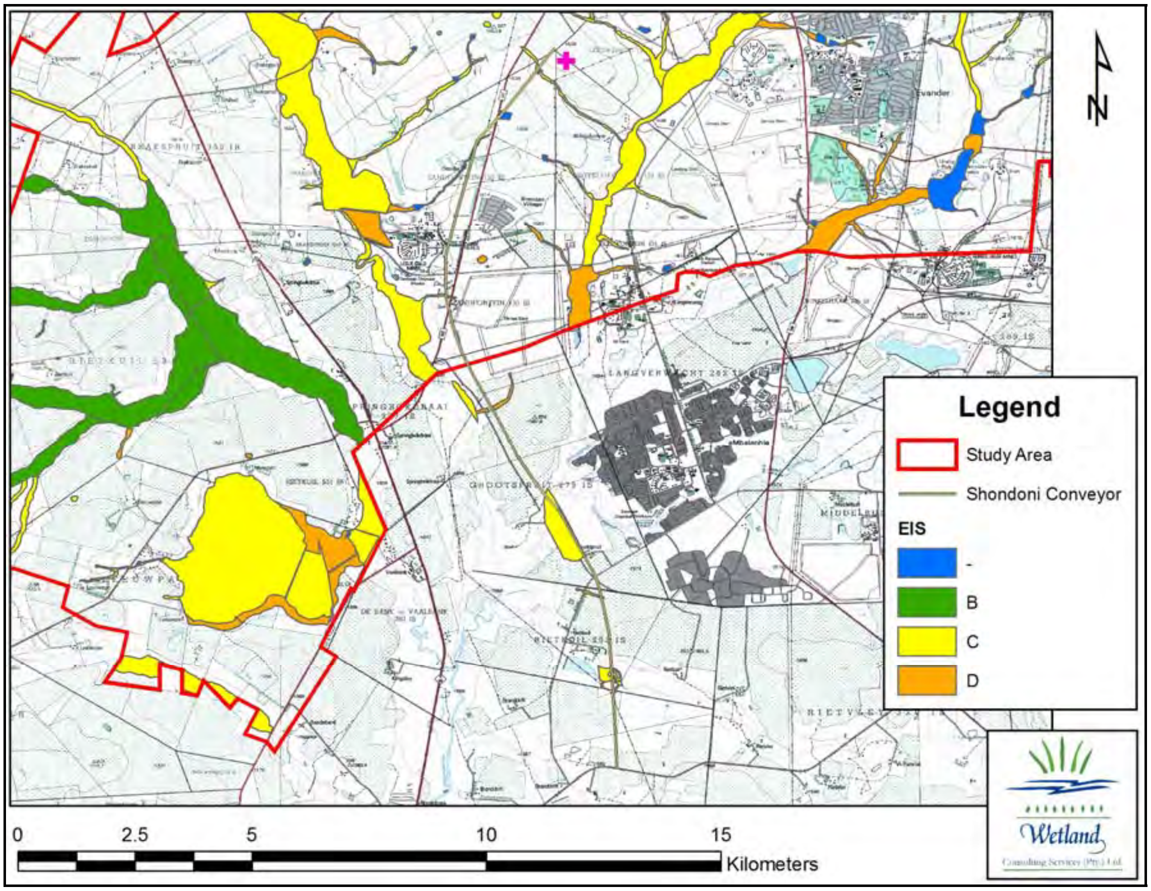


Figure 15. EIS results for the wetlands along the conveyor route.

Table 7. Table showing the scoring system used in the EIS assessment.

Ecological Importance and Sensitivity categories	Range of Median	Ecological Management Class
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	>3 and <=4	A
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3	B
Moderate Wetland that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and <=2	C
Low/marginal	>0 and <=1	D

Wetlands that is not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.

7. SUMMARY OF FINDINGS

A detailed wetland assessment was undertaken for the Middelbult Block EMPR in 2002 by Wetland Consulting Services. The current study, the field work for which was undertaken in June 2010, was commissioned to extend the wetland information contained within the 2002 Report to an additional three areas (Northern, Leeupan and Springbokdraai Reserves respectively), and to then combine this information with that contained within the 2002 Report and produce on single report for inclusion in the Sasol Mining Middelbult (Block 8) Shondoni Project EIA and EMPR currently undertaken by JMA Consulting. As such, this report quotes extensively from the 2002 Report (attached in Appendix 2), but also adds some additional information.

Given the geology and soils characteristics of the study area which markedly influence that way that water moves through the landscape, the wetland area within the study site is limited in extent to approximately 3 185ha, or 13.8% of the study area. This is less than what is generally encountered in the Upper Olifants catchment of the Mpumalanga Highveld, but is due to the nature of the soils of the area (mostly vertic clay soils) that encourage run-off, with only limited infiltration and retention of water within the landscape. This is reflected within the vegetation of many of the wetlands on site where facultative dryland species, facultative species and facultative wetlands species are more common and cover far more extensive areas that obligate wetland species.

The study found that most of the wetlands on site have been moderately modified due to a range of impacts, including agricultural practices, infrastructure developments, urbanisation and mining related activities. This has resulted in no pristine wetlands being found on site and the majority of wetlands are considered to be of moderate importance and sensitivity.

Nonetheless, it is important to point out that all water resources, irrespective of their state of degradation are considered sensitive landscapes and that ***any activity which is contemplated and which will impact on the wetlands within the study area is subject to authorisation under Section 21 of the National Water Act (Act 36, 1998). As such, all proposed wetland crossings will require a Water Use License.***

8. IMPACT ASSESSMENT

8.1 Project Description

The proposed Sasol Mining Middelbult (Block 8) Shondoni Project involves the construction and operation of a new shaft complex (Shondoni Shaft), the underground mining of coal (No. 2 & 4 seams) and a coal conveyor from the shaft complex to the existing Bankspruit conveyor to the south. The location of the various activities is illustrated in the map below.

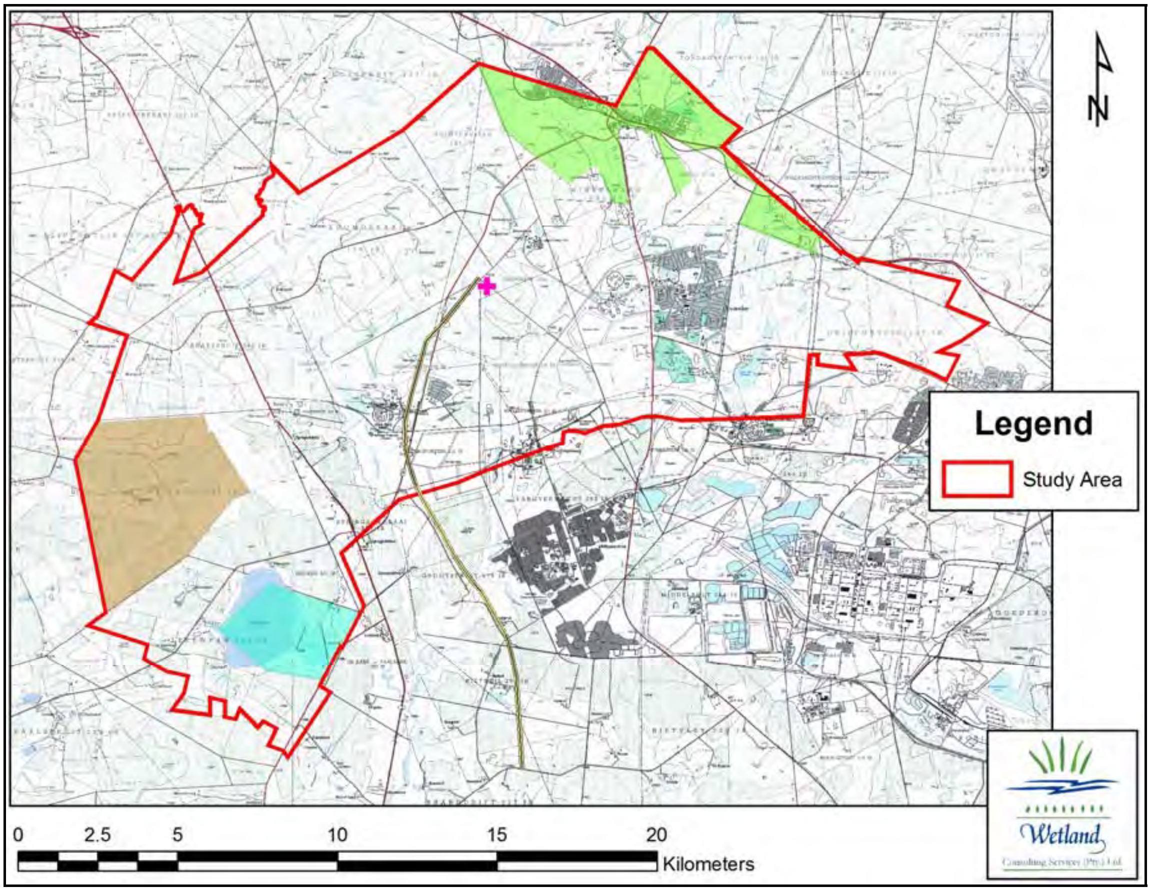


Figure 16. Map showing the location of the proposed surface infrastructure associated with the Shondoni Shaft.

The Shondoni shaft complex will include the following infrastructure:

- Access road
- Offices/workshops/wash bay/stores/change houses
- Internal roads and parking areas
- Electrical substation
- Fuel storage
- Soils/overburden stockpiles
- Water infrastructure (incl. pollution control dams, stormwater infrastructure, process water dams, domestic water supply etc)
- Sewage treatment plant
- People and materials shaft
- Ventilation shafts
- Decline shaft

A detailed project description is provided in the full EIA report (Chapters 1-4) compiled for the project by JMA Consulting, and is not reproduced here to minimise duplication.

8.2 Impact Assessment Methodology

The methodology utilised to assess was the methodology supplied by JMA Consulting. This methodology is explained in detail in the full EIA report compiled for the project by JMA Consulting, and is not reproduced here to minimise duplication. A short discussion is however provided.

The methodology makes use of the Sasol risk rating methodology and determines the severity of impacts by assessing them in terms of the following criteria:

- Quantity (volume, concentration or decibels)
- Toxicity
- Extent
- Duration
- Status
- Legislation
- I & AP's

Given these criteria, it was not always easy to apply the methodology to impacts such as "habitat fragmentation" or "loss of habitat" where no toxic substances were involved or where quantity in terms of volume or concentration is not really applicable. In such cases the toxicity was rated as 0 (non-hazardous) and the quantity, where the impact was continuous in nature, was rated as 4 (more than 1000m^3 per incident/continuous or >120mg/m3 or >85dBa).

8.3 Assumptions and Limitations

The impact assessment is based on the baseline information contained within this report, which is made up of data collected in the field during 2010, as well as data contained in the wetland report compiled in 2004.

The project description used for the impact assessment was taken from Chapters 1-4 of the Sasol Mining Middelbult-Shondoni Environmental Impact Assessment report compiled by JMA Consulting.

The impact assessment methodology was used as provided by JMA Consulting.

8.4 Impact Assessment

The detailed impact assessments, together with detailed mitigation measures, are contained within the Excel Spreadsheet provided together with this report and are reproduced in the table in Section 8.4.5 below. Impacts were assessed for each of the 4 identified project phases, namely: construction, operation, decommissioning and post closure. A short paragraph highlighting the most significant impacts associated with each of the identified phases is provided in the following sections.

8.4.1 Construction Phase

Most of the impacts associated with the construction phase of the shaft area are related to the clearing of vegetation and the disturbances to the soils, exposing the soils to erosion and resulting in increased surface run-off from these areas. Some direct impacts on wetlands and wetland loss are expected where the infrastructure development takes place within the wetland boundaries (i.e. where the development footprint intrudes into the wetland areas), but also indirect impacts where increased surface run-off from development areas adjacent to wetlands alters the hydrology supporting the wetlands, and increased sediment movement into the wetlands alters water quality (e.g. suspended solids and turbidity). Spills and waste associated with construction activities could further result in water quality deterioration.

Most of the negative impacts associated with the conveyor route will take place during the construction process, where earthworks and clearing of vegetation, especially where it takes place within the wetlands, could result in erosion, flow concentration, and deterioration in water quality.

The impact on wetlands of construction activities taking place underground should not be significant, unless water removed from underground is discharged into any wetlands on site. It has however been indicated that this will not take place.

8.4.2 Operational Phase

Operational impacts associated with the shaft area consist mostly of water quality deterioration within adjacent wetlands due to seepage and leakage of polluted water out of the dirty water management system, pollution control dams, coal stockpiles and sewage treatment plant, as well as discharge of stormwater. Disturbances to adjacent wetlands could also result through injudicious movement of vehicles and people across the site unless these sensitive systems are fenced off.

During operation, the conveyor could result in some water quality deterioration due to coal dust entering the wetlands at crossing points, as well as larger spillages due to malfunctioning of the conveyor.

The impact on wetlands of underground mining is not expected to be significant during the operational phase, except where surface subsidence occurs. Surface subsidence that occurs in wetland areas could result in an increased loss of surface water to groundwater as surface water percolates into groundwater through the cracks in the collapsed strata. This could result in desiccation of the wetlands and a resultant change in species supported by the wetland.

8.4.3 De-commissioning Phase

De-commissioning impacts are expected to be largely similar to those experienced during the construction phase as bare soil areas resulting from the removal of infrastructure result in increased surface run-off and sediment transport. Leaching of contaminants from potentially polluted soils underlying removed infrastructure could further result in deteriorating water quality.

Disturbances to the wetland soils and possibly river banks during decommissioning and removal of the conveyor at river crossings could also again result in erosion and deterioration in water quality.

The impact on wetlands of underground mining is expected to become more significant during the decommissioning phase, as surface subsidence occurs. Surface subsidence that occurs in wetland areas could result in an increased loss of surface water to groundwater as surface water percolates into groundwater through the cracks in the collapsed strata. This could result in desiccation of the wetlands and a resultant change in species supported by the wetland.

8.4.4 Post-closure Phase

The most significant impact of the proposed mining project is likely to take place during the post-closure phase as the underground workings fill up with water and start decanting. Decanting water is likely to be poor in quality, having a high salinity (Hodgson et al., 2007), and possibly also be acidic in nature. The high sodium content of mine water derived from mines in the southern part of the coalfield implies that this water cannot be used for most normal purposes and that desalination is one of the few options to improve the mine water quality. However, disposal of the brine generated during desalination without further treatment may be impossible due to environmental considerations according to Hodgson et al (2007), and crystallisation of the salt from the brine and subsequent disposal in proper waste sites would add considerable cost. Desalination is also a very energy intensive process, raising doubts about the sustainability of such a solution.

8.4.5 Impact Assessment Tables

Table 8. Impact Assessment for the Construction Phase

Environmental Component	Activity Description	Impact Identification/Description	Criteria for Determining Severity: Quantity	Toxicity	Extent	Duration	Status	Legislation	I & AP's	SEVERITY TOTAL	SEVERITY C-NUMBER	Degree Of Likelihood	Risk Level Before Mitigation	Mitigatory Difficulty	Mitigation/ Management Objective	Proposed Mitigation Measure	Severity Total After Mitigation - C Number	Risk Level After Mitigation
Wetlands	LISTED ACTIVITIES AT SHONDONI IN TERMS OF NEMA (ACT 107 OF 1998): GN 386 ACTIVITIES		LISTED ACTIVITIES AT SHONDONI IN TERMS OF NEMA (ACT 107 OF 1998): GN 386 ACTIVITIES															
	Coal throw out stockpile area at Shondoni Shaft with a storage of more than 250 tons but less than 100 000 tons - Activity 1 (c).	Construction will involve the clearing of vegetation as well as earth works (excavation, compaction, levelling etc.). Impacts resulting from these activities will include, loss of wetland habitat, increased sediment movement into adjacent wetlands, deterioration in water quality, and increased surface run-off that could lead to erosion.	4	1	1	1	1	2	2	12	C3	P7	Level 4	Low	Prevent loss of wetland habitat and minimise degradation of habitat.	Locate coal throwout stockpile outside the delineated wetland areas on site, with a minimum 50m buffer between the stockpile and the wetlands to allow space for implementation of mitigation measures during operational phase. Limit vegetation clearing to the actual footprint of the proposed stockpile. Fence off wetland areas prior to construction activities commencing to prevent access into the wetland aeras by heavy machinery and vehicles. Undertake construction activities in winter to minimise sediment transport due to run-off after rainfall events. Re-vegetate all bare areas not directly within the footprint of the developments as soon as possible.	4	Level 6
	Conveyor Pedestal for crossing of Trichardt Spruit (in the 1:10 year flood line) - Activity 1 (m).	Construction of the conveyor pedestal within the Trichardtspruit floodplain wetland will result in some loss of wetland habitat, increased erosion risk within the wetland, increase in suspended solids and turbidity downstream of the construction site and an increase in alien and weedy species within the wetland.	1	1	1	0	1	2	2	8	C2	P7	Level 5	Moderate	Minimise erosion and sediment loss during construction process.	Undertake construction work during the dry season when the Trichardtspruit is charaterised by low flows. Locate the conveyor pedestal outside the active channel of the Trichardtspruit. Locate all material stockpiles and consturctors camps outside the wetland area. Limit activities to the width of the conveyor servitude to prevent injudicious driving within the wetland. Re-vegetate bare soil areas and landscape back to the natural wetland/river profile.	4	Level 6

	Service Water Dams and Storm Water Pollution Control Dam at Shondoni Shaft Complex with a capacity of 50 000 cubic metres or more - Activity 1 (n).	Construction will involve the clearing of vegetation as well as earth works (excavation, compaction, levelling etc.). Impacts resulting from these activities will include, loss of wetland habitat, increased sediment movement into adjacent wetlands, deterioration in water quality, and increased surface run-off that could lead to erosion.	4	1	1	1	1	2	2	12	C3	P7	Level 4	Low	Prevent loss of wetland habitat and minimise degradation of habitat.	Locate dams outside the delineated wetland areas on site, with a minimum 50m buffer between the dams and the wetlands to allow space for implementation of mitigation measures during operational phase. Limit vegetation clearing to the actual footprint of the proposed dams Fence off wetland areas prior to construction activities commencing to prevent access into the wetland aeras by heavy machinery and vehicles. Undertake construction activities in winter to minimise sediment transport due to run-off after rainfall events. Re-vegetate all bare soil areas not directly within the footprint of the developments as soon as possible.	4	Level 6
	Excavation for Coal Conveyor Pedestal for crossing of Trichardt Spruit, removing more than 5 cubic meters of material - Activity 4.	Construction of the conveyor pedestal within the Trichardtspruit floodplain wetland will result in some loss of wetland habitat, increased erosion risk within the wetland, increase in suspended solids and turbidity downstream of the construction site and an increase in alien and weedy species within the wetland.	1	1	1	0	1	2	2	8	C2	P7	Level 5	Moderate	Minimise erosion and sediment loss during construction process.	Undertake construction work during the dry season when the Trichardtspruit is charaterised by low flows. Locate the conveyor pedestal outside the active channel of the Trichardtspruit. Locate all material stockpiles and consturctors camps outside the wetland area. Limit activities to the width of the conveyor servitude to prevent injudicious driving within the wetland. Re-vegetate bare soil areas and landscape back to the natural wetland/river profile.	4	Level 6
	Diesel Fuel Storage Tanks at Shondoni Shaft Complex with a combined capacity of more than 30 cubic metres but less than 1 000 cubic metres - Activity 7.	Construction will involve the clearing of vegetation as well as earth works (excavation, compaction, levelling etc.). Impacts resulting from these activities will include, loss of wetland habitat, increased sediment movement into adjacent wetlands, deterioration in water quality, and increased surface run-off that could lead to erosion.	4	1	1	1	1	2	2	12	C3	P7	Level 4	Low	Prevent loss of wetland habitat and minimise degradation of habitat.	Locate tanks outside the delineated wetland areas on site, with a minimum 50m buffer between the tanks and the wetlands to allow space for implementation of mitigation measures during operational phase. Limit vegetation clearing to the actual footprint of the proposed tanks. Fence off wetland areas prior to construction activities commencing to prevent access into the wetland aeras by heavy machinery and vehicles. Undertake construction activities in winter to minimise sediment transport due to run-off after rainfall events. Re-vegetate all bare soil areas not directly within the footprint of the developments as soon as possible.	4	Level 6
	Removal of Indigenous Vegetation of 3 hectares or more during Site Clearance for Construction of Shondoni Shaft Complex and related Infrastructure - Activity 12.	Clearing of vegetation will result in a loss of wetland habitat	4	n/a	1	2	1	2	2	12	C3	P7	Level 4	High	Prevent loss of wetland vegetation	No wetland vegetation should be cleared as part of the vegetation clearing process. Wetlands should be fenced off to prevent access prior to starting the clearing of vegetation.	0	Level 6

	Removal of water found in the underground workings on the No.4 Seam and the No.2 Seam workings to facilitate the efficient continuation of mining and for the safety of people - Activity 13.	Removal of water from the underground workings per se is not expected to have any impact on the wetlands of the area, as these wetlands are considered to be supported by surface water. However, release of this water into any water resource is likely to result in changes to the hydrology (flow volumes and velocities) of the receiving water resource, a change in water quality as well as an increased erosion risk.	4	1	2	2	1	2	2	14	C4	P7	Level 3	Low	Prevent release of water from the underground workings into any water resource	No water pumped out of the underground workings may be discharged into any water resource. A storage dam for water derived rom the underground workings should be constructed on site to store this water. The water should be re-used as process water on the mine.	2	Level 6
	Installation of a Tetra Radio System above ground at the Shaft Complex Area - Activity 14.	Construction will involve the clearing of vegetation as well as earth works (excavation, compaction, levelling etc.). Impacts resulting from these activities will include, loss of wetland habitat, increased sediment movement into adjacent wetlands, deterioration in water quality, and increased surface run-off that could lead to erosion.	4	1	1	1	1	2	2	12	C3	P7	Level 4	Low	Prevent loss of wetland habitat and minimise degradation of habitat.	Locate radio station outside the delineated wetland areas on site, with a minimum 50m buffer between the radio station and the wetlands to allow space for implementation of mitigation measures during operational phase. Limit vegetation clearing to the actual footprint of the proposed radio station. Fence off wetland areas prior to construction activities commencing to prevent access into the wetland aeras by heavy machinery and vehicles. Undertake construction activities in winter to minimise sediment transport due to run-off after rainfall events. Re-vegetate all bare areas not directly within the footprint of the developments as soon as possible.	4	Level 6
	Construction of an Access Road (wider than 4m) to Shondoni Shaft Complex from Tar road R547 - Activity 15.	Construction will involve the clearing of vegetation as well as earth works (excavation, compaction, levelling etc.). Impacts resulting from these activities will include, loss of wetland habitat, increased sediment movement into adjacent wetlands, deterioration in water quality, and increased surface run-off that could lead to erosion.	4	1	1	1	1	2	2	12	C3	P7	Level 4	Low	Prevent loss of wetland habitat and minimise degradation of habitat.	Locate road outside the delineated wetland areas as far as possible. Limit vegetation clearing to the actual footprint of the proposed road. Fence off wetland areas prior to construction activities commencing to prevent access into the wetland aeras by heavy machinery and vehicles. Undertake construction activities in winter to minimise sediment transport due to run-off after rainfall events. Re-vegetate all bare areas not directly within the footprint of the developments as soon as possible. Where the access road needs to cross any wetlands, crossings should take place perpendicular to the direction of flow. No flow concentration should be allowed to take place and no impoundment upslope of the crossings. In this regard sufficient culverts should be placed along the full width of the wetland to ensure continued wetting of the entire wetness front.	4	Level 6
	LISTED ACTIVITIES AT SHONDONI IN TERMS OF NEMA (ACT 107 OF 1998): GN 387 ACTIVITIES		**LISTED ACTIVITIES AT SHONDONI IN TERMS OF NEMA (ACT 107 OF 1998): GN 387 ACTIVITIES**															

	Construction of a Double Circuit 132 kV Overhead Poweline from Eskom Supply Point (SOL B) to Shondoni Mine Transmission Feeder Bays - Activity 1 (l).	Construction of the powerline pylons and associated service road will result in some loss of wetland vegetation, increased erosion risk where consturction takes place within wetland areas, as well as increased sediment movement into the wetlands. The powerline will further pose a hazard to larger waterbirds found within the wetlands on site.	4	1	1	2	1	2	2	13	C3	P7	Level 4		Prevent loss of wetland habitat and minimise degradation of habitat.	Powerline pylons should be located outside delineated wetland areas. Service road should not cross wetlands - access should be from either side of the wetland and along existing roads as far as possible. Limit vegetation clearing to the actual footprint of the proposed road. Fence off wetland areas prior to construction activities commencing to prevent access into the wetland aeras by heavy machinery and vehicles. Undertake construction activities in winter to minimise sediment transport due to run-off after rainfall events. Re-vegetate all bare areas not directly within the footprint of the developments as soon as possible.	4	Level 6
	Construction of a Coal Conveyor from Shondoni Shaft to Middelbult Main Shaft (to the central Sasol Coal Supply area) at a rate of more than 50 cubic meters per day - Activity 1 (j).	Construction will involve the clearing of vegetation as well as earth works (excavation, compaction, levelling etc.). Impacts resulting from these activities will include, loss of wetland habitat, increased sediment movement into adjacent wetlands, deterioration in water quality, and increased surface run-off that could lead to erosion.	4	1	1	1	1	2	2	12	C3	P7	Level 4	Low	Prevent loss of wetland habitat and minimise degradation of habitat.	Ideally the conveyor route should follow paths of existing disturbance such as existing roads, Where the conveyor crosses wetlands, some wetland loss will be unavoidable. However, to minimise impacts, conveyor pedestals should be located outside the active channels of rivers; the conveyor should follw the landscape profile and now infilling or cuts should be allowed; conveyor crossings should not result in concentration of flows or significant changes to floodlines. Limit vegetation clearing to the actual footprint of the proposed stockpile. Fence off wetland areas prior to construction activities commencing to prevent access into the wetland aeras by heavy machinery and vehicles. Undertake construction activities in winter to minimise sediment transport due to run-off after rainfall events. Re-vegetate all bare areas not directly within the footprint of the developments as soon as possible.	4	Level 6
	Development of an area including shaft surface infrastructure and conveyor route where more than 20 hectares is disturbed - Activity 2.	Construction will involve the clearing of vegetation as well as earth works (excavation, compaction, levelling etc.). Impacts resulting from these activities will include, loss of wetland habitat, increased sediment movement into adjacent wetlands, deterioration in water quality, and increased surface run-off that could lead to erosion.	4	1	1	1	1	2	2	12	C3	P7	Level 4	Low	Prevent loss of wetland habitat and minimise degradation of habitat.	Locate shaft area outside the delineated wetland areas on site, with a minimum 50m buffer between the shaft area and the wetlands to allow space for implementation of mitigation measures during operational phase. Limit vegetation clearing to the actual footprint of the proposed shaft area. Fence off wetland areas prior to construction activities commencing to prevent access into the wetland aeras by heavy machinery and vehicles. Undertake construction activities in winter to minimise sediment transport due to run-off after rainfall events. Re-vegetate all bare areas not directly within the footprint of the developments as soon as possible.	4	Level 6

	NATIONAL WATER ACT (ACT 36 OF 1998): SECTION 40		NATIONAL WATER ACT (ACT 36 OF 1998): SECTION 40															
	Taking water from a water resource - Section 21 (a).	Where water is taken from a groundwater source on site, no significant impact is expected to the wetlands. Where water is taken from a wetland, decreased flows within the affected wetland could result in a change in species composition of the biodiversity associated with that wetland.	3	0	1	0	1	2	2	9	C2	P7	Level 5	Low	Prevent abstraction of water from any wetlands on site.	No water abstraction should be allowed from any of the wetlands on site. Domestic water should be supplied by Rand Water, while process water should be derived from underground workings. No surface waters on site should be utilised as water sources for dust supression, unless authorised by a water use licence.	0	Level 6
	Impeding or diverting the flow of water in a watercourse - Section 21 (c).	Any activities that impede or impound flows within the wetlands on site could result in changes to the wetland hydrology, resulting in increased erosion risk where flow concentration has taken place, while extended saturation due to impoundment of flows could result in changes to species composition.	4	1	1	2	1	3	3	15	C4	P7	Level 3	Moderate	Prevent concentration of flows and increase in flow velocities downstream of crossings, and impoundment upslope of crossings.	No infrastructure should be located within the identified wetland areas on site, other than where the access road and conveyor route have to cross wetlands. Crossings should strive to maintain the predevelopment flows. This will require numerous culverts across the full width of wetlands in the case of the road crossing to prevent concentration and impoundment of flows. In terms of the conveyor, no conveyor footings should be located within the active channel of any water course. Post construction, the wetlands should be relandscaped to the natural landscape profile and re-vegetated with indigenous species.	5	Level 6
	Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit - Section 21 (f).	Deterioration in water quality as well as altered hydrology are likely to result from the discharge of water containing waste, resulting in changes to the species composition of aquatic fauna as sensitive taxa are lost, as well as increased sediment transport and erosion due to increased flows.	4	2	2	1	1	3	3	16	C4	P7	Level 3	Moderate	Prevent deterioration in water quality of the receiving water resource	Ideally no water containing waste should be discharged into any wetlands on site. Waste water should be treated and re-used on site. Should it become necessary to discharge any water, this water will have to comply with the applicable water quality standards.	5	Level 6
	Disposing of waste in a manner which may detrimentally impact on a water resource - Section 21 (g).	Waste disposal could result in a deterioration of water quality.	4	2	2	1	1	3	3	16	C4	P7	Level 3	Moderate	Prevent deterioration in water quality of the adjacent water resource	Waste should be disposed of in registered waste disposal sites. No waste disposal should take place on site. Temporary storage of waste on site should take place within a bunded area located within the dirty water area.	5	Level 6
	Altering the bed, banks, course or characteristics of a watercourse - Section 21 (i).	Any activity altering the bed, banks or characteristics of a water resource could result in loss of wetland habitat, increased erosion risk and sediment transport, water quality deterioration (increase in suspended solids and turbidity) and an increase in alien vegetation due to disturbance.	4	1	1	2	1	3	3	15	C4	P7	Level 3	High	Minimise erosion and sediment loss during construction process.	With the exception of the wetland crossings associated with the access road and coal conveyor, no infrastructure should be located within the wetlands on site. Wetland crossings should not result in flow concentration or alterations to the floodlines of drainage lines and rivers. Construction should be undertaken during low flow periods. No conveyor footings should be located in the active channel of any rivers or streams.	5	Level 6
	Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people -	Removal of water from the underground workings per se is not expected to have any impact on the wetlands of the area, as these wetlands are considered to be supported by surface water. However, release of this water into any water resource is likely to result in changes to the hydrology (flow volumes and velocities) of the receiving water resource, a	4	1	2	2	1	3	3	16	C4	P7	Level 3	Low	Prevent deterioration of water quality and changes to hydrology.	No discharge of water from underground in any water resources should take place. Water should be stored on site and used a process water during operation.	3	Level 6

	Section 21 (j).	change in water quality as well as an increased erosion risk.																
	Exemptions from GNR 704		**Exemptions from GNR 704**															
	No person in control of a mine or activity may locate or place any residue deposit, dam, reservoir together with any associated structure or any other facility within the 1:100 year flood line or within a horizontal distance of 100 metres from any water course or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked - Regulation 4(a).	Construction of any of the listed activities (residue deposit, dam, reservoir together with any associated structure or any other facility) within the 1:100 year floodline of any of the watercourses on site could result in loss of wetland habitat, increased sediment movement into adjacent wetlands, deterioration in water quality, and increased surface run-off that could lead to erosion.	4	1	1	1	1	2	2	12	C3	P7	Level 4	Low	Prevent loss of wetland habitat and minimise degradation of habitat.	Locate infrastructure outside the delineated wetland areas on site, with a minimum 50m buffer between the infrastructure and the wetlands to allow space for implementation of mitigation measures during operational phase. Limit vegetation clearing to the actual footprint of the proposed infrastructure. Fence off wetland areas prior to construction activities commencing to prevent access into the wetland aeras by heavy machinery and vehicles. Undertake construction activities in winter to minimise sediment transport due to run-off after rainfall events. Re-vegetate all bare areas not directly within the footprint of the developments as soon as possible.	4	Level 6
	No person in control of a mine or activity may, except in relation to a matter contemplated in Regulation 10 (winning sand and alluvial minerals), carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50 year flood line or within a horizontal distance of 100 metres from any water course or estuary, whichever is the greatest - Regulation 4(b).	Mining underneath the wetlands on site could result in collapse of the strata overlying the mine, resulting in surface subsidence. This could impact on the wetlands on site through the increased infiltration of surface water into groundwater, resulting in decreased flows within the wetlands and associated dessication of the wetland habitat. New wetland areas could also be created where subsidence leads to the formation of depressions and inwardly draining areas within the landscape. This could further reduce flows within the wetlands as water is isoloated from the main drainage lines. However, these impacts would only becoem apparent during the operational phase and post-closure phases. No impact is expected during the construction phase due to undermining of the wetlands. Construction of any infrastructure within the 1:50 year floodline of any of the watercourses on site could result in loss of wetland habitat, increased sediment movement into adjacent wetlands, deterioration in water quality, and increased surface run-off that could lead to erosion.	4	1	1	1	1	2	2	12	C3	P7	Level 4	Low	Prevent loss of wetland habitat and minimise degradation of habitat.	Locate infrastructure outside the delineated wetland areas on site, with a minimum 50m buffer between the infrastructure and the wetlands to allow space for implementation of mitigation measures during operational phase. Limit vegetation clearing to the actual footprint of the proposed infrastructure. Fence off wetland areas prior to construction activities commencing to prevent access into the wetland aeras by heavy machinery and vehicles. Undertake construction activities in winter to minimise sediment transport due to run-off after rainfall events. Re-vegetate all bare areas not directly within the footprint of the developments as soon as possible.	4	Level 6

	No person in control of a mine or activity may use any area or locate any sanitary convenience, fuel depots, reservoir or depots for any substance which causes or is likely to cause pollution of a water resource within the 1:50 year flood line of any water course or estuary - Regulation 4(d).	Construction of any of the listed activities (sanitary convenience, fuel depots, reservoir or depots for any substance which causes or is likely to cause pollution of a water resource) within the 1:100 year floodline of any of the watercourses on site could result in loss of wetland habitat, increased sediment movement into adjacent wetlands, deterioration in water quality, and increased surface run-off that could lead to erosion.	4	1	1	1	1	2	2	12	C3	P7	Level 4	Low	Prevent loss of wetland habitat and minimise degradation of habitat.	Locate infrastructure outside the delineated wetland areas on site, with a minimum 50m buffer between the infrastructure and the wetlands to allow space for implementation of mitigation measures during operational phase. Limit vegetation clearing to the actual footprint of the proposed infrastructure. Fence off wetland areas prior to construction activities commencing to prevent access into the wetland aeras by heavy machinery and vehicles. Undertake construction activities in winter to minimise sediment transport due to run-off after rainfall events. Re-vegetate all bare areas not directly within the footprint of the developments as soon as possible.	4	Level 6
	No person in control of a mine or activity may use any residue or substance which causes or is likely to cause pollution of a water resource for the construction of any dam or other impoundment or any embankment, road or railway, or for any other purpose which is likely to cause pollution of a water resource - Regulation 5.	Using residue or substances likely to cause pollution to construct any dam, impoundment, embankment, berm, road or railway etc. is likely to result in deterioration of water quality.	4	2	2	2	1	3	3	17	C5	P6	Level 2	Moderate	Prevent deterioration of water quality.	Ideally no pollution causing residue or substance should be used to construct any berms, dams, embankments etc, as per GN 704. Should this however have to be done, all infrastructure constructed from material that might cause pollution should be located within the dirty water area of the mine so that polluted water will be trapped in the pollution control dams.	10	Level 5
	NATIONAL ENVIRONMENTAL MANAGEMENT ACT: WASTE ACT, ACT NO. 59 OF 2008		**NATIONAL ENVIRONMENTAL MANAGEMENT ACT: WASTE ACT, ACT NO. 59 OF 2008**															
	NEMWA Section 19(3) and GN 718.	The construction of a sewage treatment facility will result in the clearing of vegetation and compaction and excavation of soils. This could result in a loss of wetland habitat as well as deterioration of water quality through increased sediment transport into the wetlands.	4	1	1	1	1	2	2	12	C3	P7	Level 4	Low	Prevent loss of wetland habitat and minimise degradation of habitat.	Locate infrastructure outside the delineated wetland areas on site, with a minimum 50m buffer between the infrastructure and the wetlands to allow space for implementation of mitigation measures during operational phase. Limit vegetation clearing to the actual footprint of the proposed infrastructure. Fence off wetland areas prior to construction activities commencing to prevent access into the wetland aeras by heavy machinery and vehicles. Undertake construction activities in winter to minimise sediment transport due to run-off after rainfall events. Re-vegetate all bare areas not directly within the footprint of the developments as soon as possible.	4	Level 6
	SHONDONI SHAFT AREA		**SHONDONI SHAFT AREA**															

	Construction of shaft area	Loss of wetlands will occur where the shaft area intrudes on the wetlands on site.	4	0	1	3	1	3	3	15	C4	P7	Level 3	Low	Prevent loss of wetland habitat and minimise degradation of habitat.	Locate infrastructure outside the delineated wetland areas on site, with a minimum 50m buffer between the infrastructure and the wetlands to allow space for implementation of mitigation measures during operational phase. Limit vegetation clearing to the actual footprint of the proposed infrastructure. Fence off wetland areas prior to construction activities commencing to prevent access into the wetland aeras by heavy machinery and vehicles. Undertake construction activities in winter to minimise sediment transport due to run-off after rainfall events. Re-vegetate all bare areas not directly within the footprint of the developments as soon as possible.	4	Level 6
	Construction of shaft area	Clearing of vegetation and earth works will result in increased surface run-off and increased sediment transport into the adjacent water resources, including wetlands.	4	1	1	0	1	3	2	12	C3	P7	Level 4	Moderate	Minimise sediment movement off the site.	Construction activities should take place in winter. Construction activities should be limited to the actual footprint of the development. Bare soil areas should be landscaped to the natural landscape profile and re-vegetated immediately. Dust suppression measures should be implemented.	4	Level 6
	Construction of shaft area	Disturbance to wetlands adjacent to the construction area could result in displacement of species and an increase in alien vegetation.	4	0	1	2	1	2	2	12	C3	P7	Level 4	Moderate	Prevent colonisation of disturbed ares by alien vegetation.	Construction activities should take place in winter. Construction activities should be limited to the actual footprint of the development. Bare soil areas should be landscaped to the natural landscape profile and re-vegetated immediately. Dust suppression measures should be implemented. Alien vegetation should be cleared from site with regular, long-term follow up by suitably trained staff.	4	Level 6
	Construction of shaft area	Deterioration in water quality could result as a consequence of spillages of hazardous materials on site, as well as from run-off from materials stockpiles and littering.	1	2	2	0	1	2	3	11	C3	P7	Level 4	Low	Prevent deterioration in water quality due to spillages	All hazardous substances should be stored in desiganted areas on bunded surfaces within the dirty water area of the mine. Spillages should be reported and cleaned up immediately. If spillages enter any water resources on site, the DWA should be informed immediately and suitably qualified professionals employed to clean up the spill.	4	Level 6
	UNDERGROUND MINING ACTIVITIES OF THE NO.S 2 AND 4 COAL SEAM		**UNDERGROUND MINING ACTIVITIES OF THE NO.S 2 AND 4 COAL SEAM**															
	Construction of the underground mine	During construction of the underground mine it is likely that groundwater will be pumped out of the workings. Release of this water could result in deteriorating water quality and altered flows within receiving water resources.	4	1	2	2	1	3	3	16	C4	P7	Level 3	Low	Prevent deterioration of water quality and changes to hydrology.	No discharge of water from underground in any water resources should take place. Water should be stored on site and used a process water during operation.	3	Level 6
	Construction of the underground mine	No surface disturbance will take place during construction of the underground mine. Any surface disturbance that might take place will be associated with the construction of the shaft area, dealt with above. As such, no further impacts are expected from construction of the underground mine.								0								
	CONVEYOR BELT ROUTE		**CONVEYOR BELT ROUTE**															

	Construction of the conveyor belt	Loss of wetland habitat will occur within the direct footprint of the conveyor servitude	4	0	2	2	1	3	2	14	C4	P7	Level 3	High	Minimise loss and disturbance of wetland habitat	As the conveyor will need to cross several wetlands, some wetland loss is unavoidable. At river crossings, construction activities should be limited to the width of the conveyor servitude. No activities should take place within the active channel of any wetlands. All material stockpiles, construction camps and vehicle turning circles should be located outside the wetland areas. Construction activities should take place in winter. Construction activities should be limited to the actual footprint of the development. Bare soil areas should be landscaped to the natural landscape profile and re-vegetated immediately. Dust suppression measures should be implemented. Alien vegetation should be cleared from site with regular, long-term follow up by suitably trained staff.	12	Level4
	Construction of the conveyor belt	Clearing of vegetation and earth works will result in increased surface run-off and increased sediment transport into the adjacent water resources, including wetlands. This will be especially significant on the approach and departure slopes to valley bottoms.	4	1	1	0	1	3	2	12	C3	P7	Level 4	Moderate	Minimise sediment movement off the site.	Construction activities should take place in winter. Construction activities should be limited to the actual footprint of the development. Bare soil areas should be landscaped to the natural landscape profile and re-vegetated immediately. Dust suppression measures should be implemented.	4	Level 6
	Construction of the conveyor belt	Increased erosion risks within the wetlands were conveyor pedestals are consturcuted within the wetlands (e.g. within the 1:10 year floodline of the Trichardtspruit) due to disturbance of sediments and concentration of flows.	4	0	2	2	1	3	2	14	C4	P6	Level 3	Moderate	Prevent concentration of flows during normal flows and regular return storm events	No conveyor pedestals should be located within the active channel of any wetland on site.	12	Level 5
	Construction of the conveyor belt	Increased erosion risk on the approach and departure slopes to valley bottom and floodplain wetlands due to the preferential flow path provided by the service road adjacent to the conveyor route.	4	1	1	0	1	3	2	12	C3	P7	Level 4	Moderate	Minimise sediment movement off the site.	Construction activities should take place in winter. Construction activities should be limited to the actual footprint of the development. Bare soil areas should be landscaped to the natural landscape profile and re-vegetated immediately. Dust suppression measures should be implemented.	4	Level 6
	Construction of the conveyor belt	Habitat fragmentation will result as a cosnesquence of the clearing of vegetation along the conveyor servitude and the setting up of fences.	4	0	2	2	1	2	2	13	C3	P7	Level 4	Moderate	Allow movement of small mammals underneath conveyor	The conveyor and associated fences should allow for the free movement of small mammals up to the size of a porcupine underneath the conveyor and through the fences.	7	Level 6

Table 9. Impact Assessment for the Operational Phase

			Criteria for Determining Severity															
Environmental Component	**Activity Description**	**Impact Identification/Description**	**Quantity**	**Toxicity**	**Extent**	**Duration**	**Status**	**Legislation**	**I & AP's**	**SEVERITY TOTAL**	**SEVERITY C-NUMBER**	**Degree Of Likelihood**	**Risk Level Before Mitigation**	**Mitigatory Difficulty**	**Mitigation/ Management Objective**	**Proposed Mitigation Measure**	**Severity Total After Mitigation - C Number**	**Risk Level After Mitigation**

	LISTED ACTIVITIES AT SHONDONI IN TERMS OF NEMA (ACT 107 OF 1998): GN 386 ACTIVITIES		LISTED ACTIVITIES AT SHONDONI IN TERMS OF NEMA (ACT 107 OF 1998): GN 386 ACTIVITIES															
Wetlands	Coal throw out stockpile area at Shondoni Shaft with a storage of more than 250 tons but less than 100 000 tons - Activity 1 (c).	Operation of the coal throw out stockpile area could result in the deterioration of water quality of adjacent wetlands through run-off from the stockpile and from dust.	4	2	1	2	1	2	3	15	C4	P6	Level 3	Moderate	Prevent water quality deterioration.	Coal throw out stockpile area should be located within the dirty water area of the shaft complex. All run-off from the coal stockpile should be captured in the pollution control dams. This water may not be discharged into the environment. The base of the coal stockpile should be sealed to prevent infiltration of polluted water into the ground. Regular monitoring of the water quality of adjacent wetlands should be undertaken. Should a deterioration in water quality be experience, immediate corrective measures will be required.	10	Level 5
	Conveyor Pedestal for crossing of Trichardt Spruit (in the 1:10 year flood line) - Activity 1 (m).	Most impacts of the conveyor pedestal are expected during the construction phase. However, if the pedestal leads to concentration of flows, this could result in erosion through the operational phase. Coal dust blown off the conveyor could result in deterioration of water quality.	4	1	2	2	1	2	2	14	C4	P6	Level 3	Moderate	Prevent erosion and water quality deterioration.	The conveyor should be covered and make use of roll-overs to prevent spillage of coal. Regular monitoring of all conveyor crossings need to be undertaken to check for signs of erosion and to clear debris that may have been caught on the conveyor pedestals. Any erosion damage observed needs to be repaired immediately and bare soil areas re-vegetated.	12	Level 5
	Service Water Dams and Storm Water Pollution Control Dam at Shondoni Shaft Complex with a capacity of 50 000 cubic metres or more - Activity 1 (n).	Leakage and seepage from the service water and storm water pollution control dams could lead to deterioration in water quality of adjacent wetlands.	4	2	1	2	1	2	3	15	C4	P6	Level 3	Moderate	Prevent water quality deterioration.	Dams should be sealed to prevent leakage. Dams should be located within the dirty water area of the shaft complex. Cut-off trenches should be installed downslope of the dams to intercept any leakage or seepage, with intercepted water being pumped back into the pollution control dams. This water may not be discharged into the environment. Stormwater pollution control dams should always be maintained at an empty level to maximise volumes of stormwater than can be captured during rainfall events. Dams will have to be regularly cleared of sediments to maintain capacity. Regular monitoring of the water quality of adjacent wetlands should be undertaken. Should a deterioration in water quality be experience, immediate corrective measures will be required.	10	Level 5
	Excavation for Coal Conveyor Pedestal for crossing of Trichardt Spruit, removing more than 5 cubic meters of material - Activity 4.	All excavation will take place during the construction phase. No excavation will take place during the operational phase, thus no impacts are expected.								0								

	Diesel Fuel Storage Tanks at Shondoni Shaft Complex with a combined capacity of more than 30 cubic metres but less than 1 000 cubic metres - Activity 7.	Deterioration in water quality due to leakages and spillages during operation.	4	2	1	2	1	2	3	15	C4	P6	Level 3	Moderate	Prevent water quality deterioration.	Diesel storage tanks as well as parking area for vehicles during re-fuelling should be located within the dirty water area of the shaft complex on designated bunded areas. All run-off from the bunded areas should be captured, and may not be discharged into any water resource. Regular monitoring of the water quality of adjacent wetlands should be undertaken. Should a deterioration in water quality be experience, immediate corrective measures will be required.	10	Level 5
	Removal of Indigenous Vegetation of 3 hectares or more during Site Clearance for Construction of Shondoni Shaft Complex and related Infrastructure - Activity 12.	This impact is limited to the construction phase. No vegetation clearing will take place during the operational phase.								0								
	Removal of water found in the underground workings on the No.4 Seam and the No.2 Seam workings to facilitate the efficient continuation of mining and for the safety of people - Activity 13.	Dewatering of the underground workings should not impact on the wetlands on site, as these are mostly maintained by surface water. However, discharge of this water into wetlands could result in deterioration of water quality and altered flows within the receving wetland.	4	1	2	2	1	2	2	14	C4	P7	Level 3	Low	Prevent release of water from the underground workings into any water resource	No water pumped out of the underground workings may be discharged into any water resource. A storage dam for water derived rom the underground workings should be constructed on site to store this water. The water should be re-used as process water on the mine.	2	Level 6
	Installation of a Tetra Radio System above ground at the Shaft Complex Area - Activity 14.	Operation of the Tetra Radio Station is not expected to have any impact on the wetlands on site. The radio station will be located within the shaft complex and all stormwater associated with the radio station will be captured in the shatf's stormwater management system.								0								
	Construction of an Access Road (wider than 4m) to Shondoni Shaft Complex from Tar road R547 - Activity 15.	Operation of the access road could result in the deterioration of water quality due to spillages from vehicles as well as stormwater run-off from the road surface. Stormwater run-off could also result in erosion within the water course and at erosion discharge points.	4	2	1	2	1	1	2	13	C3	P6	Level 5	Moderate	Prevent deterioration of water quality and erosion.	All spills should be reported and cleaned immediately by suitably trained staff. Where these spills enter any wetlands on site a suitable wetland specialist should be tasked with compiling a rehabilitatioon plan. All wetland crossings should be regularly inspected fro erosion and any erosion damage repaired. All debris should be removed from culverts and stormwater discharge points at regular intervals. Litter should eb collected along the road at once per week intervals.	8	Level 6
	LISTED ACTIVITIES AT SHONDONI IN TERMS OF NEMA (ACT 107 OF 1998): GN 387 ACTIVITIES		**LISTED ACTIVITIES AT SHONDONI IN TERMS OF NEMA (ACT 107 OF 1998): GN 387 ACTIVITIES**															
	Construction of a Double Circuit 132 kV Overhead Poweline from Eskom Supply Point (SOL B) to Shondoni Mine Transmission Feeder Bays - Activity 1 (l).	Most impacts associated with the powerlines are expected during the construction phase. If the mitigation measures for the construction phase are fully implemented, no significant impacts are expected during the operational phase.								0								

	Construction of a Coal Conveyor from Shondoni Shaft to Middelbult Main Shaft (to the central Sasol Coal Supply area) at a rate of more than 50 cubic meters per day - Activity 1 (j).	Deterioration of water quality due to spillages.	4	1	2	2	1	1	2	13	C3	P6	Level 5	Moderate	Prevent erosion and water quality deterioration.	The conveyor should be covered and make use of roll-overs to prevent spillage of coal. Spillage should be reported and cleaned up immediately. Where spillages enter a wetland, a suitable wetland specialist should compile a rehabilitation plan.	8	Level 6
	Development of an area including shaft surface infrastructure and conveyor route where more than 20 hectares is disturbed - Activity 2.	The impact of the surface disturbance associated with the shaft area are dealt with under the construction table. Operation of the shaft area will result in generation of stormwater, the discharge of which could result in erosion and water quality deterioration in receiving wetlands.	4	2	2	2	1	3	3	17	C4	P6	Level 3	Moderate	Prevent erosion and water quality deterioration.	Clean and dirty water should be separated. Only clean water may be discharged into the environment. Install erosion protection measures. Regular inspect discharge points for damage and repair if necessary.	8	Level 6
	NATIONAL WATER ACT (ACT 36 OF 1998): SECTION 40		**NATIONAL WATER ACT (ACT 36 OF 1998): SECTION 40**															
	Taking water from a water resource - Section 21 (a).	Where water is taken from a groundwater source on site, no significant impact is expected to the wetlands. Where water is taken from a wetland, decreased flows within the affected wetland could result in a change in species composition of the biodiversity associated with that wetland.	3	0	1	0	1	2	2	9	C2	P7	Level 5	Low	Prevent abstraction of water from any wetlands on site.	No water abstraction should be allowed from any of the wetlands on site. Domestic water should be supplied by Rand Water, while process water should be derived from underground workings. No surface waters on site should be utilised as water sources for dust supression, unless authorised by a water use licence.	0	Level 6
	Impeding or diverting the flow of water in a watercourse - Section 21 (c).	Any activities that impede or impound flows within the wetlands on site could result in changes to the wetland hydrology, resulting in increased erosion risk where flow concentration has taken place, while extended saturation due to impoundment of flows could result in changes to species composition.	4	1	1	2	1	3	3	15	C4	P7	Level 3	Moderate	Prevent concentration of flows and increase in flow velocities downstream of crossings, and impoundment upslope of crossings.	No infrastructure should be located within the identified wetland areas on site, other than where the access road and conveyor route have to cross wetlands. Crossings should strive to maintain the predevelopment flows. This will require numerous culverts across the full width of wetlands in the case of the road crossing to prevent concentration and impoundment of flows. In terms of the conveyor, no conveyor footings should be located within the active channel of any water course. Post construction, the wetlands should be relandscaped to the natural landscape profile and re-vegetated with indigenous species.	5	Level 6
	Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit - Section 21 (f).	Deterioration in water quality as well as altered hydrology are likely to result from the discharge of water containing waste, resulting in changes to the species composition of aquatic fauna as sensitive taxa are lost, as well as increased sediment transport and erosion due to increased flows.	4	2	2	1	1	3	3	16	C4	P7	Level 3	Moderate	Prevent deterioration in water quality of the receiving water resource	Ideally no water containing waste should be discharged into any wetlands on site. Waste water should be treated and re-used on site. Should it become necessary to discharge any water, this water will have to comply with the applicable water quality standards.	5	Level 6
	Disposing of waste in a manner which may detrimentally impact on a water resource - Section 21 (g).	Waste disposal could result in a deterioration of water quality.	4	2	2	1	1	3	3	16	C4	P7	Level 3	Moderate	Prevent deterioration in water quality of the adjacent water resource	Waste should be disposed of in registered waste disposal sites. No waste disposal should take place on site. Temporary storage of waste on site should take place within a bunded area located within the dirty water area.	5	Level 6

	Altering the bed, banks, course or characteristics of a watercourse - Section 21 (i).	Any activity altering the bed, banks or characteristics of a water resource could result in loss of wetland habitat, increased erosion risk and sediment transport, water quality deterioration (increase in suspended solids and turbidity) and an increase in alien vegetation due to disturbance.	4	1	1	2	1	3	3	15	C4	P7	Level 3	High	Minimise erosion and sediment loss during construction process.	With the exception of the wetland crossings associated with the access road and coal conveyor, no infrastructure should be located within the wetlands on site. Wetland crossings should not result in flow concentration or alterations to the floodlines of drainage lines and rivers. Construction should be undertaken during low flow periods. No conveyor footings should be located in the active channel of any rivers or streams.	5	Level 6
	Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people - Section 21 (j).	Removal of water from the underground workings per se is not expected to have any impact on the wetlands of the area, as these wetlands are considered to be supported by surface water. However, release of this water into any water resource is likely to result in changes to the hydrology (flow volumes and velocities) of the receiving water resource, a change in water quality as well as an increased erosion risk.	4	1	2	2	1	3	3	16	C4	P7	Level 3	Low	Prevent deterioration of water quality and changes to hydrology.	No discharge of water from underground in any water resources should take place. Water should be stored on site and used a process water during operation.	3	Level 6
	Exemptions from GNR 704		**Exemptions from GNR 704**															
	No person in control of a mine or activity may locate or place any residue deposit, dam, reservoir together with any associated structure or any other facility within the 1:100 year flood line or within a horizontal distance of 100 metres from any water course or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked - Regulation 4(a).	These activities could result in the deterioration of water quality during the operational phase.	4	2	2	2	1	3	3	17	C5	P6	Level 2	Moderate	Prevent the deterioration of water quality	All infrastructure that can ause pollution of water resources should be located within the dirty water area of the mine. Dirty water should be captured and stored - it may not be released. Dirty water should be used for dust suppression within the mine as well as for process water as far as possible.	11	Level 4
	No person in control of a mine or activity may, except in relation to a matter contemplated in Regulation 10 (winning sand and alluvial minerals), carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50 year flood line or within a horizontal distance of 100 metres from any water course or	Undermining of wetlands could result in wetland loss and degradation where surface subsidence occurs. Fractures in the strata underlying the wetlands could result in loss of surface water to groundwater, leading to dessication of wetlands and changes in species composition.	4	0	3	3	1	3	3	17	C5	P6	Level 2	High	Prevent surface subsidence under wetlands	Ideally no surface subsidence should be allowed to take place, especially not underneath the floodplain wetlands and larger valley bottom wetlands. The mine plan/mining method should be adjusted accordingly.	8	Level 6

	estuary, whichever is the greatest - Regulation 4(b).																	
	No person in control of a mine or activity may use any area or locate any sanitary convenience, fuel depots, reservoir or depots for any substance which causes or is likely to cause pollution of a water resource within the 1:50 year flood line of any water course or estuary - Regulation 4(d).	These activities could result in the deterioration of water quality during the operational phase.	4	2	2	2	1	3	3	17	C5	P6	Level 2	Moderate	Prevent the deterioration of water quality	All infrastructure that can ause pollution of water resources should be located within the dirty water area of the mine. Dirty water should be captured and stored - it may not be released. Dirty water should be used for dust suppression within the mine.	11	Level 4
	No person in control of a mine or activity may use any residue or substance which causes or is likely to cause pollution of a water resource for the construction of any dam or other impoundment or any embankment, road or railway, or for any other purpose which is likely to cause pollution of a water resource - Regulation 5.	These activities could result in the deterioration of water quality during the operational phase.	4	2	2	2	1	3	3	17	C5	P6	Level 2	Moderate	Prevent the deterioration of water quality	All infrastructure that can ause pollution of water resources should be located within the dirty water area of the mine. Dirty water should be captured and stored - it may not be released. Dirty water should be used for dust suppression within the mine.	11	Level 4
	NATIONAL ENVIRONMENTAL MANAGEMENT ACT: WASTE ACT, ACT NO. 59 OF 2008		**NATIONAL ENVIRONMENTAL MANAGEMENT ACT: WASTE ACT, ACT NO. 59 OF 2008**															
	NEMWA Section 19(3) and GN 718.	Operation of a sewage treatment plant could result in the deterioration of water quality.	4	2	2	2	1	3	3	17	C5	P6	Level 2	Moderate	Prevent the deterioration of water quality	All sewage should be treated to comply with the relevant standards. Treated		
	SHONDONI SHAFT AREA		**SHONDONI SHAFT AREA**															
	Operation of shaft complex	Water quality deterioration due to discharge of stormwater.	4	1	1	2	1	2	2	13	C3	P7	Level 4	Moderate	Minimise the deterioration of water quality	Clean and dirty water should be seperated. No dirty water may be discharged. Erosion protection measures should be installed at stormwater discharge points. Dishcrage points should be regularly inspected and cleared of debris.	5	Level 6
	Operation of shaft complex	Erosion due to discharge of stormwater.	4	1	1	2	1	2	2	13	C3	P7	Level 4	Moderate	Minimise erosion at discharge points	Clean and dirty water should be seperated. No dirty water may be discharged. Erosion protection measures should be installed at stormwater discharge points. Dishcrage points should be regularly inspected and cleared of debris. Any erosion damage should be repaired immediately.	5	Level 6

	Operation of shaft complex	Disturbance to wetlands located adjacent to the shaft area.	4	0	0	2	1	1	2	10	C3	P6	Level 5	Moderate	Minimise disturbance to wetlands	All staff should be educated regarding the importance of wetlands and natural habitats on site. Hunting should not be permitted in any wetlands on site. Burning should only be undertaken as per a fire regime recommended by a qualified pasture and range land specialist.	5	Level 6
	UNDERGROUND MINING ACTIVITIES OF THE NO.S 2 AND 4 COAL SEAM		**UNDERGROUND MINING ACTIVITIES OF THE NO.S 2 AND 4 COAL SEAM**															
	Underground mining.	Undermining of wetlands could result in wetland loss and degradation where surface subsidence occurs. Fractures in the strata underlying the wetlands could result in loss of surface water to groundwater, leading to dessication of wetlands and changes in species composition.	4	0	1	3	1	3	3	15	C4	P5	Level 3	High	Prevent loss of wetlands due to surface subsidence	Ideally no surface subsidence should be allowed to take place, especially not underneath the floodplain wetlands and larger valley bottom wetlands. The mine plan/mining method should be adjusted accordingly.	0	Level 6
	CONVEYOR BELT ROUTE		**CONVEYOR BELT ROUTE**															
	Operation of conveyor	Spillages and coal dust from the conveyor could result in water quality deterioration	4	1	2	2	1	1	2	13	C3	P6	Level 5	Moderate	Prevent erosion and water quality deterioration.	The conveyor should incorporate turnovers to minimise spillage during normal operation. Should larger spillages occur due to malfunctioning of the conveyor or for any other reason, clean up of the spillages should be undertaken as soon as possible following the event. In this regard regular inspection of the entire conveyor route should be undertaken. No belt transfers are to be located within the wetland areas on site. Where belt transfers are located in close proximity to wetland areas a small, shallow berm should be constructed between the belt transfer site and the wetland area to prevent direct run-off of storm water from the belt transfer site into the valley bottom wetland.	8	Level 6

Table 10. Impact Assessment for the De-Commissioning Phase

Environmental Component	Activity Description	Impact Identification/Description	Criteria for Determining Severity: Quantity	Toxicity	Extent	Duration	Status	Legislation	I & AP's	SEVERITY TOTAL	SEVERITY C-NUMBER	Degree Of Likelihood	Risk Level Before Mitigation	Mitigatory Difficulty	Mitigation/ Management Objective	Proposed Mitigation Measure	Severity Total After Mitigation - C Number	Risk Level After Mitigation
	LISTED ACTIVITIES AT SHONDONI IN TERMS OF NEMA (ACT 107 OF 1998): GN 386 ACTIVITIES		**LISTED ACTIVITIES AT SHONDONI IN TERMS OF NEMA (ACT 107 OF 1998): GN 386 ACTIVITIES**															
Wetlands	Coal throw out stockpile area at Shondoni Shaft with a storage of more than 250 tons but less than 100 000 tons - Activity 1 (c).	Decommissioning of the stockpile will involve the removal of all infrastructure associated with the stockpile as well as the removal of contaminated soil (if any), and the landscaping of the footprint to the surrounding landscape profile. This will result in increased sediment transport into the wetlands and increased surface run-off.	4	1	1	1	1	2	3	13	C3	P7	Level 4	Moderate	Minimise transport of sediments and alien vegetation establishment.	Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6

	Conveyor Pedestal for crossing of Trichardt Spruit (in the 1:10 year flood line) - Activity 1 (m).	Removal of the conveyor pedestal will result in similar impacts to its construction, namely increased sediment inputs to the Trichardtspruit, increased erosion risk, disturbance to the vegetation and an increase in alien vegetation.	4	1	1	1	1	2	3	13	C3	P7	Level 4	Moderate	Minimise transport of sediments and alien vegetation establishment.	Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6
	Service Water Dams and Storm Water Pollution Control Dam at Shondoni Shaft Complex with a capacity of 50 000 cubic metres or more - Activity 1 (n).	Decommissioning of the dams will involve the removal of all infrastructure associated with the dams as well as the removal of contaminated soil (if any), and the landscaping of the footprint to the surrounding landscape profile. This will result in increased sediment transport into the wetlands and increased surface run-off.	4	1	1	1	1	2	3	13	C3	P7	Level 4	Moderate	Minimise transport of sediments and alien vegetation establishment.	Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6
	Excavation for Coal Conveyor Pedestal for crossing of Trichardt Spruit, removing more than 5 cubic meters of material - Activity 4.	Removal of the conveyor pedestal will result in similar impacts to its construction, namely increased sediment inputs to the Trichardtspruit, increased erosion risk, disturbance to the vegetation and an increase in alien vegetation.								0			Level 4	Moderate	Minimise transport of sediments and alien vegetation establishment.	Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6
	Diesel Fuel Storage Tanks at Shondoni Shaft Complex with a combined capacity of more than 30 cubic metres but less than 1 000 cubic metres - Activity 7.	Decommissioning of the tanks will involve the removal of all infrastructure associated with the tanks as well as the removal of contaminated soil (if any), and the landscaping of the footprint to the surrounding landscape profile. This will result in increased sediment transport into the wetlands and increased surface run-off.	4	1	1	1	1	2	3	13	C3	P7	Level 4	Moderate	Minimise transport of sediments and alien vegetation establishment.	Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6
	Removal of Indigenous Vegetation of 3 hectares or more during Site Clearance for Construction of Shondoni Shaft Complex and related Infrastructure - Activity 12.	No natural vegetation will be removed as part of the decommissioning process. Only vegetation within the footprint of the shaft area might be impacted. This impact is dealt with under the appropriate sections above and below.								0								
	Removal of water found in the underground workings on the No.4 Seam and the No.2 Seam workings to facilitate the efficient continuation of mining and for the safety of people - Activity 13.	Dewatering will cease during decommissioning. No impact								0								

Installation of a Tetra Radio System above ground at the Shaft Complex Area - Activity 14.	Decommissioning of the station will involve the removal of all infrastructure associated with the station as well as the removal of contaminated soil (if any), and the landscaping of the footprint to the surrounding landscape profile. This will result in increased sediment transport into the wetlands and increased surface run-off.	4	1	1	1	1	2	3	13	C3	P7	Level 4	Moderate	Minimise transport of sediments and alien vegetation establishment.	Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6
Construction of an Access Road (wider than 4m) to Shondoni Shaft Complex from Tar road R547 - Activity 15.	Decommissioning of the road will involve the removal of the road and the landscaping of the footprint to the surrounding landscape profile. This will result in increased sediment transport into the wetlands and increased surface run-off.	4	1	1	1	1	2	3	13	C3	P7	Level 4	Moderate	Minimise transport of sediments and alien vegetation establishment.	Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6
LISTED ACTIVITIES AT SHONDONI IN TERMS OF NEMA (ACT 107 OF 1998): GN 387 ACTIVITIES		**LISTED ACTIVITIES AT SHONDONI IN TERMS OF NEMA (ACT 107 OF 1998): GN 387 ACTIVITIES**															
Construction of a Double Circuit 132 kV Overhead Powerline from Eskom Supply Point (SOL B) to Shondoni Mine Transmission Feeder Bays - Activity 1 (l).	Decommissioning of the powerline will involve the removal of all infrastructure associated with the powerline and the landscaping of the footprint to the surrounding landscape profile. This will result in increased sediment transport into the wetlands and increased surface run-off.	4	1	1	1	1	2	3	13	C3	P7	Level 4	Moderate	Minimise transport of sediments and alien vegetation establishment.	Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6
Construction of a Coal Conveyor from Shondoni Shaft to Middelbult Main Shaft (to the central Sasol Coal Supply area) at a rate of more than 50 cubic meters per day - Activity 1 (j).	Decommissioning of the conveyor will involve the removal of all infrastructure associated with the conveyor and the landscaping of the footprint to the surrounding landscape profile. This will result in increased sediment transport into the wetlands and increased surface run-off.	4	1	1	1	1	2	3	13	C3	P7	Level 4	Moderate	Minimise transport of sediments and alien vegetation establishment.	Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6
Development of an area including shaft surface infrastructure and conveyor route where more than 20 hectares is disturbed - Activity 2.	Decommissioning of the shaft area will involve the removal of all infrastructure associated with the shaft area as well as the removal of contaminated soil (if any), and the landscaping of the footprint to the surrounding landscape profile. This will result in increased sediment transport into the wetlands and increased surface run-off.	4	1	1	1	1	2	3	13	C3	P7	Level 4	Moderate	Minimise transport of sediments and alien vegetation establishment.	Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6
NATIONAL WATER ACT (ACT 36 OF 1998): SECTION 40		**NATIONAL WATER ACT (ACT 36 OF 1998): SECTION 40**															
Taking water from a water resource - Section 21 (a).	Water abstraction will cease upon the end of the operational stage.								0								

	Impeding or diverting the flow of water in a watercourse - Section 21 (c).	During decommissioning impeding structures will be removed. This will result in increased sediment inputs to the wetlands increased erosion risk, disturbance to the vegetation and an increase in alien vegetation.	4	1	1	1	1	2	3	13	C3	P7	Level 4	Moderate	Minimise transport of sediments and alien vegetation establishment.	Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6
	Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit - Section 21 (f).	Discharge of waste water will cease at the end of the operational phase.								0								
	Disposing of waste in a manner which may detrimentally impact on a water resource - Section 21 (g).	Disposal of waste will cease at the end of the operational phase. However, disposed waste could still contribute to water quality deterioration through leaching of pollutants.	4	1	1	1	1	2	3	13	C3	P6	Level 5	Moderate	Prevent deterioration of water quality	All waste material and contaminated soil must be removed from site during the de-commissioing phase. Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6
	Altering the bed, banks, course or characteristics of a watercourse - Section 21 (i).	This impact will occur mostly during the construction phase. However, removal of infrastructure located within water courses could results in increased sediment inputs to the wetlands increased erosion risk, disturbance to the vegetation and an increase in alien vegetation.	4	1	1	1	1	2	3	13	C3	P7	Level 4	Moderate	Minimise transport of sediments and alien vegetation establishment.	Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6
	Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people - Section 21 (j).	Water abstraction and discharge will cease upon the end of the operational stage.								0								
	Exemptions from GNR 704		**Exemptions from GNR 704**															
	No person in control of a mine or activity may locate or place any residue deposit, dam, reservoir together with any associated structure or any other facility within the 1:100 year flood line or within a horizontal distance of 100 metres from any water course or estuary, borehole or well, excluding boreholes or wells	Decommissioning of the mine will involve the removal of all infrastructure associated with the mine as well as the removal of contaminated soil (if any), and the landscaping of the footprint to the surrounding landscape profile. This will result in increased sediment transport into the wetlands and increased surface run-off.	4	1	1	1	1	2	3	13	C3	P7	Level 4	Moderate	Minimise transport of sediments and alien vegetation establishment.	Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6

	drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked - Regulation 4(a).																	
	No person in control of a mine or activity may, except in relation to a matter contemplated in Regulation 10 (winning sand and alluvial minerals), carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50 year flood line or within a horizontal distance of 100 metres from any water course or estuary, whichever is the greatest - Regulation 4(b).	Undermining of wetlands could result in wetland loss and degradation where surface subsidence occurs. Fractures in the strata underlying the wetlands could result in loss of surface water to groundwater, leading to desiccation of wetlands and changes in species composition.	4	0	3	3	1	3	3	17	C5	P6	Level 2	High	Prevent surface subsidence under wetlands	Ideally no surface subsidence should be allowed to take place, especially not underneath the floodplain wetlands and larger valley bottom wetlands. The mine plan/mining method should be adjusted accordingly.	8	Level 6
	No person in control of a mine or activity may use any area or locate any sanitary convenience, fuel depots, reservoir or depots for any substance which causes or is likely to cause pollution of a water resource within the 1:50 year flood line of any water course or estuary - Regulation 4(d).	Decommissioning of the mine will involve the removal of all infrastructure associated with the mine as well as the removal of contaminated soil (if any), and the landscaping of the footprint to the surrounding landscape profile. This will result in increased sediment transport into the wetlands and increased surface run-off.	4	1	1	1	1	2	3	13	C3	P7	Level 4	Moderate	Minimise transport of sediments and alien vegetation establishment.	Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6
	No person in control of a mine or activity may use any residue or substance which causes or is likely to cause pollution of a water resource for the construction of any dam or other impoundment or any embankment, road or railway, or for any other purpose which is likely to cause pollution of a water resource - Regulation 5.	Decommissioning of the mine will involve the removal of all infrastructure associated with the mine as well as the removal of contaminated soil (if any), and the landscaping of the footprint to the surrounding landscape profile. This will result in increased sediment transport into the wetlands and increased surface run-off.	4	1	1	1	1	2	3	13	C3	P7	Level 4	Moderate	Minimise transport of sediments and alien vegetation establishment.	Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6
	NATIONAL ENVIRONMENTAL MANAGEMENT ACT: WASTE ACT, ACT NO. 59 OF 2008		**NATIONAL ENVIRONMENTAL MANAGEMENT ACT: WASTE ACT, ACT NO. 59 OF 2008**															

	NEMWA Section 19(3) and GN 718.	Decommissioning of the sewage plant will involve the removal of all infrastructure associated with the sewage plant as well as the removal of contaminated soil (if any), and the landscaping of the footprint to the surrounding landscape profile. This will result in increased sediment transport into the wetlands and increased surface run-off.	4	1	1	1	1	2	3	13	C3	P7	Level 4	Moderate	Minimise transport of sediments and alien vegetation establishment.	Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6
	SHONDONI SHAFT AREA		**SHONDONI SHAFT AREA**															
	Decommissioning the shaft area	Decommissioning of the shaft area will involve the removal of all infrastructure associated with the shaft area as well as the removal of contaminated soil (if any), and the landscaping of the footprint to the surrounding landscape profile. This will result in increased sediment transport into the wetlands and increased surface run-off.	4	1	1	1	1	2	3	13	C3	P7	Level 4	Moderate	Minimise transport of sediments and alien vegetation establishment.	Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6
	UNDERGROUND MINING ACTIVITIES OF THE NO.S 2 AND 4 COAL SEAM		**UNDERGROUND MINING ACTIVITIES OF THE NO.S 2 AND 4 COAL SEAM**															
	Underground mining.	Undermining of wetlands could result in wetland loss and degradation where surface subsidence occurs. Fractures in the strata underlying the wetlands could result in loss of surface water to groundwater, leading to desiccation of wetlands and changes in species composition.	4	0	3	3	1	3	3	17	C5	P6	Level 2	High	Prevent surface subsidence under wetlands	Ideally no surface subsidence should be allowed to take place, especially not underneath the floodplain wetlands and larger valley bottom wetlands. The mine plan/mining method should be adjusted accordingly.	8	Level 6
	CONVEYOR BELT ROUTE		**CONVEYOR BELT ROUTE**															
	Decommissioning the conveyor	Decommissioning of the conveyor will involve the removal of all infrastructure associated with the conveyor as well as the removal of contaminated soil (if any), and the landscaping of the footprint to the surrounding landscape profile. This will result in increased sediment transport into the wetlands and increased surface run-off.	4	1	1	1	1	2	3	13	C3	P7	Level 4	Moderate	Minimise transport of sediments and alien vegetation establishment.	Minimise the disturbance footprint during decommissioning. Rip compacted soils. Re-landscape soils to the natural landscape profile. Re-vegetate bare soils areas as soon as possible with indigenous species. Undertake regular alien vegetation surveys and remove all alien species. This will require long-term follow up.	6	Level 6

Table 11. Impact Assessment for the Post-closure Phase

			Criteria for Determining Severity															
Environmental Component	**Activity Description**	**Impact Identification/Description**	**Quantity**	**Toxicity**	**Extent**	**Duration**	**Status**	**Legislation**	**I & AP's**	**SEVERITY TOTAL**	**SEVERITY C-NUMBER**	**Degree Of Likelihood**	**Risk Level Before Mitigation**	**Mitigatory Difficulty**	**Mitigation/ Management Objective**	**Proposed Mitigation Measure**	**Severity Total After Mitigation - C Number**	**Risk Level After Mitigation**
Ground water	**LISTED ACTIVITIES AT SHONDONI IN TERMS OF NEMA (ACT 107 OF 1998): GN 386 ACTIVITIES**		**LISTED ACTIVITIES AT SHONDONI IN TERMS OF NEMA (ACT 107 OF 1998): GN 386 ACTIVITIES**															
	Coal throw out stockpile area at Shondoni Shaft with a storage of more than 250 tons but less than 100 000 tons - Activity 1 (c).	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevetn erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5

	Conveyor Pedestal for crossing of Trichardt Spruit (in the 1:10 year flood line) - Activity 1 (m).	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevetn erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5
	Service Water Dams and Storm Water Pollution Control Dam at Shondoni Shaft Complex with a capacity of 50 000 cubic metres or more - Activity 1 (n).	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevetn erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5
	Excavation for Coal Conveyor Pedestal for crossing of Trichardt Spruit, removing more than 5 cubic meters of material - Activity 4.	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevetn erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5
	Diesel Fuel Storage Tanks at Shondoni Shaft Complex with a combined capacity of more than 30 cubic metres but less than 1 000 cubic metres - Activity 7.	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevetn erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5
	Removal of Indigenous Vegetation of 3 hectares or more during Site Clearance for Construction of Shondoni Shaft Complex and related Infrastructure - Activity 12.	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevetn erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5
	Removal of water found in the underground workings on the No.4 Seam and the No.2 Seam workings to facilitate the efficient continuation of mining and for the safety of people - Activity 13.	Not applicable to the post-closure phase								0								
	Installation of a Tetra Radio System above ground at the Shaft Complex Area - Activity 14.	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevetn erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5
	Construction of an Access Road (wider than 4m) to Shondoni Shaft Complex from Tar road R547 - Activity 15.	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevent erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5
	LISTED ACTIVITIES AT SHONDONI IN TERMS OF NEMA (ACT 107 OF 1998): GN 387 ACTIVITIES		**LISTED ACTIVITIES AT SHONDONI IN TERMS OF NEMA (ACT 107 OF 1998): GN 387 ACTIVITIES**															

	Construction of a Double Circuit 132 kV Overhead Poweline from Eskom Supply Point (SOL B) to Shondoni Mine Transmission Feeder Bays - Activity 1 (l).	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevent erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5
	Construction of a Coal Conveyor from Shondoni Shaft to Middelbult Main Shaft (to the central Sasol Coal Supply area) at a rate of more than 50 cubic meters per day - Activity 1 (j).	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevent erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5
	Development of an area including shaft surface infrastructure and conveyor route where more than 20 hectares is disturbed - Activity 2.	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevent erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5
	NATIONAL WATER ACT (ACT 36 OF 1998): SECTION 40		**NATIONAL WATER ACT (ACT 36 OF 1998): SECTION 40**															
	Taking water from a water resource - Section 21 (a).	Not applicable to the post-closure phase								0								
	Impeding or diverting the flow of water in a watercourse - Section 21 (c).	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevent erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5
	Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit - Section 21 (f).	Not applicable to the post-closure phase								0								
	Disposing of waste in a manner which may detrimentally impact on a water resource - Section 21 (g).	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevetn erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5
	Altering the bed, banks, course or characteristics of a watercourse - Section 21 (i).	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevetn erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5
	Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people - Section 21 (j).	Not applicable to the post-closure phase								0								

	Exemptions from GNR 704		Exemptions from GNR 704															
	No person in control of a mine or activity may locate or place any residue deposit, dam, reservoir together with any associated structure or any other facility within the 1:100 year flood line or within a horizontal distance of 100 metres from any water course or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked - Regulation 4(a).	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevetn erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5
	No person in control of a mine or activity may, except in relation to a matter contemplated in Regulation 10 (winning sand and alluvial minerals), carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50 year flood line or within a horizontal distance of 100 metres from any water course or estuary, whichever is the greatest - Regulation 4(b).	Undermining of wetlands could result in wetland loss and degradation where surface subsidence occurs. Fractures in the strata underlying the wetlands could result in loss of surface water to groundwater, leading to dessication of wetlands and changes in species composition.	4	0	3	3	1	3	3	17	C5	P6	Level 2	High	Prevent surface subsidence under wetlands	Ideally no surface subsidence should be allowed to take place, especially not underneath the floodplain wetlands and larger valley bottom wetlands. The mine plan/mining method should be adjusted accordingly.	8	Level 6
	No person in control of a mine or activity may use any area or locate any sanitary convenience, fuel depots, reservoir or depots for any substance which causes or is likely to cause pollution of a water resource within the 1:50 year flood line of any water course or estuary - Regulation 4(d).	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevetn erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5

	No person in control of a mine or activity may use any residue or substance which causes or is likely to cause pollution of a water resource for the construction of any dam or other impoundment or any embankment, road or railway, or for any other purpose which is likely to cause pollution of a water resource - Regulation 5.	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevent erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5
	NATIONAL ENVIRONMENTAL MANAGEMENT ACT: WASTE ACT, ACT NO. 59 OF 2008		**NATIONAL ENVIRONMENTAL MANAGEMENT ACT: WASTE ACT, ACT NO. 59 OF 2008**														
	NEMWA Section 19(3) and GN 718.	The disturbed area might be colonised by alien vegetation and be exposed to erosion.								0								
	SHONDONI SHAFT AREA		**SHONDONI SHAFT AREA**														
	Shaft area	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevent erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5
	UNDERGROUND MINING ACTIVITIES OF THE NO.S 2 AND 4 COAL SEAM		**UNDERGROUND MINING ACTIVITIES OF THE NO.S 2 AND 4 COAL SEAM**														
	Underground mining.	Decanting of polluted mine water expected to have a high salt load and to potentially be acidic	4	2	3	2	1	3	3	18	C5	P7	Level 2	High	Limit water quality deterioration	The volume, location and expected quality of decant should be determined. Decant will need to be managed to prevent deterioration of the receiving water resource. Where decanting water does not comply with the RWQO, this water will need to be captured and treated to the required standards prior to release.	14	Level 3
	CONVEYOR BELT ROUTE		**CONVEYOR BELT ROUTE**														
	Conveyor route	The disturbed area might be colonised by alien vegetation and be exposed to erosion.	4	0	1	2	1	2	2	12	C3	P6	Level 5	Moderate	Control alien vegetation invasions and prevent erosion damage	Regular long-term monitoring of rehabilitated sites should be undertaken to determine success of rehabilitation measures and to undertake corrective action should alien vegetation or erosion damage be observed on site.	12	Level 5

8.5 Cumulative Impacts

The most significant cumulative impact associated with the proposed Shondoni Project is that of deteriorating water quality within the Waterval River and the Vaal River further downstream. The cumulative impact that coal mining has on water quality is illustrated by current conditions in the Upper Olifants River, where the salinity loads already exceed the Resource Water Quality Objectives for the Upper Olifants River. The southern coalfields are charaterised by higher sodium concentrations, indicating a serious risk of deteriorating water quality due to increased salinities within the rivers draining this area, namely the Vaal River and its tributaries, once the coal mines in the area start decanting. Decanting of acidic water must also be considered. While numerous new coal mines and shafts have in the recent past been commissioned in the Secunda region, it is important to recognise the time lag between commissioning of the mine and decanting of polluted water. The life of mine of the Middelbult Reserve will be extended to 2041 by the Shondoni Shaft, where after it will take several years before the mine starts decanting polluted water. While polluted decant from one or two of these mines might be within the assimilative capacity of the receiving water resources, the combined impact of polluted decant from all of the collieries within the Vaal River will need to be considered to accurately assess the significance of this impact. Given the reliance of South African industry on water obtained from the Vaal River, the maintenance of water quality within this river should be of utmost importance.

The construction and operation of the surface infrastructure will contribute to the cumulative loss of natural habitats and biodiversity within the Secunda area.

8.6 Proposed Monitoring

Monitoring in terms of water quality will be covered by the monitoring plans proposed by the relevant surface water and aquatic ecology specialist. In terms of monitoring wetlands, it is recommended that fixed point photography be utilised to record the state of the wetlands and rivers at all the biomonitoring sample points, as well as at every floodplain crossing along the conveyor route. These photographs should be used to identify problems associated with erosion, increased sedimentation and colonisation by reeds and changes in habitat structure. It is recommended that photographs are taken at least biennially, before and after the onset of the main rainfall season.

9. CONCLUSION

Given the geology and soil characteristics of the study area which markedly influence the way that water moves through the landscape, the wetland area within the study site is limited in extent to approximately 3 185ha, or 13.8% of the study area. This is less than what is generally encountered in the Upper Olifants catchment of the Mpumalanga Highveld, but is due to the nature of the soils of the area (mostly vertic clay soils) that encourage run-off, with only limited infiltration and retention of water within the landscape. This is reflected within the vegetation of many of the wetlands on site where facultative dryland species, facultative species and facultative wetlands species are more common and cover far more extensive areas that obligate wetland species.

The study found that most of the wetlands on site have been moderately modified due to a range of impacts, including agricultural practices, infrastructure developments, urbanisation and mining related activities. This has resulted in no pristine wetlands being found on site and the majority of wetlands are considered to be of moderate importance and sensitivity.

The most significant cumulative impact associated with the proposed Shondoni Project is that of deteriorating water quality within the Waterval River and the Vaal River further downstream as a result of decanting mine water post-closure. This will need to be carefully monitored and managed to prevent deterioration of water quality within the receiving water resources. Conditions in the adjacent Upper Olifants catchment where salinity loads already exceed the RWQO would suggest that current methods of managing decant of polluted mine water are not successful. A further significant negative impact is associated with surface subsidence, and especially where this takes place under wetlands. The mine plan should be adjusted, if necessary, so as to ensure that no surface subsidence takes place underneath the floodplain wetlands, large valley bottom wetlands and the Leeupan.

Most of the negative impacts associated with the conveyor route will take place during the construction process, where earthworks and clearing of vegetation, especially where it takes place within the wetlands, could result in erosion, flow concentration, and deterioration in water quality. Various mitigation measures have been proposed to manage the negative impacts associated with wetland crossings. It is recommended that no conveyor pedestals are constructed within any active channels or oxbows on site.

Impacts associated with the shaft complex are related mostly to surface disturbance and loss of natural habitat during the construction phase, and to water quality deterioration during the operational phase. Clean and dirty water should at all times be separated and no dirty water should be allowed to discharge unless authorised by the relevant government departments.

Any activity which is contemplated and which will impact on the wetlands within the study area is subject to authorisation under Section 21 of the National Water Act (Act 36, 1998). As such, all proposed wetland crossings will require a Water Use License.

10. REFERENCES

Brinson, M. M. 1993. *A hydrogeomorphic classification for wetlands*. Wetlands Research Program Technical Report WRP-DE-4. U. S. Army Corps of Engineers, Waterway Experiment Station. Vicksburg, MS: Bridgham and Richardson.

Department of Water Affairs and Forestry. 1999a. *Resource Directed Measures for Protection of Water Resources.* Volume 4. Wetland Ecosystems Version 1.0, Pretoria.

Department of Water Affairs and Forestry. 1999b. *Resource Directed Measures for Protection of Water Resources.* Volume 1. River Ecosystems Version 1.0, Pretoria.

Department of Water Affairs and Forestry, 2005. *A practical field procedure for identification and delineation of wetland and riparian areas*. DWAF, Pretoria.

Ewel, C., 1997, '*Water quality improvement by wetlands*', in Daily, G. (Ed.) Nature's Services: Societal Dependence on Natural Ecosystems, Island Press: Washington DC. pp. 329-344

Gren, I., 1995, '*The value of investing in wetlands for nitrogen abatement*', European Review of Agricultural Economics 22: 157-172

Kleynhans, C.J. 1996. A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River. *Journal of Aquatic Ecosystem Healt*h 5: 41 - 54.

Kleynhans, C.J. 1999. *A procedure for the determination of the ecological reserve for the purposes of the national water balance model for South African Rivers*. Institute for Water Quality Studies. Department of Water Affairs and Forestry, Pretoria.

Kotze, D.C, Marneweck, G.C., Batchelor, A.L., Lindley, D. and Collins, N. 2004. *Wetland Assess: A rapid assessment procedure for describing wetland benefits*. Mondi Wetland Project, Unpublished report.

Kotze D.C., Hughes J.C., Breen C.M. and Klugg J.R. 1994. The development of a wetland soils classification system for KwaZulu/Natal. Report to the Water Research Commission by the Institute of Natural Resources and Department of Grassland Science, University of Natal, WRC Report No 501/4/94.

Kotze, D.C. and Marneweck, G.C. 1999. *Guidelines for delineating the boundaries of a wetland and the zones within a wetland in terms of the South African Water Act. As part of the development of a protocol for determining the Ecological Reserve for Wetlands in terms of the Water Act Resource Protection and Assessment Policy Implementation Process*. Department of Water Affairs and Forestry, South Africa.

Marneweck, G.C., Palmer, R.W, Engelbrecht, J., Jacobsen, N. and Turpie, J. 2002. *Biodiversity of the upper Olifants River catchment wetlands*. In: Palmer, R. W., Turpie, J., Marneweck, G.C. and Batchelor, A.L. (Eds). Ecological and Economic Evaluation of Wetlands in the Upper Olifants River Catchment. Water Research Commission Report No K5/1162

Marneweck, G.C. and Batchelor, A. 2002. Wetland inventory and classification. In*: Ecological and economic evaluation of wetlands in the upper Olifants River catchment*. (Palmer, R.W., Turpie, J., Marneweck, G.C and Batchelor (eds.). Water Research Commission Report No. 1162/1/02.

Postel, S. and Carpenter, S., 1997, '*Freshwater ecosystem services*', in Daily, G. (Ed.) Nature's Services: Societal Dependence on Natural Ecosystems, Island Press: Washington DC. pp. 195-214

Reed, P.B. 1988. *National list of plant species that occur in wetlands: national summary*. U.S. Fish and Wildlife Service, Washington, DC. Report No. 88.

Rogers F.E., Rogers K.H. and Buzer J.S. 1985. *Wetlands for wastewater treatment: with special reference to municipal wastewaters*. WITS University Press, Johannesburg.122pp

Thompson, J.R. and Goes, B. 1997. *Inundation and groundwater recharge in the Hadejia-Nguru wetlands, Northeast Nigeria: Hydrological analysis*. Hadejia-Nguru Wetlands Conservation Project, Kano and the Wetland Research Unit, University College London.

Turpie, J. and van Zyl, H. 2002. *Direct use values of wetlands*. In: Palmer, R. W., Turpie, J., Marneweck, G.C. and Batchelor, A.L. (Eds). Ecological and Economic Evaluation of Wetlands in the Upper Olifants River Catchment. Water Research Commission Report No K5/1162

Walker, L.R. 1999. *Ecosystems of Disturbed Ground*. In: *Ecosystems of the World*. Elsevier

Wetland Inventory Consortium, 2000. *A pilot project for the determination of methods for the National Wetland Inventory*. Department of Environmental Affairs and Tourism, Pretoria.

11. APPENDIX 1:

FAMILY	SPECIES	INDICATOR CATEGORY	RIPARIAN ZONE	FLOODPLAIN	OXBOWS/ DEPRESSIONS	DRAINAGE LINES	PANS
	Bidens formosa	N/A	1			1	
	Cirsium vulgare	N/A	1	1	1	1	1
	Conyza bonariensis	N/A					
	Crepis hypochoeridea	N/A		1		1	
	Hypochaeris radicata	N/A				1	
	Pseudognaphalium luteo-album	N/A				1	
	Sonchus oleraceus	N/A	1	1			
	Tagetes minuta	N/A	1			1	
	Tragopogon dubius	N/A	1	1		1	
ONAGRACEAE	*Oenothera rosea*	N/A		1			
PLANTAGINACEAE	*Plantago lancelolata*	N/A	1				
POLYGONACAEA	*Persicaria lapathifolia*	N/A	1		1		1
	Rumex crispus	N/A		1	1	1	
SALICACEAE	*Salix babylonica*	N/A		1			
VERBENACEAE	*Verbena bonariensis*	N/A			1		
	Verbena braziliensis	N/A		1		1	
TOTALS			**7**	**10**	**4**	**9**	**3**

FAMILY	SPECIES	INDICATOR CATEGORY	RIPARIAN ZONE	FLOODPLAIN	OXBOWS/ DEPRESSIONS	DRAINAGE LINES	PANS
INDIGENOUS							
AMARYLLIDACEAE	*Crinum bulbispermum*	fw	1	1	1	1	1
ASCLEPIADACEAE	*Asclepias fruticosa*	fd		1			
	Asclepias gibba var. *gibba*	fw	1	1		1	
	Xysmalobium undulatum	fw	1	1			
ASTERACEAE	*Berkheya radula*	f		1		1	
	Berkheya spp.	fd	1	1	1	1	1
	Haplocarpha scaposa	fw		1	1		
	Helichrysum aureonitens	f	1				
	Helichrysum pilosellum	fw		1		1	
	Helichrysum rugulosum	f				1	
	Senecio erubescens	f	1				
	Senecio inornatus	f		1		1	
	Stoebe vulgaris	fd		1			
	Vernonia oligocephala	f		1			
COMMELINACEAE	Cyanotis spp.	f		1			
CRASSULACEAE	Crassula spp.	fd				1	
CYPERACEAE	Cyperus spp.	fw			1		
	Cyperus spp.	fw			1		
	Cyperus spp.	ow			1		
	Cyperus denudatus	ow				1	
	Cyperus fastigiatus	ow	1	1	1	1	
	Cyperus longus	fw		1	1		
	Eleocharis dregeana	ow		1	1	1	1
	Fimbristylis complanata	fw		1	1		1
	Fuirena pubescens	ow				1	1
	Isolepis costata	ow				1	
	Kyllinga erecta	fw		1		1	

FAMILY	SPECIES	INDICATOR CATEGORY	RIPARIAN ZONE	FLOODPLAIN	OXBOWS/ DEPRESSIONS	DRAINAGE LINES	PANS
	Mariscus congestus	ow			1	1	
	Schoenoplectus corymbosus	ow				1	
	Schoenoplectus spp.	ow			1		
EUPHORBIACEAE	*Euphorbia striata*	f	1				
FABACEAE	*Erythrina zeyheri*	fd	1				
	UNKNOWN SHRUB	fd	1				
GERANIACEAE	*Geranium* spp.	fd		1			
HYPOXIDACEAE	*Hypoxis acuminata*	f		1		1	
	Hypoxis hemerecocallidea	fd		1			
IRIDACEAE	*Gladiolus elliotii*	fw		1		1	
JUNCACEAE	*Juncus exsertus*	ow				1	
	Juncus oxycarpus	ow				1	
LEGUMINOSAE	*Crotalaria* spp.	UNKNOWN	1				
LENTIBULARIACEAE	*Utricularia stellaris*	ow			1		1
LILIACEAE	*Aloe* spp.	UNKNOWN					1
	Protoasparagus laricinus	fd	1				
OXALIDACEAE	*Oxalis obliquifolia*	fw			1	1	
PLANTAGINACEAE	*Plantago longissima*	fw	1				
POACEAE	*Agrostis eriantha* subsp. *eriantha*	f				1	
	Andropogon appendiculatus	fw			1		1
	Andropogon huillensis	fw	1				
	Aristida adscensionis	f	1	1			
	Aristida bipartita	f	1	1			
	Aristida congesta subsp. *barbicollis*	fd	1	1		1	
	Aristida congesta subsp. *congesta*	f		1		1	
	Aristida junciformis subsp. *junciformis*	fd	1	1		1	
	Arundinella nepalensis	fw	1				
	Cymbopogon plurinoides	fd		1			1
	Cymbopogon validus	f		1		1	
	Cynodon dactylon	f		1		1	
	Cynodon nlemfuensis	f		1			
	Dactylectinum aegyptium	fw			1		1
	Digitaria eriantha	f				1	

FAMILY	SPECIES	INDICATOR CATEGORY	RIPARIAN ZONE	FLOODPLAIN	OXBOWS/ DEPRESSIONS	DRAINAGE LINES	PANS
	Echinochloa colona	fw			1		
	Eragrostis curvula	fd	1	1	1	1	1
	Eragrostis gummiflua	fd				1	1
	Eragrostis heteromera	fw		1			
	Eragrostis plana	fw	1	1	1	1	1
	Eragrostis racemosa	f		1			
	Harpechloa falx	fd		1			
	Helicotrichon turgidulum	fw				1	1
	Hyparrhenia hirta	fd	1	1		1	1
	Ischaemum fasciculum	ow					1
	Leersia hexandra	ow			1	1	1
	Miscanthus junceus	fw	1				
	Panicum schinzii	fw				1	
	Paspalum dilatatum	fw	1	1	1	1	
	Pennisetum sphacelatum	fw				1	
	Phragmites australis	ow		1			
	Schizachyrium sanguineum	fw			1		1
	Setaria incrassata	fw			1		1
	Setaria sphacelata var. *sericea*	fw		1	1	1	1
	Setaria nigrirostris	fw				1	
	Themeda triandra	fd	1	1		1	
	Tragus spp.	UNKNOWN		1			
POLYGONACAEA	*Persicaria attenuata*	ow			1		
	Persicaria serrulata	ow	1		1	1	1
	Rumex lanceolatus	fw	1				
POTAMOGETONACEAE	*Potamogeton pectinatus*	ow			1		1
	Potamogeton thunbergii	ow			1		1
TYPHACEAE	*Typha capensis*	ow		1	1	1	1
TOTALS			**27**	**42**	**29**	**42**	**24**
EXOTICS							
APIACEAE	*Centella asiatica*	fw		1			
ASTERACEAE	*Bidens bipinnata*	N/A		1			1

12. APPENDIX 2:

**WETLAND BASELINE AND IMPACT ASSESSMENT:
MIDDELBULT BLOCK 8**

For:
Andrew Duthie
of
Oryx Environmental

By:
G. C. Marneweck

Wetland Consulting Services (Pty.) Ltd.

P.O. Box 72295
Lynnwood Ridge
Pretoria
0040

Tel: 012 349 2699
Fax: 012 349 2993

E-mail: wetland@smartnet.co.za

JULY 2002

Reference 75/2002

FINAL

SASOL MINING
MIDDELBULT - BLOCK 8 - SHONDONI

EIAR (NEMA, MPRDA & NEMWA)

APPENDICES

DATE: 29 FEBRUARY 2012
PROJECT REFERENCE: JMA/10391
JMA FILE REFERENCE: Prj5451
REPORT NUMBER: SMMB8S/EIAR/FEB-2012
DEA REFERENCE: 12/9/11/L623/6

VOLUME IV (c) OF V

COMPILED FOR

SASOL MINING (Pty) Ltd
Middelbult – Block 8 – Shondoni

COMPILED BY

JMA Consulting (Pty) Ltd
Sustainable Environmental Solutions
through
Integrated Science and Engineering

APPENDIX 5.11(A)

SPECIALIST REPORT
AQUATIC BIOMONITORING

AQUATIC ECOSYSTEMS

Impact Assessment

SASOL MINING
MIDDELBULT (BLOCK 8) SHONDONI PROJECT

For:

JMA Consulting (Pty) Ltd
Jasper Müller
P O Box 883
Delmas, 2210
Tel: +27 13 665 1788
Fax: +27 13 665 2364

By:

Wetland Consulting Services (Pty) Ltd

Wetland Consulting Services (Pty.) Ltd.
PO Box 72295
Lynnwood Ridge
Pretoria
0040
Tel: 012 349 2699
Fax: 012 349 2993
Email: info@wetcs.co.za

Ref: 596a/2010

DOCUMENT SUMMARY DATA

PROJECT: **Assessment of Aquatic Ecosystems for the Sasol Mining Middelbult (Block 8) Shondoni Project**

CLIENT: **JMA Consulting (Pty) Ltd**

CONTACT DETAILS: **Jasper Müller**
P O Box 883
Delmas, 2210
Tel: +27 13 665 1788
Fax: +27 13 665 2364

CONSULTANT: **Wetland Consulting Services, (Pty) Ltd.**

CONTACT DETAILS: **Allan Batchelor**
PO Box 72295
Lynnwood Ridge
0040
Telephone number: (012) 349 2699
Fax number: (012) 349 2993
E-mail: allanb@wetcs.co.za

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

INDEMNITY AND CONDITIONS RELATING TO THIS REPORT

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and Wetland Consulting Services (Pty.) Ltd. and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

Although Wetland Consulting Services (Pty.) Ltd. exercises due care and diligence in rendering services and preparing documents, Wetland Consulting Services (Pty.) Ltd. accepts no liability, and the client, by receiving this document, indemnifies Wetland Consulting Services (Pty.) Ltd. and its directors, managers, agents and employees against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by Wetland Consulting Services (Pty.) Ltd. and by the use of the information contained in this document.

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

1. BACKGROUND INFORMATION

Wetland Consulting Services (Pty) Ltd was appointed by JMA Consulting (Pty) Ltd to undertake an assessment of aquatic ecosystems within three additional areas associated with the Sasol Mining Middelbult (Block 8) Shondoni Project west of Secunda, and to incorporate the findings of this study into the existing aquatic ecosystem study available for the area (Palmer and Engelbrecht 2002). The three additional areas surveyed as part of this report (indicated in Figure 1 below) are as follows:

- Northern Reserve
- Springbokdraai Reserve
- Leeupan Reserve

The 2002 study was undertaken under appointment by Oryx Environmental. The investigation formed part of the Middelbult Block 8 EMPR for Sasol Coal. The study provided a baseline report on the aquatic ecosystems that fall within the extent of the proposed underground mining areas.

The purpose of this new report is to extend the baseline information contained within the original report to include the three additional areas, and then to compile one single report to cover the entire Sasol Mining Middelbult (Block 8) Shondoni Project study area (referred to as the study area hereafter). Field work during the current study was only undertaken for the additional areas; no additional field work was undertaken in the area covered by the 2002 Report. As such, this report draws extensively from the 2002 Report, the entire report of which is included for reference in Appendix B.

Following on from this Phase 1 report, the Phase 2 report will be compiled, which will address the impact assessment and recommended mitigation measures for the proposed developments, namely the proposed shaft complex and the conveyor route.

2. TERMS OF REFERENCE

To extend the baseline information contained within the 2002 Report to include the three additional areas: Northern Reserve, Springbokdraai Reserve and Leeupan Reserve. For this purpose, the following activities were undertaken:

- Initial desktop review of existing information;
- Bioassessment of aquatic macroinvertebrates (using SASS5);
- Present Ecological State of instream and riparian areas;
- Baseline Assessment Report, incorporating the findings of the 2002 study.
- Impact Assessment
- Management Plan

3. LIMITATIONS

- Reference conditions are unknown. This limits the confidence with which the present ecological category is assigned. However, data collected during this study can serve as a point of departure for future biomonitoring surveys;
- Aquatic ecosystems vary both temporally and spatially. Once-off surveys such as this are therefore likely to miss substantial ecological information, thus limiting accuracy, detail and confidence; and
- The 2002 field survey was conducted during March and data for this study were collected during June 2010. This seasonal discrepancy may have introduced slight seasonal differences not related to water quality conditions.
- The impacts for ecosystems were rated according to a once-off field survey which may have missed important species with spatially or temporally isolated distributions. For example, certain fish species may have been missed and may erroneously have been assumed to be absent.
- The ratings given for listed activities and water use licence applications have been lumped and should therefore be seen as an estimate of the overall impact. These should therefore be viewed as guidelines only and should be considered in association with individual impacts for each activity.
- Specific activities were not identified under each water use licence application and exemption application category and impacts may therefore have been missed.

4. STUDY AREA

The 2002 Report study area is approximately 19 300 ha in extent and is situated to the northeast and east of Secunda and south of Kinross. It includes the area surrounding Evander and the farms, or portions of the farms, Driefontein 137 IS, Kinross 133 IS, Winkelhaak 135IS, Witkleifontein 131 IS, Leeuwspruit 134 IS, Zandfontein 130 IS, Ruigtekuilen 129 IS, Kromdraai 128 IS, Brakspruit 359 IR, Springbokdraai 377 IS, Rietkuil 531 IR, and Leeuwpan 532 IR (Figure 1). The area lies between 26024’ and 26036S and 28056’ and 29011’E and is located on portions of the topographic map sheets 2628BD Leandra, 2628DB Willemsdal, 2629AC Evander and 2629CA Secunda (Published by the Chief Directorate: Surveys and Land Information, Mowbray).

The three areas added to the study area during the current survey constitute an additional approximately 4 000ha, bringing the total size of the study area to 23 300ha.

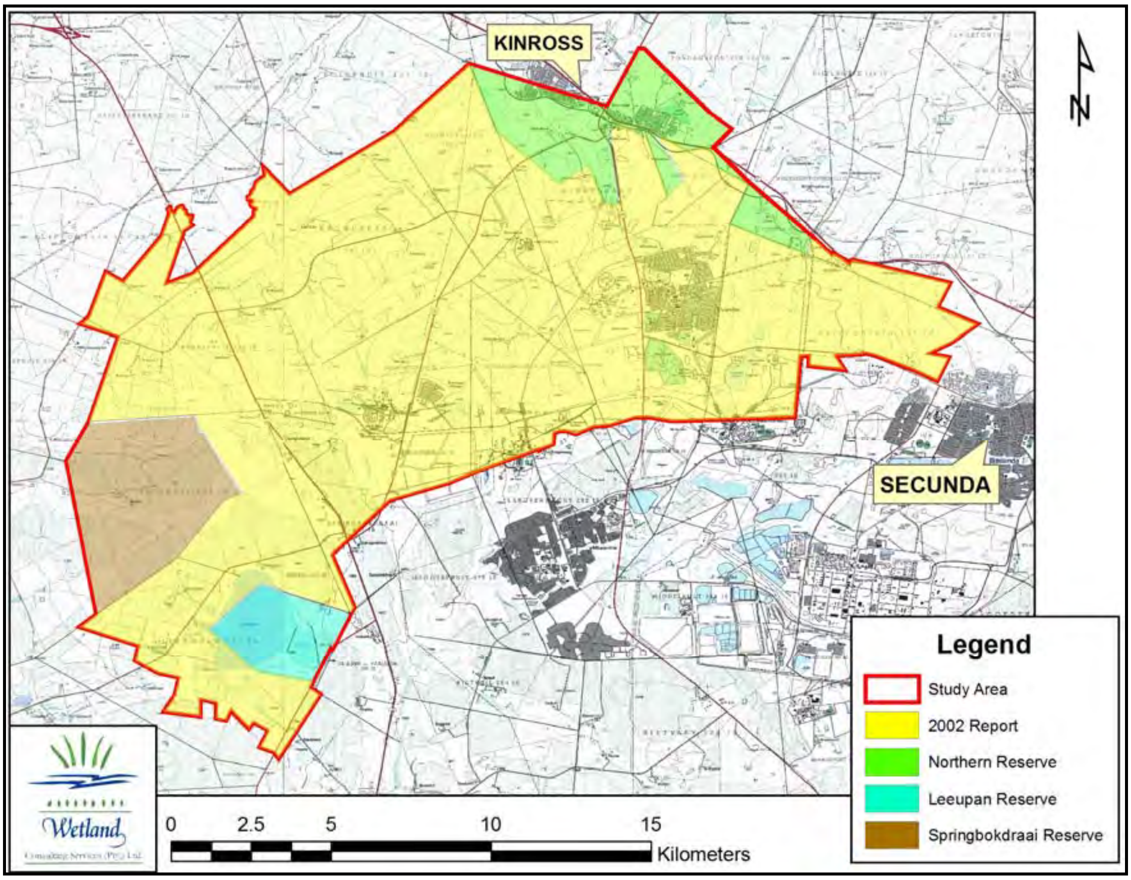


Figure 1. Map showing the extent and location of the study area. The area covered by the 2002 Report is shaded yellow, while the additional areas surveyed during the current study are shaded green, brown and blue respectively.

4.1 CATCHMENTS

The study area is located predominantly in primary catchment C, the Vaal River catchment, with the northern-most reaches of the site draining into primary catchment B, the Olifants River catchment. The affected quarternary catchments include catchments C12D, in which the majority of the study area falls, and C12F, both of which are drained by the Waterval River, as well as catchment B11D, which is drained by the Steenkoolspruit. More details on the affected catchments are provided below. There are a number of tributaries of the Waterval River that also traverse the study area. These are the Kaalspruit (C12F), Bankspruit, Grootspruit, Evanderspruit and Trichardspruit (all C12D). The Waterval River drains into the Vaal River upstream of the Vaal Dam.

Table 1. Table showing the mean annual precipitation, run-off and potential evaporation per quaternary catchment (Middleton, B.J., Midgley, D.C and Pitman, W.V., 1990).

Quaternary Catchment	Catchment Surface Area (ha)	Mean Annual Rainfall (MAP) in mm	Mean Annual Run-off (MAR) in mm	MAR as a % of MAP	Study area as % of catchment
C12D	81 343	666.9	59.3	8.9 %	29 %
C12F	75 655	634.9	49.1	7.7 %	> 0.5 %
B11D	49 812	671.5	30.1	4.5 %	1 %

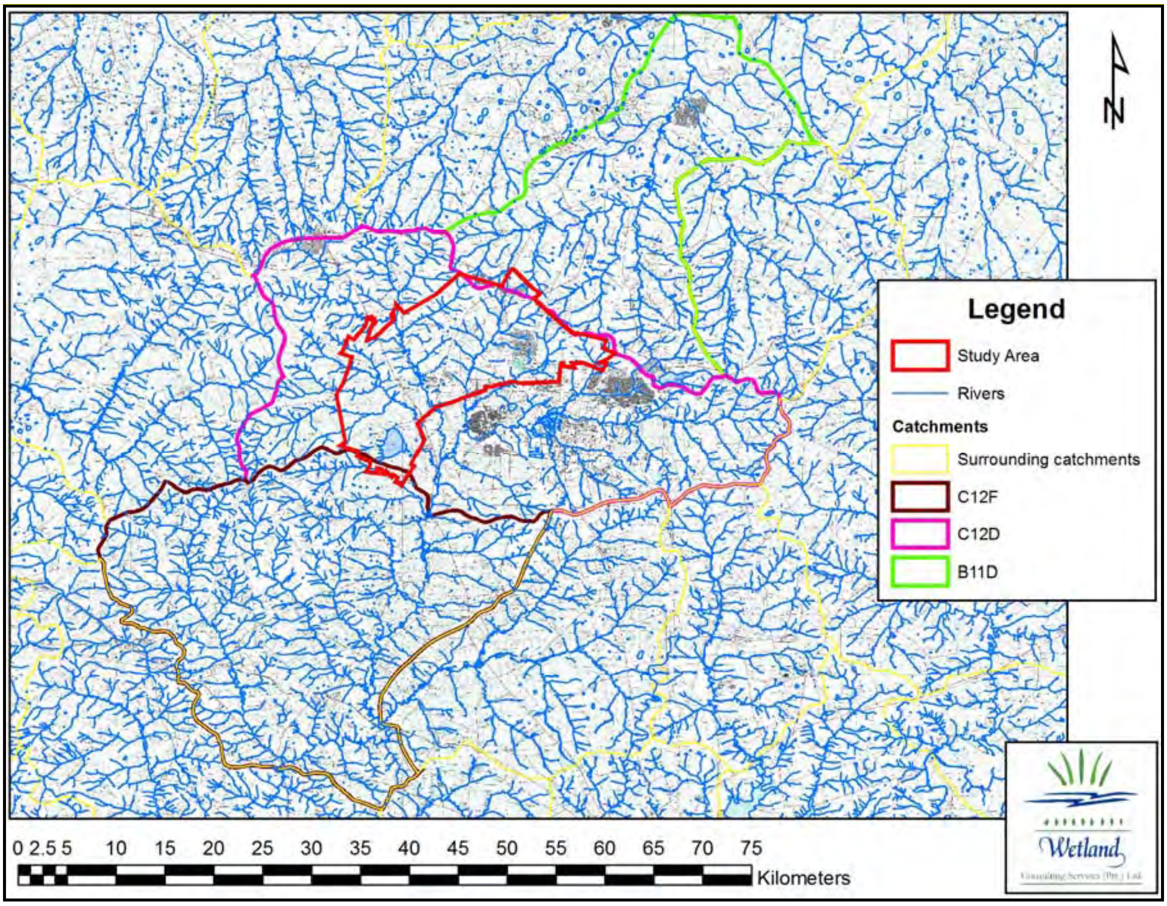


Figure 2. Map showing the Shondoni Project study area in relation to the quaternary catchments.

5. APPROACH: BASELINE SURVEY

5.1 Assessment of Aquatic Ecosystems

The following tools were used to assess the integrity of the aquatic ecosystems in surface water:

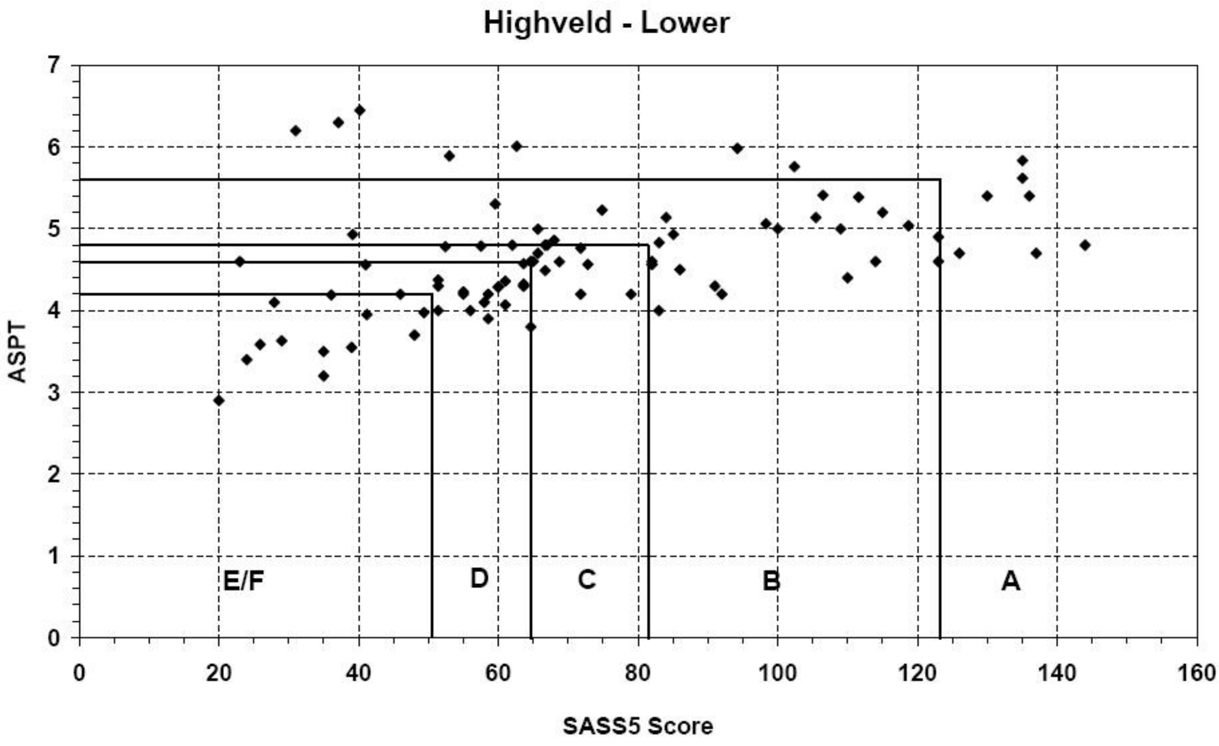
- Water quality: On-site assessment of conductivity, TDS, pH and temperature.

- The Present Ecological State was determined in consultation with the wetland specialists and is repeated in this report for the sake of completeness (Wetland Consulting Services 2009), thus providing an overall evaluation of aquatic ecosystem integrity. The scoring system as described in the document "Resource Directed Measures for Protection of Water Resources. Volumes 3 and 4. River and Wetland Ecosystems" (DWAF, 1999) was applied for the determination of the PES. The scoring system is outlined in the table below.

Table 2. Table showing the rating scale used for the PES assessment (Based on DWAF 1999)

Class	Description	Score (% of total)
A	Unmodified, natural.	90-100
B	Largely natural, with few modifications.	80-90
C	Moderately modified.	60-79
D	Largely modified.	40-59
E	Extensively modified.	20-39
F	Critically modified.	<20

- Aquatic macroinvertebrates using SASS 5 (South African Scoring System). SASS5 is based on the presence or absence of sensitive aquatic macroinvertebrates collected and analysed according to the methods outlined in Dickens and Graham (2002). A high relative abundance and diversity of sensitive taxa present indicates a relatively healthy system with good water quality. Disturbance to water quality and habitat results in the loss of sensitive taxa. As this method was developed specifically for rivers, the methods of collection and analysis were modified for wetlands and pans. This meant sampling vegetation and substrate biotopes only, as no stone biotopes were available, and interpreting the results in terms of overall diversity and taxon composition in cases where no flowing water was present. In 2002, interpretation of SASS5 scores was based on a scatterplot of samples collected from the Olifants River catchment. In this report, data were interpreted according to updated guidelines provided in Dallas (2007) and illustrated below. This updated method introduced some interpretational changes to the 2002 results.



Biological Band/ Ecological Category	Ecological Category Name	Description
A	Natural	Unmodified natural
B	Good	Largely natural with few modifications
C	Fair	Moderately modified
D	Poor	Largely modified
E	Seriously modified	Seriously modified
F	Critically modified	Critically or extremely modified

Figure 3. Biological Bands and Ecological Categories for the Highveld (Lower zone), calculated using percentiles (extracted from Dallas 2007)

- Fish were only sampled in 2002 as follows: Historical data on fish was based on literature studies (Skelton 1993, Jubb 1967) and a few surveys conducted by the former Transvaal Directorate of Nature Conservation. Fish were sampled using mainly a 10mm-mesh seine net. Electro-narcosis was only used in riffle areas. All fish species were identified and anomalies and general age structure were recorded. Sampling effort was kept to about 15 minutes. A qualitative approach was used to estimate fish assemblage integrity. This method and scoring system takes into account the best available fish assemblage information, as well as the impact on physical habitat modifications and possible impacts of alien biota (Kleynhans and Engelbrecht 2001).

Table 3. Guidelines used for a qualitative assessment of fish [extracted from Palmer and Engelbrecht 2002].

FISH ASSEMBLAGE INDICATORS CONSIDERED FOR ESTIMATION	RIVER ZONE OR DEFINED RESOURCE UNIT (scoring/assessment criteria; provide comments for each score)
Native Species Richness	Number of species expected: number of species currently present (most recent). Score according to: None of expected present=0 Only few of expected present=1-2 Majority of expected species present=3-4 All/almost all of expected present=5
Presence of Native intolerant species	No intolerant species present=0 Few intolerant species =1-2 Majority of intolerant species present =3-4 All/almost all intolerant species present (OR no intolerants naturally present)=5
Abundance of native species	No fish=0 Only few individuals=1-2 Moderate abundance=3-4 Abundance as expected for natural conditions=5
Native species Frequency of Occurrence	Fish absent at all sites=0 Fish present at only very few sites=1-2 Fish present at most sites=3-4 Fish present at all sites=5
Health/condition; native & introduced species	All fish seriously affected/fish absent=0 Most fish affected=1-2 Most fish unaffected=3-4 Only single/few individuals affected=5
Presence of introduced fish species	Predaceous species and/or habitat modifying species with a critical impact on native species=0 Predaceous species and/or habitat modifying species with a serious impact on native species=1-2 Predaceous species and/or habitat modifying species with a moderate impact on native species=3-4 Predaceous species and/or habitat modifying species no impact on native species=5
Instream habitat modification	Water quality/Flow/Stream bed substrate, critically modified, no suitable conditions for expected species=0 Water quality/Flow/Stream bed substrate, seriously modified, little suitable conditions for expected species=1-2 Water quality/Flow/Stream bed substrate, moderately modified, moderately suitable conditions for expected species=3-4 Water quality/Flow/Stream bed substrate, little/no modification, abundant suitable conditions for expected species=5
FISH PES: ESTIMATED OVERALL FISH ASSEMBLAGE INTEGRITY	TAKING INTO ACCOUNT THE ABOVE INFORMATION: RATE FISH ASSEMBLAGE INDEX CATEGORY A – F BASED ON GENERAL SCORING GUIDELINES: Category — % of total expected score A: 90 – 100 B: 80 – 90 C: 60 – 80 D: 40 – 60 E: 20 – 40 F: 0 – 20

5.2 Sampling Sites

Seventeen sites were sampled during the 2002 study. An additional eight sites were sampled in 2010. Combined sampling sites are illustrated in Figure 4 and summarised in Tables 4 and 5.

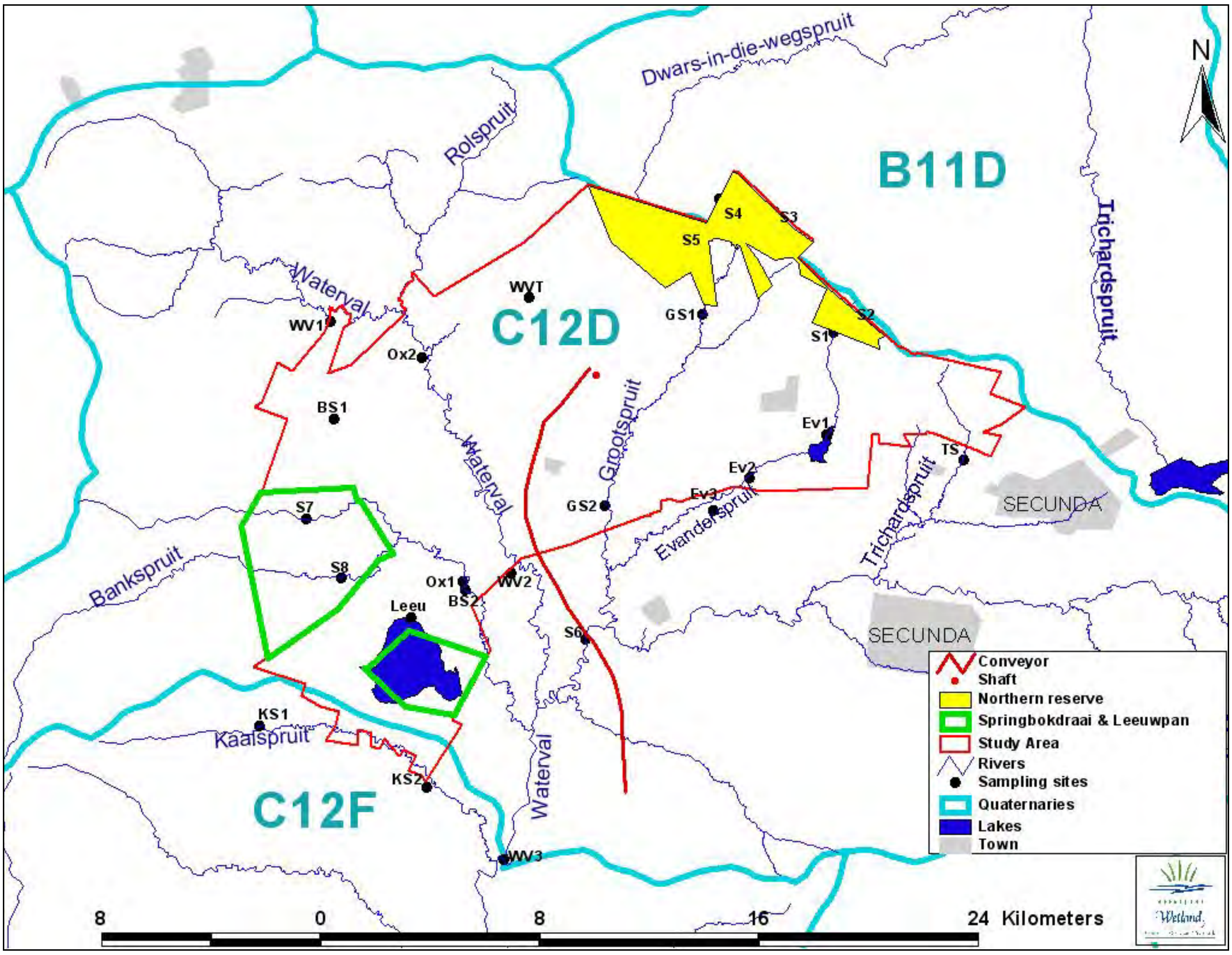


Figure 4. Aquatic ecosystems sampled during 2010 (S1-8) and 2002 relative to proposed conveyor routes and mining areas.

Table 4. List of pans, streams and oxbow lakes sampled for aquatic macroinvertebrates and fish in March 2002, relative to Block 8 mining area (from Palmer and Engelbrecht 2002).

Site No	Code	River	Farm name	Position in relation to mining area	Altitude (m amsl)	Locality
Pans						
1	Leeu	N/A	Rietkuil 531IR	Downstream	1566	26° 32' 51.4"S; 28° 59' 37.3''E
Oxbow lakes						
13	OX1	Bankspruit	Springbokdraai 277 IS	Within	1564	26° 32' 08.3"S; 29° 00' 38.6"E
7a	OX2	Waterval	Kromdraai 128 IS	Within	1578	26° 27' 43.8"S; 28° 59' 50.2"E
Streams						
2	KS1	Kaalspruit	Kaalspruit 528 IR	Upstream	1582	26° 34' 59.0"S; 28° 56' 39.4"E
3	KS2	Kaalspruit	Roodebank 323 IS	Downstream	1558	26° 36' 12.6"S; 28° 59' 56.2"E
4a	BS1	Bankspruit	Brakspruit 359 IR	Upstream	1595	26° 28' 56.9"S; 28° 58' 06.9"E
4	BS2	Bankspruit	Springbokdraai 277 IS	Downstream	1562	26° 32' 18.3"S; 29° 00' 41.9"E
7c	WVT	Waterval trib.	Kromdraai 128 IS	Upstream	1601	26° 26' 33.9"S; 29° 01' 57.0"E
6	WV1	Waterval	Klipfontein 357 IS	Upstream	1590	26° 27' 02.1S; 28° 58' 02.6"E
5	WV2	Waterval	Springbokdraai 277 IS	Downstream	1562	26° 31' 59.2"S; 29° 01' 35.2"E
Roo	WV3	Waterval	Roodebank 323 IS	Downstream	1550	26° 37' 36.8"S; 29° 01' 26.7"E
9	GS1	Grootspruit	Winkelhaak 135 IS	Upstream	1596	26° 26' 53.0"S; 29° 05' 21.6"E
8	GS2	Grootspruit	Witkleifontein 131 IS	Downstream	1567	26° 30' 39.0"S; 29° 03' 26.3"E
12	EV1	Evanderspruit	Driefontein 137 IS	Within	1606	26° 29' 15.4"S; 29° 07' 48.3"E
10	EV2	Evanderspruit	Winkelhaak 135 IS	Within	1596	26° 30' 07.2"S; 29° 06' 17.6"E
11	EV3	Evanderspruit	Goedvervagting 287 IS	Downstream	1577	26° 30' 45.5"S; 29° 05' 35.0"E
14	TS	Trib. Trichardspruit	Driefontein 137 IS	Within	1590	26° 29' 45.7"S; 29° 10' 29.8"E

Table 5. List of sites sampled for aquatic macroinvertebrates in June 2010.

Site	River/Position	Affecting Mining Area	Classification	Locality
Quaternary Catchment B11D				
S3	Tributary of the Dwars-in-die-wegspruit	Northern Reserve	Channelled Valley Bottom Wetland	S26 24 52.6 E29 06 46.7
S4	Tributary of the Dwars-in-die-wegspruit	Northern Reserve	Channelled Valley Bottom Wetland	S26 24 36.9 E29 05 41.6
Quaternary Catchment C12D				
S1	Evanderspruit,	Northern Reserve	Channelled Valley Bottom Wetland	S26 27 14.1 E29 07 56.7
S2	Tributary of the Evanderspruit	Northern Reserve	Channelled Valley Bottom Wetland	S26 27 07.4 E29 08 37.0
S5	Tributary of the Grootspruit	Northern Reserve	Channelled Valley Bottom Wetland	S26 25 39.1 E29 05 11.0
S6	Grootspruit	Conveyor Route	Floodplain	S26 33 16.6 E29 03 04.1
S7	Tributary of the Bankspruit	Springbokdraai/ Leeupan	Floodplain	S26 30 54.8 E28 57 34.7
S8	Bankspruit	Springbokdraai/ Leeupan	Floodplain	S26 32 05.4 E28 58 15.4

6. BASELINE FINDINGS

6.1 Water quality

On-site water quality data is given in the SASS5 table in Appendix A. Water was generally clear, with pH ranging from neutral to alkaline at most sites. The oxbow lakes were slightly acidic. pH is affected by temperature, this partly explaining the difference between readings taken in March (temperatures greater than 16 degrees Celsius) and those taken in June (less than 10 degrees Celsius).

Leeupan is now a permanently inundated pan due to waste water inputs from Harmony Gold Mine. Two weirs have been constructed in order to increase its storage capacity and the water levels are now artificially maintained. Leeupan has a high level of TDS. Water quality data for sites S6 (Grootspruit below Embalenhle), the Watervalspruit and Bankspruit are shown below (Table 6) and can be used as a baseline for future monitoring. Water quality within the Watervalspruit and Grootspruit are likely to be impacted by the conveyor route, while the Bankspruit will be impacted by potential mining within the Leeupan and Springbokdraai areas. The Grootspruit had high levels of salts, in particular, sulphates.

Table 6. Water quality results for samples taken in watercourses potentially impacted by the conveor route and possible mining in the Springbokdraai area.

	S6 Grootspruit	**WV2 Waterval River**	**BS2 Bankspruit**
pH	7.28	8.52	8.35
Electrical Conductivity (mS/m)	66	55	50
Cations/Anions (mg/l)			
Fluoride (1.5)	0.7	0.41	0.25
Nitrite (4.0)	1.21	0	0
Nitrate (44.0)	16.39	1.12	0.82
Chloride (250)	32.19	17.05	11.12
Sulphate (500)	136.39	42.25	35.15
Phosphate	4.65	0	0
Carbonate (20.0)	0	9	4.5
Bicarbonate	173.85	350.75	338.55
Subtotal	365.4	420.58	390.39
Sodium Carbonate	0	15.9	7.95
Sodium Bicarbonate	0	37.24	20.03
Alkalinity	142.50	302.5	285
Temp. Hardness	142.50	265.3	265.58
Perm. Hardness	86.01	0	0
Sodium (400)	74.32	53.93	38.9
Potassium (400)	8.78	4.32	4.38
Calcium (200)	50.19	48.17	48.56
Magnesium (100)	24.35	35.14	35.03
Boron (1.5)	0.21	0.03	0.01
Subtotal	157.85	141.59	126.88
Total dissolved Solids	436.08	386.63	347.73

6.2 Habitat Integrity

Results of the Habitat Integrity assessments of 2002 and 2010 are summarised in Table 7 below. These results are site specific for the reaches sampled and do not reflect conditions upstream or downstream within the catchment. A more catchment-level approach to present state is outlined in the wetlands report.

In general, sites along the Bankspruit were considered near-pristine, with agricultural impacts being the only disturbance. Trampling by cattle, weirs and farm roads have caused erosion and channel incision. The upper reaches (BS1) were considered close to pristine, with negligible incision and no alien fish.

The Kaalspruit was also considered near-pristine, the only impacts being from farm dams in the upper reaches which may have aggravated seasonal cessation of flows.

The Waterval River and Grootspruit had highly incised main channels, with associated bank collapse in places. This is probably due to road crossings or dams which have lowered the water table, negatively affecting the growth of riparian vegetation. Carp are expected to occur throughout the Waterval River although they were only recorded from the lower reaches. Site S6 lies on the Grootspruit immediately downstream of Embalenhle and is likely to have been impacted by stormwater and effluent inputs containing high levels of organic matter, salts, nutrients and sewage, in addition to mining-derived contaminants from further up in the catchment.

The upper Evanderspruit has been highly modified by grazing cattle (trampling and eutrophication) and farm dams. In 2002, sewage effluent and associated water quality impacts were evident at EV2 and EV3.

The main impacts within the two Dwars-in-die-wegspruit tributaries were dams, which cause channel incision and erosion in downstream reaches. In addition, grazing and trampling by cattle had compacted the substrate and affected water quality (by nutrient enrichment).

Leeupan was not assessed for habitat integrity in 2002 but was considered in the wetland Assessment report to be Category E (Seriously Modified) on account if its altered hydrology. Neverthless, the presence of flamingos within the pan suggests it may have some importance as a habitat for water birds.

Table 7. PES of aquatic sampling sites based on the Index of Habitat Integrity (DWAF 1999)

	C12F		C12D																					B11D	
	Kaalspruit		Leeu pan	Banksspruit					Waterval River					Grootspruit				Evanderspruit					Trichardt spruit	Dwars-in die-	
	KS1	KS2	Leeu	BS1	S7	S8	BS2	Ox1	Ox2	WV1	WVT	WV2	WV3	S5	GS1	GS2	S6	S1	S2	Ev1	Ev2	Ev3	TS	S3	S4
Instream																									
Water Abstraction	3	3		1	2	2	2			3	1	5	5	0	0	2	10	8	0	5	3	2	0	8	0
Flow Modification	8	2		1	2	2	1			2	1	3	3	5	5	5	14	14	11	15	20	20	10	16	10
Bed Modification	2	4		0	4	3	3			11	10	3	6	2	4	8	6	6	7	20	2	7	3	7	4
Channel Modification	4	2		0	7	5	7			8	6	10	2	8	2	12	5	5	13	20	2	6	4	15	11
Water Quality	2	4		3	3	3	3			7	4	5	13	5	10	8	20	5	2	8	25	20	12	2	4
Inundation	0	0		0	1	1	1			0	2	0	10	0	0	0	0	0	0	12	2	3	2	8	0
Exotic Macrophytes	0	0		0	0	0	0			0	0	0	0	0	0	0	1	0	0	0	8	0	0	1	1
Exotic Fauna	0	0		0	0	0	0			0	0	5	5	0	0	0	0	0	0	5	0	0	0	0	0
Solid Waste	0	0		0	1	0	1			0	3	12	8	2	5	5	7	0	0	2	0	0	10	0	0
TOTAL (Instream)	**A**	**A**		**A**	**A**	**A**	**A**			**B**	**B**	**B**	**C**	**B**	**B**	**B**	**D**	**C**	**C**	**D**	**D**	**D**	**B**	**C**	**B**
Riparian																									
Indigenous vegetation removal	0	0		0	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exotic Vegetation encroachment	2	2		1	1	1	1			4	1	3	5	4	1	4	5	3	2	0	0	0	0	2	2
Bank erosion	3	6		1	5	5	5			15	5	8	3	4	3	10	4	4	2	0	5	12	3	2	5
Channel modification	3	2		0	5	5	5			15	5	8	0	3	2	14	8	8	10	15	2	3	3	16	10
water abstraction	3	0		0	0	0	0			3	0	0	0	0	0	0	5	10	0	3	0	3	0	8	8
Inundation	0	0		0	0	0	0			0	0	0	4	0	0	0	0	0	0	5	3	3	0	8	0
Flow modification	2	0		0	0	0	0			0	0	0	3	10	0	2	10	10	7	12	15	8	3	11	10
Water quality	0	0		2	0	0	0			3	0	3	5	0	3	4	4	4	2	10	15	8	8	2	5
TOTAL (Riparian)	**A**	**A**		**A**	**A**	**A**	**A**			**C**	**A**	**B**	**B**	**B**	**A**	**B**	**B**	**B**	**B**	**C**	**B**	**B**	**A**	**D**	**B**
TOTAL PES (Habitat Integrity)	**A**	**A**	**n/a**	**A**	**A**	**A**	**A**	**n/a**	**n/a**	**B/C**	**A/B**	**B**	**B/C**	**B**	**A/B**	**B**	**C/D**	**C**	**C**	**C/D**	**C/D**	**C**	**A/B**	**C/D**	**B**

6.3 Aquatic Macroinvertebrates

SASS5 aquatic macroinvertebrate results are displayed in Appendix A and summarised in Table 8 overleaf. PES categories assigned according to invertebrates may have changed since the 2002 study due to updated interpretation guidelines, as described in section 5.1.

Oxbow lakes and Leeupan could not be analysed according to SASS5 criteria, which apply specifically to running water. These wetlands were not sampled during 2010 and the relevant excerpts from Palmer and Engelbrecht (2002) are reproduced in the box below.

Site 1: Leeupan

During this study, the invertebrate fauna at Leeupan was characterised by a low numbers and low numbers of species, dominated mainly by bugs (hemiptera), particularly Notonectidae (Appendix A). One species of mayfly was recorded, and a single freshwater shrimp (Caridina africana) was collected. The water column contained low populations of zooplankton (copepoda). The taxa present were hardy and highly tolerant of polluted conditions. The low numbers of invertebrates may reflect severe predation by fish, as refuges from predation in the pan by way of habitat diversity, are limited. Overall, and based on professional judgement, the present condition of the invertebrate assemblage at this site is considered poor (Category E).

Oxbow lakes

Aquatic vegetation in both oxbow lakes that were sampled provided excellent habitat conditions for aquatic invertebrates (Score=5). The diversity of crustacean species in the oxbow lakes was high, but this would not be detected by the SASS method. The fauna was characterised by a wide variety of taxa typically associated with temporary ponds, including Anostraca, Conchostraca, Copepoda, Ostrocoda and Cladocera. Crabs were notably absent from these lakes. Baetid mayflies were abundant and comprised more than two species. Fish were absent from both ponds, and this may partly explain the high numbers of invertebrates. It is likely that fish are naturally absent from these systems. Shrimps were also absent, as would be expected. Overall, the invertebrate fauna at these sites comprises an interesting group of taxa that justifies special conservation measures to protect these habitats. This is particularly so for the oxbow lake adjacent to the Bankspruit (OX1), which based on professional judgement, was considered to be in an excellent Present Ecological State in terms of invertebrates (Category B).

Table 8. Summarised SASS5 results for aquatic sites sampled in 2002 and 2010.

Quaternary	C12F		C12D																					B11D	
River System	Kaalspruit		Leeu pan	Bankspruit					Waterval River					Grootspruit				Evanderspruit					Trichardt spruit	Dwars-in-die-Wegspruit	
SITE	KS1	KS2	Leeu	BS1	S7	S8	BS2	Ox1	Ox2	WV1	WVT	WV2	WV3	S5	GS1	GS2	S6	S1	S2	Ev1	Ev2	Ev3	TS	S3	S4
Sampling Date	March 2002	March 2002	March 2002	March 2002	June 2010	June 2010	March 2002	March 2002	March 2002	March 2002	March 2002	March 2002	March 2002	June 2010	March 2002	March 2002	June 2010	June 2010	June 2010	March 2002	March 2002	March 2002	March 2002	June 2010	June 2010
Temp (°C):	17	22	22	17	7.8	7.57	24		22	20	28		24	8.6	25	24	10.6	8.5	7.7	22		23		9.3	8.93
pH:	7.1	7.4	7.4	7.5	10.02	9.41	7.6	6.8	6.6	7.5	8.6	7.5	7.6	8.8	8	7.1	8.8	8.8	9.36	7.9	8.1	8.1	8.2	8.4	8.7
Cond (mS/m):	48.5	54.7	1560	46.9	58.6	55.3	56.3	26.6	15.6	75	49.4	92.2	69.9	97	108	105	66.4	111	70.5	90.7	82.8	105	113	66.6	131.9
Biotopes Sampled (Rated 1-5) Stones	0	1	0	0	1	1	2	0	0	4	2	4	4	0	0	4	0	0	0	0	3	2	0	0	0
Marginal vege	4	3	4	5	3	3	3	5	5	4	3	3	4	4	3	3	3	3	3	3	4	4	3	3	3
Sediment	2	2	2	3	2	2	1	3		3	3	4	3	1	2	3	2	2	1	3	1	2	3	1	2
TOTAL No. SASS TAXA (+non-SASS taxa)	17	19	9 (+1)	21	13	20	15	8 (+5)	12 (+2)	19	23	14	13	12	18	14	8	9	13	20	7	11	14	5 (+1)	12
SASS Score	89	88	N/A	103	61	100	70	N/A	N/A	86	108	67	55	61	82	58	28	39	59	90	20	44	69	n/a	n/a
Average Score per Taxon	5.2	4.6	N/A	4.9	4.7	5.0	4.7	N/A	N/A	4.5	4.7	4.8	4.2	5.1	4.6	4.1	3.5	4.3	4.5	4.5	2.9	4.0	4.9	n/a	n/a
PES (aquatic macroinvertebrates)	B	C	E	B	C	B	C	B	C	C/D	B	C	E	B	C	E	F	E	D	C/D	F	E	C	C	C

Streams

The highest overall diversity of aquatic macroinvertebrates was recorded within the Bankspruit system (S7 and S8), the tributary of the Watervalrivier (WVT) and the upper reaches of the Evanderspruit (Ev1).

Category B: Largely Natural

SASS5 scores were also highest within the Bankspruit and its tributaries (BS1 and S8), as well as the Watervalrivier tributary (WVT). These sites indicated a higher prevalence of sensitive taxa and were considered Largely Natural (Category B) for invertebrates (ASPT = 4.9 and 5.0). The Bankspruit system was characterised by high numbers of atyid shrimps, limpets (Ancylids), bulinid snails, lestid damselflies and water mites (Hydracarina) (at BS1). In addition, a mussle (Unionidae) shell was found at S8, together with an abundance of dixid midges which are highly sensitive to changes in water quality. Otter scats were observed along the Bankspruit tributary at S7.

A number of Oxbow lakes are associated with the Bankspruit (e.g. adjacent to S8 and BS2). These lakes are inhabited by highly specialised invertebrates that are adapted to seasonal drying, including pan-adapted taxa such as Conchostraca and Anostraca, recorded at Ox1. As such, they contribute significantly to the overall biodiversity of the area. In addition, they provide abundant food resources for waterfowl, further increasing the local biodiversity.

The Watervalrivier tributary (WVT) was characterised by sensitive lestid damselflies, more than two species of baetid mayfly and caenid mayflies.

The upper reaches of the Kaalspruit was also characterised by a number of sensitive taxa (ASPT = 5.2), including lestid damselflies and dixid midges.

Category B-C: Largely Natural to Moderately Modified

Sites along the Watervalrivier showed a decline in water quality from upstream to downstream reaches. The river was characterised by high numbers of baetid mayflies and freshwater shrimps, and the notable absence of Gerridae, Hydracarina and Pleidae. Freshwater sponges (Porifera) were recorded in the middle reaches of the Waterval River (WV2), and nowhere else in the study area. Downstream of the confluence with the Grootspruit, the water quality declines markedly and at WV3 water quality issues can be considered serious.

The same trend is evident in the Grootspruit, with sensitive taxa being present within the upper reaches (S5 and GS1), including dixid midges, aeshnid dragonflies, hydraenid beetles and water mites. At site GS2, downstream of Evander and associated mining activities, atyid shrimps were still present but at site S6, downstream of Embalenhle and the confluence with the Evanderspruit, no sensitive taxa remain and the river was considered Critically Modified for invertebrates.

Category D-F: Largely to Critically Modified.

Very low SASS5 scores were recorded from the Evanderspruit, with sensitive taxa only being recorded at S2 and Ev1 (aeshnid dragonflies and water mites respectively). However, S1 and S2 had very limited biotope availability, this contributing to the low scores.

Sites S3 and S4, both tributaries of the Dwars-in-die-wegspruit, recorded low diversities and SASS5 scores. However, this is unlikely to be due to water quality impacts and is more likely to be associated with low habitat diversity, as well as very low flows at the time of sampling. These two sites were essentially wetland areas and should ideally not be analysed according to the SASS5 methodology. A subjective assessment of these sites was therefore mad, classifying them as Category C (Moderately Modified) for invertebrates.

6.4 Fish

Fish were not assessed in 2010 and results from Palmer and Engelbrecht (2002) are summarised below. The full fish assessment can be found in section 4.4 (pg33) of Appendix B.

The most important sites for fish were:

- the Bankspruit (Category A, Unimpacted – Category B, Largely Natural). The fish in the Bankspruit recorded high observed species richness, abundance, sensitivity and health compared with those expected. Exotic fish were absent and habitat suitability was high.
- the upper reaches of the Kaalspruit (Category B, Largely Natural)

There is a possibility that the rare Rock Catlet (*Austroglanis sclateri*) could occur in at least the lower reaches of the Watervalrivier.

Table 9. Qualitative assessment of the fish assemblage integrity at the sampling sites in Middelbult Block 8 mining area. Sites are arranged in order of decreasing Present Ecological State with respect to fish. (Extracted from Palmer and Engelbrecht 2002).

	SAMPLING SITE																
INDICATORS	BS1	KS1	BS2	GS2	TS	WV1	KS2	WV2	VW3	EV1	GS1	WVT	EV3	Lee	EV2	OX1	OX2
Native Species Richness	5	3	5	4	4	4	3	4	3	4	3	3	3	2	0	N/A	N/A
Presence of Native intolerant species	5	3	5	5	4	3	3	4	4	3	3	3	3	2	0	N/A	N/A
Abundance of native species	4	4	3	3	3	4	3	3	3	3	2	2	2	2	0	N/A	N/A
Native species Frequency of Occurrence	4	4	3	3	3	4	3	3	3	3	2	2	2	2	0	N/A	N/A
Health/condition; native & introduced species	5	5	5	5	5	5	3	5	5	5	5	5	4	5	0	N/A	N/A
Presence of introduced fish species	5	5	5	5	5	4	5	4	4	4	5	5	5	3	5	N/A	N/A
Instream habitat modification	4	5	3	5	3	3	5	2	3	2	3	2	1	2	2	N/A	N/A
	32	29	29	2	27	27	25	25	25	24	23	21	20	18	7	N/A	N/A
SCORE	**91**	**83**	**83**	**77**	**77**	**77**	**71**	**71**	**71**	**69**	**66**	**60**	**57**	**51**	**20**	**N/A**	**N/A**
CLASS	**A**	**B**	**B**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**D**	**D**	**E**	**N/A**	**N/A**

7. BASELINE ASSESSMENT: SUMMARY

7.1 Overall PES and Ecological Importance and Sensitivity

The overall PES is given in the table below.

Table 10. Overall PES for aquatic sampling sites, derived from assessments of invertebrates, habitat integrity and fish.

			Habitat Integity PES	Invertebrates PES	Fish PES	OVERALL PES
C12F	Kaalspruit	KS1	A	B	B	B
		KS2	A	C	C	C
C12D	Leeupan	Leeu	n/a	E	D	E
	Bankspruit	BS1	A	B	A	A
		S7	A	C		B
		S8	A	B		A/B
		BS2	A	C	B	B
		Ox1	n/a	B	n/a	B
	Waterval River	Ox2	n/a	C	n/a	C
		WV1	B/C	C/D	C/D	C
		WVT	A/B	B	C	C
		WV2	B	C	C	C
		WV3	B/C	E	C	D
	Grootspruit	S5	B	B		B
		GS1	A/B	C	C	C
		GS2	B	E	C	D
		S6	C/D	F		E
	Evanderspruit	S1	C	E		C
		S2	C	D		C
		Ev1	C/D	C/D	C/D	C
		Ev2	C/D	F	E	E
		Ev3	C	E	D	E
	Trichardtspruit	TS	A/B	C	C	C
B11D	Dwars-in-die-Wegspruit	S3	C/D	C		C
		S4	B	C		B/C

7.2 Sensitive and Ecologically Important Ecosystems

PES A/B: HIGH Ecological Importance and Sensitivity

The Bankspruit should receive priority status in terms of sensitivity and conservation importance. BS1 and S8 were considered to be close to pristine in terms of habitat integrity and fish. All species of indigenous fish that were expected within the Bankspruit were recorded (BS1 and BS2). No exotic fish were present and at BS1 there was negligible incision of the main channel. Sites S7 and S8 were not sampled for fish but are expected to yield the same results. In addition, the oxbow lakes present along the Bankspruit should be considered ecologically important as they support unique and highly adapted crustaceans that increase the overall biodiversity value of the area, as well as supporting a diversity of waterfowl. The pan-adapted crustaceans that were recorded within Ox1 are highly sensitive to changes in water quality and seasonal hydrology.

The Upper reaches of the Kaalspruit was considered to be Largely Natural (Category B), with a number of sensitive invertebrates having being recorded, together with a high habitat integrity and healthy fish population (with no alien fish species).

PES C: Moderate Importance and Sensitivity

The Watervalrivier was, for the most part, considered to be Moderately Modified (Category C), although there was a gradual deterioration downstream with the Roodewaal site (WV3) considered Largely Modified (Category D), particularly with respect to invertebrates and water quality.

The upper Grootspruit, upper Evanderspruit, Dwars-in-die-wegspruit, Trichardtspruit and the lower reaches of the Kaalspruit were considered Moderately Modified, although conditions along the Grootspruit and Evanderspruit deteriorated significantly in their lower reaches.

The most significant feature of these streams is severe incision of the main channel, and associated bank slumping. This appears to have been caused by stream crossings, which have constricted flows and increased erosion downstream. The deepening of the main channel has reduced the level of the riparian water table, and in doing so, the survival of remaining riparian wetlands is at stake. Carp are expected to occur throughout most of the Waterval River, although they were recorded in the lower reaches only, at Roodebank.

PES D/E: Low Importance and Sensitivity

Flow within the middle and lower Evanderspruit, at the time of sampling in 2002, consisted entirely of treated sewage effluent and was classified as seriously modified (Category E). No fish were recorded immediately downstream of the sewage outlet (EV2), while two out of the three species expected were recorded further downstream (EV3) but only in aerated riffle areas, suggesting low levels of dissolved oxygen at this site. The invertebrate fauna in this stream comprised fauna typically associated with highly polluted conditions.

The Grootspruit below Embalenhle and above the confluence with the Watervalriver was also Seriously Modified with a complete absence of sensitive invertebrates and a low diversity of taxa. Water quality impacts are likely to be from mining and sewage within urban stormwater effluent.

It should be noted that impacts on the Evanderspruit and Grootspruit are likely to be carried further downstream into the Watervalspruit.

Leeupan was also classified as seriously modified (Category E), on account of the unnaturally high and stable water levels, the high concentration of Total Dissolved Solids, and the depauperate fish and invertebrate fauna. However, it may have some importance in providing habitat for water birds.

Conclusions

The Bankspruit was found to be highly sensitive and important, with near-pristine conditions present. As such, it should be given priority conservation status, with little risk allowed. Mining in the Springbokdraai area is likely to have highly significant impacts on this river system.

In addition, the temporary oxbow lakes associated with the Bankspruit, as well as the Waterval River, should be regarded as important and sensitive ecosystems for their role in supporting and enhancing biodiversity. It is suggested that rehabilitation of incised reaches of the Bankspruit and Watervalrivier will assist in maintaining the hydrology that supports these oxbow lakes.

The upper reaches of the Kaalspruit should also be maintained in a Largely Natural (Category B) condition. Rehabilitation within the lower reaches will offset some of the impacts of farm dams in the upper reaches.

The Waterval River was considered, for the most part, to be Moderately Modified (Category C) with channel incision and erosion being the main impact. Water quality appears to be relatively good upstream of its confluence with the Grootspruit.

Most of the Evanderspruit has been polluted by sewage effluent, mining contaminants and urban stormwater. The lower reaches were considered to be Seriously Modified (Category E) and these impacts are transferred downstream into the lower reaches of the Grootspruit, also considered Seriously Modified.

Leeupan was also considered to be Seriously Modified for fish and invertebrates, although it does support a diversity of water birds, including flamingos and, as such, should be regarded as ecologically important and sensitive for birds.

Finally, it is important to point out that any activity which is contemplated and which will impact on the wetlands within the study area is subject to authorisation under Section 21 of the National Water Act (Act 36, 1998). As such, all proposed wetland crossings will require a Water Use License.

8. IMPACT ASSESSMENT

8.1 Methods

Impacts were assessed for each phase of the development according to the rating system (excel spreadsheet) provided by JMA consulting. These are summarised below:

TABLE 1: CRITERIA FOR DETERMINING SEVERITY		
Criteria	**Definition**	**Points**
Quantity	**The quantity (Volume) that will impact on the environment**	
	Less than 1m^3 / incident or > 10 mg/ m^3 or < 61dBa	0
	More than 1 m^3 but less than 10 m^3 per incident or > 25	1
	More than 10 m^3 but less than 100 m^3 per incident > 50 mg/ m^3 or > 61dBa	2
	More than 100 m^3 but less than 1000 m^3 per incident or > 100mg/ m^3	3
	More than 1000 m^3 per incident \ continuous or > 120 mg/ m^3 or > 85dBa	4
Toxicity	**Hazard rating (Dangerous properties of hazardous material)**	
	Non-hazardous – (substances which will not result in any risk)	0
	Hazard rating 1 – (Substances which could result in relatively low risk)	1
	Hazard rating 2 – (Substances which could result in serious risk)	2
	Hazard rating 3 – (Substance which could result in severe risk)	3
Extend	**How far does the impact extend?**	
	Limited to Business unit	0
	Limited to mine lease area	1
	Regional (Refer to TEKSA area)	2
	National (Refer to Mpumalanga area)	3
	International (refer to beyond South Africa's boundaries)	4
Duration	**How long will the impact last?**	
	Less than 5 years	0
	Between 5 – 15 years	1
	Exceeding mine lifetime	2
	Impact permanently present	3
Status	**Status of impact**	
	Beneficial (Improve the environment) – no risk reduction needed	-1
	Neutral (No change to the environment) – No risk reduction needed	0
	Adverse (Degradation of the environment) – Risk reduction needed	1
Legislation	**Are there any regulatory requirements applicable to aspects – impacts?**	
	None	0
	Yes, No fines, not cause loss of operating permit, but still reportable incident	1
	Yes, and will result in / prosecution or loss in production	2
	Yes, and will cause loss of operating permit or mine stoppage.	3
	Yes, and may lead to closing down of mine	4
I & AP's	**Interested and affected parties (I&AP)**	
	No impact	0
	Impact to employees in unit	1
	Impact to local community / stakeholders	2
	Impact to general public – beyond TEKSA area (Bad publicity)	3

TABLE 2: CONSEQUENCE CATEGORY (C-VALUE)	
Severity score	**Risk matrix Consequence category**
21 - 22	C7
19 - 20	C6
17 - 18	C5
14 - 16	C4
^10 - 13	C3
^5 - 9	C2
Less than 5	C1

TABLE 3: PROBABILITY MATRIX (P-VALUE)			
Likelihood Descriptors	**Prob Intervals**	**Likelihood Definitions**	**P-value**
Unforeseen	0 – 0.1%	The event is not foreseen to occur	P1
Highly unlikely	0.1 – 1%	The event may occur in exceptional circumstances (very remote)	P2
Very unlikely	1 – 5%	The event may occur in certain circumstances (remote chance)	P3
Low	5 – 15%	The event could occur (moderate chance)	P4
Possible	15 – 40%	The event may occur (realistic chance)	P5
Likely	40 – 75%	The event will probably occur (significant chance)	P6
Almost Certain	75 – 100%	The event is expected to occur or occurs regularly	P7

TABLE 4: RISK LEVEL TABLE

LIKELIHOOD

IMPACT		P1	P2	P3	P4	P5	P6	P7
		Unforeseen	Highly unlikely	Very unlikely	Low	Possible	Likely	Almost certain
	C7	Level 3 Risk	Level 3 Risk	Level 3 Risk	Level 1 Risk	Level 1 Risk	Level 1 Risk	Level 1 Risk
	C6	Level 3 Risk	Level 3 Risk	Level 3 Risk	Level 2 Risk	Level 2 Risk	Level 2 Risk	Level 1 Risk
	C5	Level 4 Risk	Level 4 Risk	Level 4 Risk	Level 3 Risk	Level 2 Risk	Level 2 Risk	Level 2 Risk
IMPACT	C4	Level 5 Risk	Level 5 Risk	Level 5 Risk	Level 3 Risk	Level 3 Risk	Level 3 Risk	Level 3 Risk
	C3	Level 6 Risk	Level 6 Risk	Level 6 Risk	Level 5 Risk	Level 5 Risk	Level 5 Risk	Level 4Risk
	C2	Level 6 Risk	Level 6 Risk	Level 6 Risk	Level 6 Risk	Level 6 Risk	Level 6 Risk	Level 5 Risk
	C1	Level 6 Risk	Level 6 Risk	Level 6 Risk	Level 6 Risk	Level 6 Risk	Level 6 Risk	Level 6 Risk
		P1	P2	P3	P4	P5	P6	P7
		Unforeseen	Highly unlikely	Very unlikely	Low	Possible	Likely	Almost certain

8.2 Limitations

1. The impacts for ecosystems were rated according to a once-off field survey which may have missed important species with spatially or temporally isolated distributions. For example, certain fish species may have been missed and may erroneously have been assumed to be absent.
2. The ratings given for listed activities and water use licence applications have been lumped and should therefore be seen as an estimate of the overall impact. These should therefore be viewed as guidelines only and should be considered in association with individual impacts for each activity.
3. Specific activities were not identified under each water use licence application and exemption application category and impacts may therefore have been missed.

8.3 Summary of Significant Impacts

The complete list of impacts for each phase of development are rated in the Excel spreadsheet and are therefore not discussed in detail here. Highly significant impacts are summarised below:

8.3.1 Acidification and Salinisation of Surface Water

Oxidation and leaching of pyritic material in mined areas and stockpiles will result in the release of low pH, high metal and sulphate rich discharges into the surface waters and wetlands adjacent to the mining areas. Release into surface water can be direct (leaks or spills e.g. from dewatered mine water) or indirect (seepage via groundwater). This impact is expected to be of Very High (Definite, International, Very long-term, and of High intensity) significance.

Mitigation

It is currently impossible to effectively mitigate impacts from AMD. The probability of acid mine generation during the operational phase of the mine should be established. It is recommended that all mining activities, in particular, total extraction mining, be planned so as to avoid mining under drainage lines and wetlands. Mining under the slimes dam (including an appropriate buffer) should also be avoided.

Stockpiles and pollution control dams should be appropriately lined. Berms/drainage channels should be constructed both below and above stock piles to enable the separation of clean and contaminated water.

Pipelines used for dewatering should be regularly inspected and meticulously maintained and emergency preparedness plans should be prepared in the event of major spills.

In addition, water quality should be regularly monitored according to the suggested protocol and appropriate and timeous remedial interventions made in the case of non-compliance.

The water treatment plant should be able to cater for unforeseen high volumes and provision should be made for ongoing maintenance and capacity to operate throughout the operational phase and post-closure phases.

8.3.2 Loss of Biodiversity and Sensitive Ecosystems

The floodplain systems along the Waterval and Bankspruit have oxbow lakes associated with the main channel. The oxbows and the channel are hydrologically connected, acting as a functional whole. The oxbows provide additional habitats for aquatic fauna and flora, most notably dragonflies and damselflies, frogs and crustaceans, which, in turn, are eaten by animals higher up in the food chain such as birds and otter. They therefore increase the overall biodiversity of the catchment. Decreased base flows during mining will result in increased channelisation of the main channel, ultimately reducing the connectivity between the channel and oxbow lakes and resulting in a loss of species.

In addition, contamination of surface water with acidic, salt-rich mine water, either directly as a result of spills, subsidence or decanting mine water, or indirectly as a result of seepage, will cause the loss of sensitive aquatic biota. Other water quality impacts such as increased turbidity and suspended solids, could affect visual predators such as fish, while habitat changes (e.g. sedimentation and excessive reed growth) will result in changes in species composition.

Loss of sensitive invertebrate taxa may affect other animals higher up in the food chain, such as birds, otter and frogs. Ultimately, the loss of sensitive biota will result in a decline in the overall biodiversity value of the area. The significance of this impact is likely to be High in the Bankspruit catchment, which was considered pristine to Largely Natural in the baseline report.

Mitigation
All recommendations pertaining to acid drainage, sedimentation, erosion, spillages, leaks and alien invasion apply. Particular care should be taken at stream crossings. It is important that all staff be educated on the importance of conserving biodiversity and in identifying areas of importance, so that impacts to these areas can be minimized.

8.3.3 Subsidence and Decanting of Mine Water

Decanting water will likely have a low pH and be metal and sulphate rich. It is likely to discharge into the surface waters and wetlands adjacent to the mining area. This impact is expected to be of Very High significance (Definite, International, Very long-term, and High intensity).

Of greatest concern is that areas of total extraction will underlie wetland areas within the Bankspruit catchment, classified as “Pristine to Largely Natural” in the baseline assessment. In addition, the Vaal River catchment is, as yet, relatively unimpacted by mining. As more and more mines are approved in this catchment, it is likely that the Vaal will eventually suffer the same water quality problems evident in the Olifants River.

Subsidence in this area is likely to have a Highly Significant impact on the entire catchment, potentially triggering bad publicity and mine stoppage.

Mitigation
1. It is recommended that pillar extraction methods NOT be used where they coincide with delineated wetlands

2. Decant and treatment of mine water should be planned to effectively continue throughout post-closure. Provision must be made for financial, maintenance and capacity requirements, including provision for unexpected excessive volumes and emergency spills.

8.4 Cumulative Impacts

The most significant cumulative impact will be on water quality within the Vaal and Olifants River catchments. Both systems, in particular the Olifants, are already highly impacted by mining and continued impacts may result in the loss of ecological integrity and functioning along large sections. Their ability to buffer any accidental or unforeseen pollution events will be severely compromised. International water users (Mozambique) will be affected and international treaties may come into consideration.

In addition, the Vaal River catchment is, as yet, relatively unimpacted by mining. As more and more mines are approved in this catchment, it is likely that the Vaal will eventually suffer the same water quality problems evident in the Olifants River. Moreover, previously unimpacted systems, such as the Bankspruit will be permanently impacted, further reducing the number of pristine aquatic ecosystems in the country.

A further cumulative impact is likely to be an increase in sediment loads within the Vaal and Olifants River catchments, with consequences for dam capacities, riparian habitats and biota.

9. MANAGEMENT RECOMMENDATIONS

Objectives and mitigation measures are summarised in the Excel spreadsheet and under each impact discussed in Section 8 and are not repeated here. Recommendations for monitoring are given below:

9.1 Recommendations for Monitoring

It is recommended that monitoring be undertaken during all phases of mining as described in the sections below. Data collected during this study should serve as a baseline against which future data can be measured. Therefore, monitoring points should coincide as closely as possible to the sites sampled during the Baseline Surveys (Co-ordinates are given in Tables 4 and 5). Any significant difference from the baseline levels should be red-flagged, investigated and follow-up action taken. Such follow-up action should be recorded in a register so that repeated recordings of similar problems are treated as non-compliances or incidents that trigger more effective interventions.

It is recommended that monitoring endpoints (i.e. Target Ecological Management Category) be set as follows:

- Bankspruit: Category B (Largely Natural)
- Kaalspruit: Category C (Moderately Modified)
- Trichardtspruit: Category C (Moderately Modified)
- Waterval River: Category D (Largely Modified)
- Grootspruit: Category E (Seriously Modified)
- Evanderspruit: Category E (Seriously Modified)
- Leeupan: Category E (Seriously Modified)
- Dwars-in-die-Wegspruit: Category C (Moderately Modified)

9.1.1 Water quality

It is recommended that sampling points be analysed on a monthly basis for basic anions and cations (including sulphates, calcium and sodium) as well as Total Dissolved Solids (i.e. salts), electrical conductivity and pH. Levels should not be significantly higher than those measured during the baseline report (Table 6) and pH should not drop below 6.5. Target water quality levels should be set in conjunction with the Department of Water Affairs. It is recommended that the Water Quality Guidelines for ecosystems be applied as far as possible.

In addition, it is recommended that diatoms be analysed as a more long-term and reliable means of measuring water quality. Diatoms provide a rapid response to specific physico-chemical conditions in aquatic ecosystems and are often the first indication of change. The presence or absence of indicator taxa can be used to detect specific changes in environmental conditions such as eutrophication, organic enrichment, salinisation and changes in pH.

9.1.2 Wetland habitat integrity

An annual assessment of wetlands, preferably conducted in summer should assess the PES (Present Ecological State) of affected wetlands. It is important that photographs be taken as a record of changes in, for example, vegetation and channel morphology over time. An annual wetland assessment report should include recommendations for rehabilitation, where necessary. These recommendations should be immediately addressed and recorded in a register, together with a record of the corrective action taken. PES should not fall more than one category below the category attained in the baseline survey (Table 10).

9.1.3 Aquatic Macroinvertebrates and fish

It is recommended that sampling points be sampled and analysed on a biennial basis for aquatic macroinvertebrates and fish. Sampling should be conducted during spring and autumn (October and April/May). The SASS5 results should be analysed according to guidelines given in Dallas (2008) for the sake of continuity. Fish should be sampled in all channelled systems, including sites S7 and S8 along the Bankspruit (not sampled during the baseline survey.). The PES category for both fish and macroinvertebrates should not drop by more than one category than those given in the baseline study. Loss of any fish species or any sensitive invertebrate taxon (scoring 8 or more) should trigger immediate corrective action. It is recommended that a system be implemented whereby all specialist advice can be incorporated into action plans.

9.1.4 Avifauna

An annual survey of avifauna, in particular flamingos, by a qualified specialist, is recommended for Leeupan. Recommendations should automatically trigger management interventions.

9.1.5 Rehabilitation

A rehabilitation plan should be compiled by a wetland specialist to address impacts to wetlands during all phases of the development. The plan should include:

- An alien vegetation plan and programme for regular alien inspections and clearing.
- A monitoring programme for regular inspections of rehabilitation success (e.g. erosion, revegetation success, effectiveness of interventions, etc.)

10. REFERENCES

Brinson, M. M. 1993. *A hydrogeomorphic classification for wetlands*. Wetlands Research Program Technical Report WRP-DE-4. U. S. Army Corps of Engineers, Waterway Experiment Station. Vicksburg, MS: Bridgham and Richardson.

Dallas, H.F. 2007. River Health Programme: South African Scoring (SASS) data interpretation guidelines; Unpublished Report to the INR and DWAF.

Department of Water Affairs and Forestry. 1999a. *Resource Directed Measures for Protection of Water Resources.* Volume 4. Wetland Ecosystems Versi
on 1.0, Pretoria.

Department of Water Affairs and Forestry. 1999b. *Resource Directed Measures for Protection of Water Resources.* Volume 1. River Ecosystems Version 1.0, Pretoria.

Department of Water Affairs and Forestry, 2005. *A practical field procedure for identification and delineation of wetland and riparian areas*. DWAF, Pretoria.

Dickens, C., & Graham, M. 2001. South African Scoring System (SASS) Version 5. Rapid bioassessment method for river. Umgeni Water. Unpublished report.

Jubb, R. A. (1967). Freshwater fishes of southern Africa. Balkema, Cape Town. 248 pp.

Kleynhans, C. J. & J. S. Engelbrecht, (2001). The use of ecological information on fish in the specification of the flow component of the reserve (desktop, rapid, intermediate and comprehensive determinations). In: MacKay, H (ed.): Water resources protection policy implementation. Resource directed measures for protection of water resources. River Ecosystems Revised Version . DWAF, Pretoria.

Kleynhans, C.J. 1996. A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River. *Journal of Aquatic Ecosystem Healt*h 5: 41 - 54.

Kleynhans, C.J. 1999. *A procedure for the determination of the ecological reserve for the purposes of the national water balance model for South African Rivers*. Institute for Water Quality Studies. Department of Water Affairs and Forestry, Pretoria.

Palmer, R. and Engelbrecht, J. 2002. Middelbult Block 8: Aquatic Ecosystems Baseline Assessment, Unpublished Report to Oryx Environmental.

Skelton, P. (1993). A complete guide to the freshwater fishes of southern Africa. Southern Book Publishers. Halfway House.

Walker, L.R. 1999. *Ecosystems of Disturbed Ground*. In: *Ecosystems of the World*. Elsevier

11. APPENDIX A: SASS5 RESULTS

Table 11. Full list of SASS5 data collected during March 2002 (by Palmer and Engelbrecht 2002) and June 2010.

Quaternary		C12F		C12D																			B11D	
River System		Kaalspruit		Leeu pan	Bankspruit					Waterval River					Grootspruit				Evanderspruit					Trichardt spruit	Dwars-in-die-Wegspruit	
SITE		KS1	KS2	Leeu	BS1	S7	S8	BS2	Ox1	Ox2	WV1	WVT	WV2	WV3	S5	GS1	GS2	S6	S1	S2	Ev1	Ev2	Ev3	TS	S3	S4
Sampling Date		March 2002	March 2002	March 2002	March 2002	June 2010	June 2010	March 2002	March 2002	March 2002	March 2002	March 2002	March 2002	March 2002	June 2010	March 2002	March 2002	June 2010	June 2010	June 2010	March 2002	March 2002	March 2002	March 2002	June 2010	June 2010
	Temp (°C):	17	22	22	17	7.8	7.57	24		22	20	28		24	8.6	25	24	10.6	8.5	7.7	22		23		9.3	8.93
	pH:	7.1	7.4	7.4	7.5	10.02	9.41	7.6	6.8	6.6	7.5	8.6	7.5	7.6	8.8	8	7.1	8.8	8.8	9.36	7.9	8.1	8.1	8.2	8.4	8.7
	Cond (mS/m):	48.5	54.7	1560	46.9	58.6	55.3	56.3	26.6	15.6	75	49.4	92.2	69.9	97	108	105	66.4	111	70.5	90.7	82.8	105	113	66.6	131.9
Biotopes Sampled (Rated 1-5)	Stones	0	1	0	0	1	1	2	0	0	4	2	4	4	0	0	4	0	0	0	0	3	2	0	0	0
	Marginal vege	4	3	4	5	3	3	3	5	5	4	3	3	4	4	3	3	3	3	3	3	4	4	3	3	3
	Sediment	2	2	2	3	2	2	1	3		3	3	4	3	1	2	3	2	2	1	3	1	2	3	1	2
TOTAL No. SASS TAXA (+non-SASS taxa)		17	19	9 (+1)	21	13	20	15	8 (+5)	12 (+2)	19	23	14	13	12	18	14	8	9	13	20	7	11	14	5 (+1)	12
SASS Score		89	88	N/A	103	61	100	70	N/A	N/A	86	108	67	55	61	82	58	28	39	59	90	20	44	69	n/a	n/a
Average Score per Taxon		5.2	4.6	N/A	4.9	4.7	5.0	4.7	N/A	N/A	4.5	4.7	4.8	4.2	5.1	4.6	4.1	3.5	4.3	4.5	4.5	2.9	4.0	4.9	n/a	n/a
PES (aquatic macroinvertebrates)		B	C	E	B	C	B	C	B	C	C/D	B	C	E	B	C	E	F	E	D	C/D	F	E	C	C	C
SASS5 Taxon	SASS5 Sensitivity Score*																									
Porifera	5												A													
Turbellaria	3					1			A		A															
ANNELIDA																										
Oligochaeta (Earthworms)	1				A	A	A		C		B	B	A				B	B			A	B	A	A		
Hirudinea (Leeches)	3								1					1				1				1				
CRUSTACEA																										
Potamonautidae* (Crabs)	3	A									B	A	A			A	A				1	A		1		
Atyidae (Freshwater Shrimps)	8	B	B	1	C		A	B			C	1	C	C			B				B		1	B		
HYDRACARINA (Mites)	8	1	A		B					A		A				A				1	A			C	1	
EPHEMEROPTERA (Mayflies)																										
Baetidae 1sp	4			A										1	A				A	A					A	A
Baetidae 2 sp	6	B	A				A	A						B		C	A	B			B		A	B		
Baetidae > 2 sp	12				B	B			C	C	B	B	B													
Caenidae (Squaregills/Cainfles)	6					A	A	A			1	B	A				A		A							A
Leptophlebiidae (Prongills)	9																									
ODONATA (Dragonflies & Damselflies)																										
Coenagrionidae (Sprites and blues)	4	B	A	B	B	A	A	A		A	B	A	A	C	A	B	B	A	A	A	B		A	A		A
Lestidae (Emerald Damselflies/Spreadwings)	8	B	1		B							1												A		
Aeshnidae (Hawkers & Emperors)	8	A	A	A	1		1								A	A				A						
Gomphidae (Clubtails)	6																									
Libellulidae (Darters/Skimmers)	4		1				1			1		1				A	1				1					
HEMIPTERA (Bugs)																										
Belostomatidae* (Giant water bugs)	3	A	1	A	A		A			A	1		A	A		B	A			A	C	B	A	1		A
Corixidae* (Water boatmen)	3	1	A	A	A	B	B			A	A	A				A			A	A	D		1			A
Gerridae* (Pond skaters/Water striders)	5	A	A		A		A	A	A	A		A			A	A			A	A	A					A
Hydrometridae* (Water measurers)	6															A					1					
Naucoridae* (Creeping water bugs)	7																									
Nepidae* (Water scorpions)	3		A					1						A			A				A	1				
Notonectidae* (Backswimmers)	3	A	A	C	B	A	A	A	B		A	A	A			B	A	A	A	A	A			A		A
Pleidae* (Pygmy backswimmers)	4	1		A	A							B			A	B			A		B		A	1	A	
Veliidae/M...veliidae* (Ripple bugs)	5	A									A			A		A								A		A

Quaternary		C12F		C12D																					B11D	
River System		Kaalspruit		Leeu pan	Banksspruit					Waterval River					Grootspruit				Evanderspruit					Trichardt spruit	Dwars-in-die-Wegspruit	
SITE		KS1	KS2	Leeu	BS1	S7	S8	BS2	Ox1	Ox2	WV1	WVT	WV2	WV3	S5	GS1	GS2	S6	S1	S2	Ev1	Ev2	Ev3	TS	S3	S4
Sampling Date		March 2002	March 2002	March 2002	March 2002	June 2010	June 2010	March 2002	March 2002	March 2002	March 2002	March 2002	March 2002	March 2002	June 2010	March 2002	March 2002	June 2010	June 2010	June 2010	March 2002	March 2002	March 2002	March 2002	June 2010	June 2010
Temp (°C):		17	22	22	17	7.8	7.57	24		22	20	28		24	8.6	25	24	10.6	8.5	7.7	22		23		9.3	8.93
pH:		7.1	7.4	7.4	7.5	10.02	9.41	7.6	6.8	6.6	7.5	8.6	7.5	7.6	8.8	8	7.1	8.8	8.8	9.36	7.9	8.1	8.1	8.2	8.4	8.7
Cond (mS/m):		48.5	54.7	1560	46.9	58.6	55.3	56.3	26.6	15.6	75	49.4	92.2	69.9	97	108	105	66.4	111	70.5	90.7	82.8	105	113	66.6	131.9
Biotopes Sampled (Rated 1-5)	Stones	0	1	0	0	1	1	2	0	0	4	2	4	4	0	0	4	0	0	0	0	3	2	0	0	0
	Marginal vege	4	3	4	5	3	3	3	5	5	4	3	3	4	4	3	3	3	3	3	3	4	4	3	3	3
	Sediment	2	2	2	3	2	2	1	3		3	3	4	3	1	2	3	2	2	1	3	1	2	3	1	2
TOTAL No. SASS TAXA (+non-SASS taxa)		17	19	9 (+1)	21	13	20	15	8 (+5)	12 (+2)	19	23	14	13	12	18	14	8	9	13	20	7	11	14	5 (+1)	12
SASS Score		89	88	N/A	103	21	38	70	N/A	N/A	86	108	67	55	26	82	58	15	24	34	90	20	44	69	n/a	n/a
Average Score per Taxon		5.2	4.6	N/A	4.9	1.6	1.9	4.7	N/A	N/A	4.5	4.7	4.8	4.2	2.2	4.6	4.1	1.875	2.7	4.5	4.5	2.9	4.0	4.9	n/a	n/a
PES (aquatic macroinvertebrates)		B	C	E	B	C	B	C	B	C	C/D	B	C	E	B	C	E	F	E	D	C/D	F	E	C	C	C
TRICHOPTERA (Caddisflies)																										
Hydropsychidae 1 sp	4				1	1	1	A			B	A	A	B			A	A								
Cased caddis:																										
Hydroptilidae	6																									
Leptoceridae	6																									
COLEOPTERA (Beetles)																										
Dytiscidae* (Diving beetles)	5	A	A		A	A	A	1	B	B	A	B	A		A	B				A			A		A	A
Noteridae*	5																									
Gyrinidae* (Whirligig beetles)	5	B	A		1						A		A			A	A				A					
Haliplidae* (Crawling water beetles)	5																									
Helodidae (Marsh beetles)	12																									
Hydraenidae* (Minute moss beetles)	8					1	1					A			1											
Hydrophilidae* (Water scavenger beetles)	5				A	1		1				A			A	A			1	A	A		A			A
Limnichidae (Marsh-Loving Beetles)	10																									
DIPTERA (Flies)																										
Ceratopogonidae (Biting midges)	5				1		1				1	1							1					1		
Chironomidae (Midges)	2		B	A	B	A	A	A	A	A	B	A	A	B	A	A	A	A			B	C	A	C	A	A
Culicidae* (Mosquitoes)	1		1		1							A														
Dixidae* (Dixid midge)	10	B					B								B											
Empididae (Dance flies)	6																									
Ephydridae (Shore flies)	3																									
Muscidae (House flies, Stable flies)	1											1														
Psychodidae (Moth flies)	1																									
Simuliidae (Blackflies)	5		C			A		A			C	B		C				A		A	A	A	A			
Syrphidae* (Rat tailed maggots)	1																									
Tabanidae (Horse flies)	5																									
Tipulidae (Crane flies)	5																									
GASTROPODA (Snails)																										
Ancylidae (Limpets)	6		A		C		A	A			1		A	A			1									
Sphaeridae	3									A	A													B		
Unionidae (mussels)	6						1 shell																			
Lymnaeidae* (Pond snails)	3						A							1												
Physidae* (Pouch snails)	3				C			1		A		1		1	A	A				A	A					A
Planorbinae* (Orb snails)	3									A					A					A	A					
Thiaridae* (=Melanidae)	3																									
NON-SASS5 Taxa	N/A																									
Cladocera	N/A	Present	Present			C	C		Present	Present					B	Present									C	B
Copepoda	N/A	Present		B		B	B		Present											B				Present		
Ostracoda	N/A						B		Present	Abundant									B							
Conchostraca	N/A								Present																	
Anostraca	N/A								Present																	

12. APPENDIX B: 2002 REPORT

MIDDELBULT BLOCK 8:

AQUATIC ECOSYSTEMS

BASELINE ASSESSMENT

July 2002

Prepared for
Oryx Environmental
Everite Building
Braamfontein

Prepared by
Dr Rob Palmer
AfriDev Consultants (Pty) Ltd
PO Box 4349
White River, 1240
Tel & Fax: 013-751 1533
email: afridevr@iafrica.com

&

Dr Johan Engelbrecht
PO Box 8024
Lydenburg, 1120
Tel: 013-235 4300
email: jseng@cis.co.za

TABLE OF CONTENTS

SUMMARY

This report provides a baseline assessment of the aquatic environment in the vicinity of the proposed Middelbult Block 8 mining area, west of Secunda. The report is based on a three-day site visit by two aquatic ecologists (RW Palmer and J Engelbrecht). Seventeen sites were selected for sampling fishes and invertebrates, fourteen of which were situated in streams, two in oxbow “lakes”, and one in Leeupan, an endorheic pan that is used to store excess mine water. The report assesses the ecological importance and sensitivity of the aquatic environment in the vicinity of the proposed mining area, describes the present Ecological State, and suggests measures for mitigation and monitoring.

Ecological Importance and Sensitivity

In general, aquatic ecosystems in the area are of low ecological importance and sensitivity (Class D: Large risk allowed). However, there is a possibility that the rare Rock Catlet (*Austroglanis sclateri)* could occur in at least the lower portion of the river. Furthermore, riparian wetlands and temporary oxbow lakes associated with the Waterval River and Bankspruit provide suitable habitats for a wide diversity of invertebrate fauna, particularly crustaceans.

Present Ecological State

The Present Ecological State of the aquatic ecosystems in the vicinity of Middelbult Block 8 is highly variable, and range from near pristine (Class A) in the west, to highly degraded (Class E) in the east. The upper reaches of the Bankspruit (BS1) are in a near pristine ecological state (Class A), both in terms of Habitat Integrity and fish species composition. The upper reaches of the Kaalspruit (KS1), and the middle reaches of the Bankspruit, are largely natural (Class B). Most of the Waterval River and Grootspruit are classified as largely modified (Class D), mainly on account of severe incision of the main channel, and associated bank slumping and consequent isolation of riparian wetlands. These changes appear to have been caused mainly by stream crossings, which have constricted flows, and increased erosion downstream. Leeupan and the Evanderspruit downstream of the Evander Sewage Works are considered to be highly degraded (Class E) on account of poor water quality.

In general, Habitat Integrity is high, with many sites classified as near-pristine (Class A). Most of the sites surveyed contain the natural fish biodiversity that would be expected in these streams. However, the lower reaches of the Waterval River support about half the number of species than would be expected under natural conditions. The composition of aquatic invertebrates comprises mainly hardy, widespread taxa, with low SASS scores. However, the spatial diversity of invertebrate fauna is high, as is the species diversity of crustaceans in the temporary oxbow lakes sampled. There is also a noticeable reduction in the number of invertebrate taxa and sensitivity of taxa with distance downstream, indicating a deterioration of conditions downstream.

Summary Recommendations

1. **Classification:** We suggest that the Best Attainable Ecological Class for most of the streams in the area should be "Largely Modified" (Class D), but we suggest that the Kaalspruit and Bankspruit should be classified as Largely Natural" (Class B). These streams should therefore be given priority conservation status.

2. **Rehabilitation:** We suggest that the Bankspruit and Kaalspruit should be rehabilitated to prevent these rivers and associated riparian wetlands and oxbow lakes from following the same trajectory of degradation that is currently seen in the adjacent Waterval River and Grootspruit.

3. **Biomonitoring:** We suggest that annual biomonitoring of fish and aquatic invertebrates should be conducted every spring (September). The aim of the surveys would be to monitor general river health conditions.

4. **Specialist Study:** A once-off specialist survey of the crustacea in the temporary oxbow lakes is recommended. The aim of the survey would be to determine the conservation and biodiversity of importance of these wetland systems.

TERMS OF REFERENCE

The Terms of Reference for this study are detailed in Category 9 of the "Scope of Work". Briefly, they were:

- *To characterize the aquatic ecosystem in the vicinity of the proposed mining operations (i.e. collect baseline data);*

- *To recommend management measures to mitigate the impacts of the proposed mining operation;*

- *To recommend a practical monitoring protocol in relation to the aquatic environment.*

1. INTRODUCTION

Sasol Mining is investigating options to augment Middelbult Colliery's coal reserves with the recently acquired Block 8, from Billiton SA Ltd and various of its affiliated companies. The proposed mining will be underground, and is therefore unlikely to impact directly on surface aquatic ecosystems. However, it is likely that there will be impacts on aquatic ecosystems related to water quality and general surface infrastructure development (roads, buildings etc).

Six perennial streams, all tributaries of the Vaal River, cross or arise within the Block 8 Coal Reserve. The lower portions of these streams are characterised by extensive riparian (floodplain) wetlands. In their natural state, these wetlands are likely to serve a useful function by buffering flood peaks and providing base flows. The proposed mining and associated developments may have detrimental impacts on the ecological functioning of these streams and associated wetland systems.

This report provides a baseline assessment of the past and present ecological conditions of the streams that flow over the proposed mining area. Particular attention is given to fishes and aquatic invertebrates, as these provide reliable indicators of the general condition or health of a stream. The report is based on available records and one three-day field survey of fishes and aquatic invertebrates, undertaken in March 2002.

2. STUDY AREA AND SITES SAMPLED

This study concerns the proposed Middelbult Block 8 mining area, west of Secunda. The area falls within quaternary catchment C12D, which is situated in the Vaal River Water Management Area. The Waterval River is the main stream that crosses the study area, but there are a number of tributaries of the Waterval River that also cross or arise within the study area. These are the Kaalspruit, Bankspruit, Grootspruit, Evanderspruit and an unnamed tributary of the Trichardspruit.

Seventeen sites were selected for sampling fishes and invertebrates, fourteen of which were situated in streams, two in oxbow "lakes", and one in Leeupan, an endorheic pan that is used to store excess mine water (Figure 1). The choice of sites was based on their accessibility, diversity of habitats, and position in relation to the proposed development. For each stream that crosses the study area, one site was chosen at the upstream border of the development area (ie. control site), and one site was chosen in the vicinity of the downstream border (ie. potentially impacted site). Sites were numbered in the order that they were sampled, and later given codes to make identification easier. For example, the Kaalspruit was sampled upstream and downstream of the mining area, and these sampling sites were coded as KS1 and KS2 respectively. Details of the sites sampled are discussed below and summarised in Table 1.

Table 1: Sites in the vicinity of Middelbult Block 8 where aquatic invertebrates and fishes were sampled in March 2002.

Site No	Code	River	Farm name	Position in relation to mining area	Altitude (m amsl)	Locality
Pans						
1	Leeu	N/A	Rietkuil 531IR	Downstream	1566	26^{o} 32' 51.4"S; 28^{o} 59' 37.3''E
Oxbow lakes						
13	OX1	Bankspruit	Springbokdraai 277 IS	Within	1564	26^{o} 32' 08.3"S; 29^{o} 00' 38.6"E
7a	OX2	Waterval	Kromdraai 128 IS	Within	1578	26^{o} 27' 43.8"S; 28^{o} 59' 50.2"E
Streams						
2	KS1	Kaalspruit	Kaalspruit 528 IR	Upstream	1582	26^{o} 34' 59.0"S; 28^{o} 56' 39.4"E
3	KS2	Kaalspruit	Roodebank 323 IS	Downstream	1558	26^{o} 36' 12.6"S; 28^{o} 59' 56.2"E
4a	BS1	Bankspruit	Brakspruit 359 IR	Upstream	1595	26^{o} 28' 56.9"S; 28^{o} 58' 06.9"E
4	BS2	Bankspruit	Springbokdraai 277 IS	Downstream	1562	26^{o} 32' 18.3"S; 29^{o} 00' 41.9"E
7c	WVT	Waterval trib.	Kromdraai 128 IS	Upstream	1601	26^{o} 26' 33.9"S; 29^{o} 01' 57.0"E
6	WV1	Waterval	Klipfontein 357 IS	Upstream	1590	26^{o} 27' 02.1S; 28^{o} 58' 02.6"E
5	WV2	Waterval	Springbokdraai 277 IS	Downstream	1562	26^{o} 31' 59.2"S; 29^{o} 01' 35.2"E
Roo	WV3	Waterval	Roodebank 323 IS	Downstream	1550	26^{o} 37' 36.8"S; 29^{o} 01' 26.7"E
9	GS1	Grootspruit	Winkelhaak 135 IS	Upstream	1596	26^{o} 26' 53.0"S; 29^{o} 05' 21.6"E
8	GS2	Grootspruit	Witkleifontein 131 IS	Downstream	1567	26^{o} 30' 39.0"S; 29^{o} 03' 26.3"E
12	EV1	Evanderspruit	Driefontein 137 IS	Within	1606	26^{o} 29' 15.4"S; 29^{o} 07' 48.3"E
10	EV2	Evanderspruit	Winkelhaak 135 IS	Within	1596	26^{o} 30' 07.2"S; 29^{o} 06' 17.6"E
11	EV3	Evanderspruit	Goedvervagting 287 IS	Downstream	1577	26^{o} 30' 45.5"S; 29^{o} 05' 35.0"E
14	TS	Trib. Trichardspruit	Driefontein 137 IS	Within	1590	26^{o} 29' 45.7"S; 29^{o} 10' 29.8"E

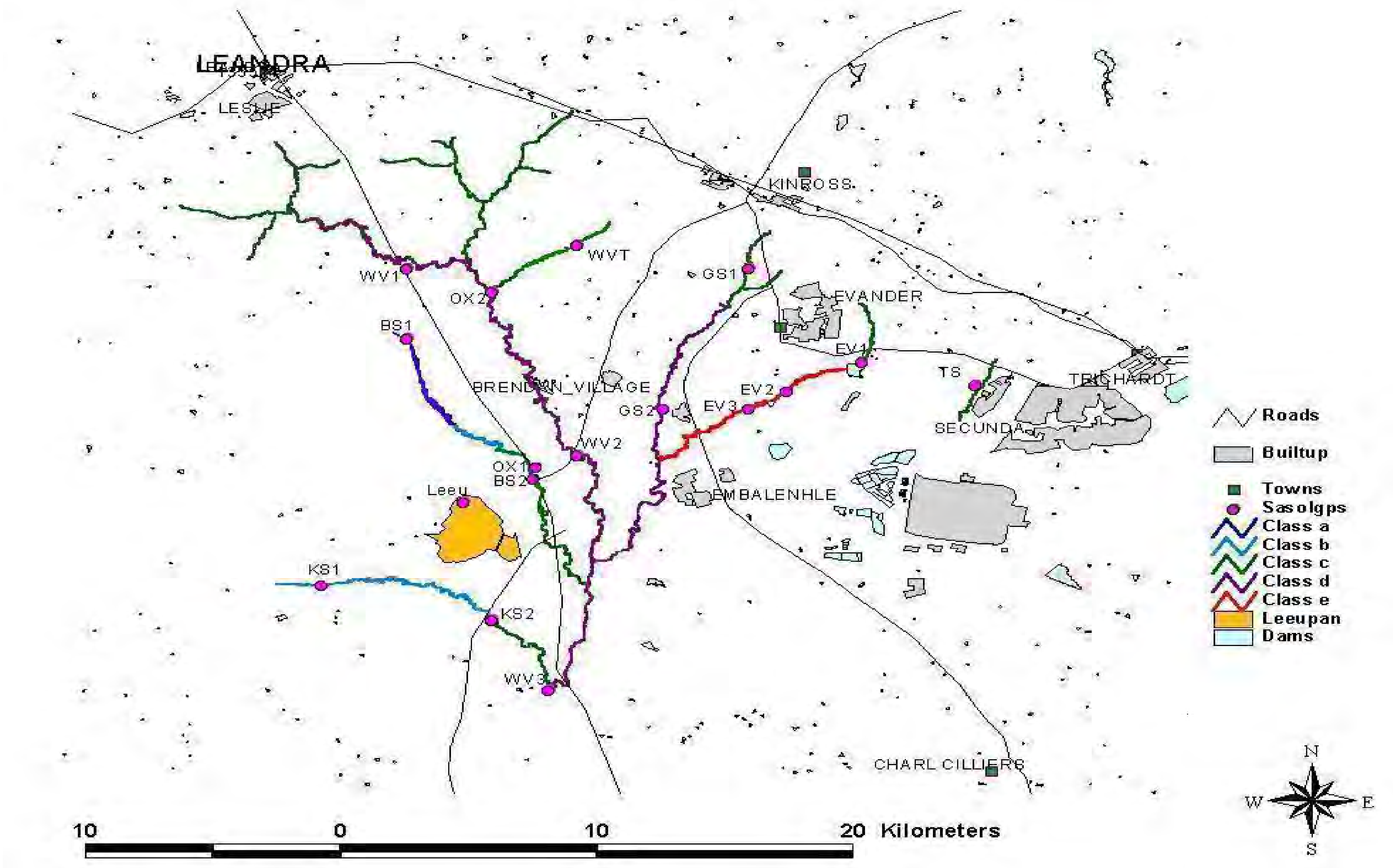


Figure 1. Sites where fish and aquatic invertebrates were sampled in March 2002. The main streams within the study area are indicated, and colour-coded in terms of their Present Ecological State (Classes A-F). (Based on 1:50 000 scale maps.)

Site 1: Leeupan

Site 1 is situated on the northern shores of Leeupan, a natural endorheic pan that has been used for many years by the mining industry to store surplus mine water (Figure 2). Water quality in the pan is poor, with TDS exceeding 10 000mg/L (Table 5). Despite the water quality problem, the area has become a popular fishing and recreational venue. The pan is managed so that no surface water is released from the pan, although this does occur from time to time.

The capacity of the pan has been increased by the construction of an earth wall, which was later supplemented by a second, larger wall, situated a short distance downstream of the first wall. A small stand of gum trees that were once on the shores of the lake is now inundated (Figure 2). The dead trees provide roosting sites for birds, particularly cormorants. The pan currently covers an area of about 700 ha when full, and has a maximum depth of about 25 m. The pan is open, and characterised by an extensive and homogenous growth of aquatic weeds (*Potamogeton pectinatus*). The low diversity of aquatic weeds in the pan can possibly be attributed to the high TDS. Bottom substrates consist of unconsolidated mud and decomposed organic material. Small, isolated patches of reeds (*Phragmites* and *Typha capensis*) are also present along the edges. Invertebrates were sampled from aquatic *vegetation (Potamogeton pectinatus, Phragmites* and *Typha capensis*), marginal sediments and the water column. Fish were sampled using a seine net, fish traps baited with bread and fish meal, and a 50mm gill net, left overnight.

Figure 2. Site 1, Leeupan, containing highly saline water. The photograph shows gum trees that died when water levels were increased. A small stand of *Phragmites* reeds is seen on the right.

Site 13: OX1 – Oxbow on Bankspruit

Site 13 is a small (±0.1ha), temporary oxbow "lake" situated on the riparian floodplain of the Bankspruit, on the farm Springbokdraai 277 IS, within the proposed development area. The river channel is within 100m of the lake, and is incised by about 2m. The incision of the main channel has reduced the frequency of overtopping, and so the oxbow lake is now mainly rainfed, as indicated by the low concentration of Total Dissolved Solids (170mg/l). Aquatic invertebrates were sampled from the mud substrate and aquatic vegetation within the lake (mainly *Utricularia stellaris* and *Potamogeton thunbergii*). A small patch of the exotic water fern (*Azolla filiculoides*) was also present. Water in the pond was slightly acidic (6.8), presumably because of the decomposition of plant material.

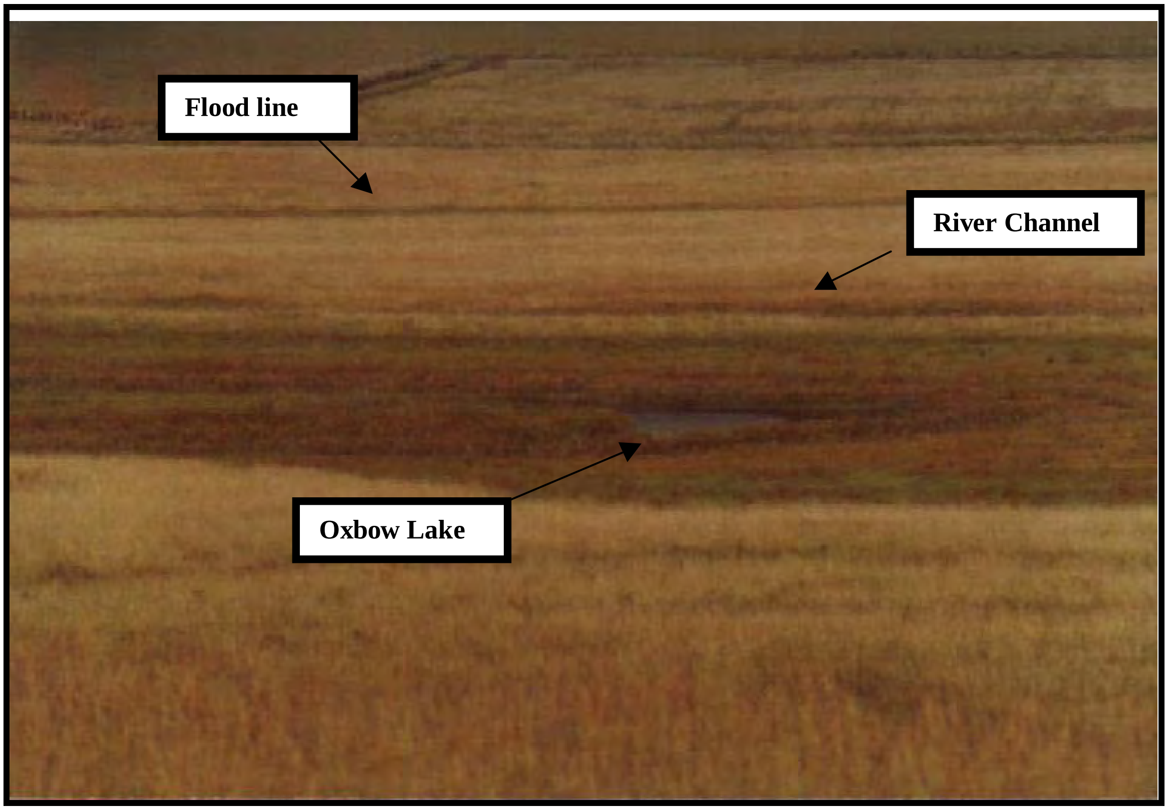


Figure 3. Temporary oxbow "lake" on the Bankspruit (Site 13), showing the lake and the incised main channel in the middle distance.

Site 7a: OX2 – Oxbow on Waterval River

Site 7a is a small (±0.1ha), temporary oxbow "lake" situated on the riparian floodplain of the Waterval River, on the farm Kromdraai 128 IS, within the proposed development area (Figure 4). The river channel is severely incised, and this has isolated the oxbow lake. The low salinity of the water (TDS 100 mg/L) suggests that the lake is now mainly rainfed. Aquatic invertebrates were sampled from the mud substrate and aquatic vegetation within the lake (mainly *Utricularia stellaris* and *Potamogeton thunbergii*). Water in the pond was slightly acidic (6.6), presumably because of the decomposition of plant material. The area was moderately disturbed by cattle trampling and grazing.

Figure 4. Temporary oxbow lake on the Waterval River (Site 7a).

Site 2: KS1 - Kaalspruit upstream

Site 2 is situated in the upper reaches of the Kaalspruit on the farm Kaalspruit 528 IR, upstream of the proposed development area. There was no flow at the time of sampling, so sampling was restricted to isolated, permanent pools (Figure 5). The water was clear and cold (17^{o}C). Biotopes sampled were limited to marginal vegetation and sediments. Marginal vegetation consisted mainly of *Cyperus fastigiatus* and *Leersia hexandra*, and provided highly suitable habitats for instream fauna (Suitability Score = 4). Bottom substrates consisted mainly of unconsolidated mud, which was considered unsuitable habitat for aquatic invertebrates (2). Exotic vegetation was limited to a few clusters of poplars (*Populus alba*) and some willows (*Salix babylonica*). There was no flow at the time of sampling, presumably because of upstream impoundment.

Figure 5. Kaalspruit upstream of the proposed development (Site 2), comprising isolated, permanent pools of clear, cold water. Notice absence of erosion.

Site 3: KS2 - Kaalspruit downstream

Site 3 is situated in the Kaalspruit on the farm Roodebank 323 IS, downstream of the proposed development area (Figure 6). An artificial crossing made of rocks provided habitat for flow-dependant fauna. Flow at the time of sampling was a slight trickle (≈0.01 m^3/s), and the stones-in-current biotope was considered barely suitable for flow-dependant fauna (suitability score = 1). Marginal vegetation was dominated by the robust *Cyperus fastigiatus*. Bottom substrate consisted of unconsolidated mud. Erosion, slumping and trampling by cattle affected about 30% of margins. Exotic riparian vegetation was limited to a few willow trees *(Salix babylonica)*.

Figure 6. Kaalspruit downstream of the proposed development (Site 3), showing an artificial crossing that forms a riffle, and moderate erosion of banks.

Site 4a: BS1 – Bankspruit upstream

Site 4a is situated in the upper reaches of the Bankspruit on the farm Brakspruit 359 IR, upstream of the proposed development area (Figure 7). There was no flow at the time of sampling. The site was characterised by permanent, in-channel pools and clear, cold water (17^{o}C). Instream vegetation consisted mainly of oxygen weed (*Lagorosiphon major*), while marginal vegetation consisted mainly of robust stands of *Cyperus fastigiatus* reeds. Biotopes sampled were marginal vegetation and mud. There were no signs of bank erosion or incision, and the site was considered to be in an exceptionally healthy ecological state, although TDS is higher than expected (310 mg/L).

Figure 7. Banksprui upstream of the proposed development (Site 4a), showing natural in-channel pool and absence of erosion.

Site 4: BS2

Site 4 is situated in the Bankspruit on the farm Springbokdraai 277 IS, downstream of the proposed development area (Figure 8). Flow at the time of sampling was very low, although a bedrock outcrop provided a small quantity of habitat for flow-dependant invertebrates. Biotopes sampled were stones and bedrock in and out-of-current and marginal vegetation, consisting mainly of *Schoenoplectus corymbosus*, *Cyperus fastigiatus* and *Leersia hexandra.* Bottom substrate consisted mainly of bedrock. Erosion, slumping and cattle paths affect about 60% of margins.

Figure 8. Bankspruit downstream of the proposed development (Site 4), showing small bedrock cascade and signs of bank slumping.

Site 7c: WVT - Tributary of the Waterval River, upstream

Site 7c is situated in a seasonal, unnamed tributary of the Waterval River, on the farm Kromdraai 128 IS, upstream of the proposed development area (Figure 9). Flow at the time of sampling was very low (≈0.01 m3/s). The water temperature was noticeably high (28^{o}C), and this was attributed to the open, shallow nature of the stream. The pH was noticeably high (8.6). Biotopes sampled were marginal vegetation (out-of-current), stones (in trickle), and mud and stone substrate (including rubble from bridge construction). The sampling site was at a low-level causeway, and the river channel was incised, and floods had damaged the banks and bed of the channel. Overall, the site was in a poor ecological condition.

Figure 9. Seasonal, unnamed tributary of the Waterval River (Site 7c), upstream of the proposed development.

Site 6: WV1 – Waterval River upstream

Site 6 is situated in the Waterval River on the farm Klipfontein 357 IS, upstream of the proposed development area (Figure 10). Flow at the time of sampling was low (≈$0.1m^3/s$) but sufficient to provide a suitable variety of hydraulic biotopes for invertebrate colonisation. Biotopes sampled included stones-in-current, stones out of current, aquatic vegetation, marginal vegetation in and out of current, gravel and mud. The site was characterised by severe channel incision, bank erosion and slumping.

Figure 10. Waterval River upstream of the proposed development (Site 6), showing a small, permanent riffle and incised channel.

Site 5: WV2 – Waterval River downstream

Site 5 is situated in the Waterval River on the farm Springbokdraai 277 IS, downstream of the proposed development area (Figure 11). Flow at the time of sampling was low ($\approx 0.2 m^3/s$) but sufficient to provide a reasonable variety of hydraulic biotopes for invertebrate colonisation. Biotopes sampled included stones-in-current, stones out of current, aquatic vegetation and gravel. The site was characterised by eroded banks, slumping and severe incision of the channel. The site appears to be used as an informal dumping ground for rubbish.

Figure 11. Waterval River downstream of the proposed development (Site 5), showing a small, permanent riffle and incised channel.

WV3 - Roodebank Weir

Roodebank gauging weir (C1H004), is situated in the Waterval River on the farm Roodebank, about 12km downstream of the lower border of the proposed development area (no photograph). Although this is well downstream of the study area, and will be impacted upon by other developments in the catchment, the site was sampled to provide an overall index of conditions in the Waterval Catchment as a whole. The site was also sampled to enable biomonitoring information to be linked to water quality and quantity data collected at the gauging weir. The site was also of interest because riffle habitats at the site are potentially suitable for the Rock Catlet, *Austroglanis sclateri*, a flow-dependant fish of conservation importance. Flow at the time of sampling was moderate ($0.5m^3/s$), and the water was an unhealthy grey colour. Sampling was carried out upstream and downstream of the waterfall and gauging weir. Biotopes sampled were stones-in-current, bedrock-in-current, aquatic vegetation and gravel. The aquatic vegetation included *Phragmites australis, Typha capensis* and *Persicaria sp.*

Site 9: GS1 – Grootspruit upstream

Site 9 is situated in the Grootspruit on the farm Winkelhaak 135 IS, upstream of the proposed development area (Figure 12). The stream appears to be historically seasonal, and so the absence of flow at the time of sampling was not unexpected. Biotopes sampled were limited to marginal vegetation out-of-current and mud.

Figure 12. Grootspruit upstream of the proposed development (Site 9).

Site 8: GS2 – Grootspruit downstream

Site 8 is situated in the Grootspruit on the farm Witkleifontein 131 IS, downstream of the proposed development area (Figure 13). There was no flow at the time of sampling. The stream channel was highly incised, and there were very few suitable biotopes available for fish or invertebrate colonisation. Biotopes sampled were limited to stones-out-of-current, marginal vegetation out-of-current and mud.

Figure 13. Grootspruit downstream of the proposed development (Site 8).

Site 12: EV1- Evanderspruit/Winkelhaakspruit (between two dams: upstream)
Site 12 is situated in an unnamed tributary, referred to here as the Evanderspruit [Some maps refer to this stream as the Winkelhaakspruit.] The site is located on the farm Driefontein 137 IS, within the proposed development area, and between the Evander Dam, and an unnamed dam a short distance upstream (Figure 14). Although it would have been preferable to have sampled upstream of the top dam, this was not possible as the drainage lines upstream of the dam were dry at the time. The area downstream of the top dam had a number of artificially created and deep channels that provided permanent standing water suitable for sampling. There was no flow at the time of sampling. Fishes and invertebrates were sampled in marginal vegetation consisting mainly of *Cyperus fastigiatus* and *Leersia hexandra*.

Figure 14. Evanderspruit [=Winkelhaakspruit] upstream of the Evander Dam (Site 12), showing deep, permanent pool that had been artificially excavated. This highly disturbed site is within the proposed development area.

Site 10: EV2 - Evanderspruit downstream of Sewage Works

Site 10 is situated in the Evanderspruit [=Winkelhaakspruit] downstream of the Evander sewage works, within the proposed development area. The stream is characterised by permanent, fast-flowing clear water, and abundance of water cress (*Rorippa nasurtium-aquaticum*). A small riffle provided ideal conditions for flow-dependent fishes and invertebrates.

Figure 15. Evanderspruit [=Winkelhaakspruit] downstream of the Evander sewerage works (Site 10), showing fast-flowing, clear water and abundance of watercress (*Rorippa* *nasurtium-aquaticum*).

Site 11: EV3 - Evanderspruit downstream

Site 11 is situated in the Evanderspruit [=Winkelhaakspruit] on the farm Goedvervagting 287 IS, downstream of the proposed development area (Figure 16). Flow at the time of sampling was moderate (0.3m^3/s), and comprised of treated sewage effluent from the Evander sewage works. Biotopes sampled were stones-in-current, stones out-of-current, marginal vegetation out-of-current, gravel and mud.

Figure 16. Evanderspruit [=Winkelhaakspruit] downstream of the proposed development area (Site 11).

Site 14: TS - Unnamed tributary of the Trichardspruit

Site 14 is situated in a tributary of the Trichardspruit, immediately west of Secunda, on the farm Driefontein 137 IS, within the proposed development area. There was no flow at the time of sampling. The streambed was covered in a dense carpet of filamentous algae, which restricted the suitability of benthic substrates. The concentration of Total Dissolved Solids was notably high (720 mg/l). Biotopes sampled were restricted to marginal vegetation out-of-current and mud.

Figure 17. A seasonal tributary of the Trichardspruit, immediately west of Secunda (Site 14), and within the proposed development area.

3. METHODS

3.1 Approach

The general approach used for this study was a rapid appraisal, based partly on the guidelines published by the Institute for Water Quality Studies, entitled "Resource Directed Measures for Protection of Water Resources" (version 1, September 1999). The guidelines stress that the efforts taken to mitigate the detrimental impacts of a proposed development should not only reflect the potential environmental impacts of the proposed development, but should also reflect the ecological classification of the area in which the development is to take place. The classification distinguishes between *past* Ecological Importance and Sensitivity, *Present* Ecological State, and *future* (desired) best attainable Ecological Class.

Past Ecological Importance and Sensitivity and best was based on the Department of Water Affairs and Forestry's Desktop Ecological Classification of quaternary catchments. The Present Ecological State was assessed separately for Habitat Integrity, fish and aquatic invertebrates, and this is explained in more detail below. There is no formal way of integrating these results into an overall assessment of the Present Ecological State, and so this was based on professional judgement.

3.2 Background Information

The following studies provided the most useful sources of information for this assessment:

- **Desktop Ecological Classification** of quaternary catchments, forming part of the National Water Balance Model (IWQS data).
- **Limnological survey of the Vaal River** Catchment, including the Waterval River, undertaken in 1959 and 1960 (Chutter 1967).

3.3 Site Visits

A three-day field visit to the proposed development area was held in autumn (21-23rd March 2002). Seventeen sampling sites were selected, and at each site aquatic invertebrates and fish were sampled in a variety of biotopes. Flow and basic water quality measurements (pH, Total Dissolved Solids and water temperature) were taken into consideration when interpreting the results. Flows at each site were roughly estimated, with the exception of the Waterval River at Roodebank, which is gauged.

3.4 Habitat Integrity

A rapid assessment of instream and riparian Habitat Integrity was undertaken at each stream site. The method was based on the Resource Directed Measures for the Protection of Water Resources (Version 1, September 1999). The method classifies Habitat Integrity into one of six classes, ranging from unmodified, natural (Class A), to critically modified (Class F) (Table 2).

Table 2: Delineation of Present State Classes in terms of Habitat Integrity. Reference conditions were defined as a score > 90% (i.e. Class A). [Based on DWAF 1999.]

Class	Description	Score (% of total)
A	Unmodified, natural.	90-100
B	Largely natural, with few modifications.	80-90
C	Moderately modified.	60-79
D	Largely modified.	40-59
E	Extensively modified.	20-39
F	Critically modified.	<20

3.5 Aquatic Invertebrates

3.5.1 Past Conditions

An assessment of the likely past status of aquatic invertebrates was based on available historical data collected from the Waterval River at Roodebank (Chutter 1967), and present day biomonitoring data collected from sites within the upper Olifants River Catchment which are least impacted by development (Palmer, 2001).

3.5.2 Present Conditions

Aquatic invertebrates were collected using a standard SASS net and identified to at least family level according to the SASS5[1] sampling technique (Dickens and Graham 2001). Biotopes sampled included marginal vegetation out-of-current, stones and cobbles in-current and sediments. Results for each biotope were kept separate to enable comparison of results from similar habitats. The suitability of each biotope to invertebrates was assessed on a 4-point scale (1=poor, 2=fair, 3=good, 4=excellent). This method was used in favour of the Integrated Habitat Assessment System (IHAS), developed specifically for SASS sampling by the CSIR (MacMillan 1998), as the latter method has been shown to be of limited value (Vos et al 2002).

The SASS method was also used to sample invertebrates from the oxbow “lakes” and pan, but the results were not analysed in terms of SASS5 scores. The reason for this is that the SASS method was developed specifically for flowing waters, and should not be applied to standing waters.

The results were classified into one of six classes, ranging from unimpaired (Class A), to very severely impaired (Class F) (Table 3).

1 SASS5, or South African Scoring System (version 5), is a rapid method of quantifying the condition or health of a river, based on the presence of major invertebrate groups (mostly families), each of which have been allocated a “sensitivity” value (Chutter 1998). The values are summed to provide a Total Score, and divided by the total number of taxa to provide an Average Score Per Taxon (ASPT).

Table 3: Delineation of Present State Classes in terms of invertebrate composition and SASS biomonitoring results. The delineation was based on a scatter plot of SASS scores from the Olifants River and its tributaries, against the Average Score per Taxon (ASPT). Reference conditions were defined as a SASS Score > 175 and ASPT > 7 (i.e. Class A) (Palmer 2001).

Class	Description	SASS Score	ASPT
A	Unimpaired. High diversity of taxa with numerous sensitive taxa.	> 175	> 7
B	Slightly impaired. High diversity of taxa, but with fewer sensitive taxa.	140 –175	6.2 – 7
C	Moderately impaired. Moderate diversity of taxa.	85 - 139	5.6 - 6.1
D	Considerably impaired. Mostly tolerant taxa present.	60 - 84	4.8 - 5.5
E	Severely impaired. Only tolerant taxa present.	41 - 59	4 - 4.7
F	Very severely impaired. Very few tolerant taxa present.	< 40	

3.6 Fishes

3.6.1 Past Conditions

Historical data on fish for this river section is largely based on literature studies (Skelton 1993, Jubb 1967) and a few surveys conducted by the former Transvaal Directorate of Nature Conservation.

3.6.2 Present Conditions

Fish were sampled using mainly a 10mm-mesh seine net. Electro-narcosis, which is only used in riffle areas, was used only in the riffles at Site 6 and at Roodebank (Waterval River). All fish species were identified and anomalies and general age structure were recorded. Sampling effort were kept to about 15 minutes shocking and a seine net were used in deeper habitats.

A qualitative approach was used to estimate fish assemblage integrity. This method and scoring system takes into account the best available fish assemblage information, as well as the impact on physical habitat modifications and possible impacts of alien biota (Table 4) (Kleynhans and Engelbrecht 2001). This assessment approach was previously also applied in the Crocodile, Thukela and Mgeni Rivers.

Table 4: Guidelines for the qualitative assessment of the fish assemblage integrity.

FISH ASSEMBLAGE INDICATORS CONSIDERED FOR ESTIMATION	RIVER ZONE OR DEFINED RESOURCE UNIT (scoring/assessment criteria; provide comments for each score)
Native Species Richness	Number of species expected: number of species currently present (most recent). Score according to: None of expected present=0 Only few of expected present=1-2 Majority of expected species present=3-4 All/almost all of expected present=5
Presence of Native intolerant species	No intolerant species present=0 Few intolerant species =1-2 Majority of intolerant species present =3-4 All/almost all intolerant species present (OR no intolerants naturally present)=5
Abundance of native species	No fish=0 Only few individuals=1-2 Moderate abundance=3-4 Abundance as expected for natural conditions=5
Native species Frequency of Occurrence	Fish absent at all sites=0 Fish present at only very few sites=1-2 Fish present at most sites=3-4 Fish present at all sites=5
Health/condition; native & introduced species	All fish seriously affected/fish absent=0 Most fish affected=1-2 Most fish unaffected=3-4 Only single/few individuals affected=5
Presence of introduced fish species	Predaceous species and/or habitat modifying species with a critical impact on native species=0 Predaceous species and/or habitat modifying species with a serious impact on native species=1-2 Predaceous species and/or habitat modifying species with a moderate impact on native species=3-4 Predaceous species and/or habitat modifying species no impact on native species=5
Instream habitat modification	Water quality/Flow/Stream bed substrate, critically modified, no suitable conditions for expected species=0 Water quality/Flow/Stream bed substrate, seriously modified, little suitable conditions for expected species=1-2 Water quality/Flow/Stream bed substrate, moderately modified, moderately suitable conditions for expected species=3-4 Water quality/Flow/Stream bed substrate, little/no modification, abundant suitable conditions for expected species=5
FISH PES: ESTIMATED OVERALL FISH ASSEMBLAGE INTEGRITY	TAKING INTO ACCOUNT THE ABOVE INFORMATION: RATE FISH ASSEMBLAGE INDEX CATEGORY A – F BASED ON GENERAL SCORING GUIDELINES: Category — % of total expected score A: 90 – 100 B: 80 – 90 C: 60 – 80 D: 40 – 60 E: 20 – 40 F: 0 – 20

3.7 Assumptions and limitations

Some species may be missed

This report is based on a review of available information, a three-day field survey. Spot surveys such as this are likely to miss many species. Furthermore, aquatic ecosystems are dynamic and highly complex, and our understanding of their biota's taxonomy, behaviour, life-histories, distributions and habitat requirements is limited. It is inevitable that many aspects, some of which may be important, have been overlooked. A more reliable assessment of the biota would require seasonal sampling and identification to species level if possible. However, this is not considered necessary for the purposes of the study. River levels were very low during this field survey, and the full complement of biotopes that are usually sampled, were not always present. The SASS results therefore represent a typical dry-season scenario.

Focus on habitats, aquatic invertebrates and fish

This study focussed on aquatic habitats, aquatic invertebrates and fish, as these provide complementary indexes of stream conditions. We have excluded amphibians, reptiles, birds and mammals. This is not because they are deemed to be unimportant, but because we believe that by protecting their habitats, their survival may be better ensured.

Focus on instream component only

This study focussed on the instream component of the river, as issues concerning the wetlands formed part of a separate study (Marneweck, Wetland Consulting Services, in prep).

Reference conditions are unknown

The composition of aquatic biota in the study area prior to major disturbance will never be known for certain. For this reason, reference conditions are hypothetical, and are based on professional judgement and/or inferred from limited data available. Reference conditions for aquatic invertebrates were based on a scatter plot of biomonitoring data collected throughout the Olifants River Catchment, including major tributaries.

4. RESULTS

4.1 Past Ecological Importance and Sensitivity

The Department of Water Affairs and Forestry's Desktop Ecological Classification considers quaternary catchment C12D to be of low ecological importance and sensitivity (Class D: Large risk allowed). According to the database there are no rare or endangered fish species in this area, and no unique or endemic aquatic fauna. The diversity of habitats is considered low, and the area is not considered an important refuge site or migration corridor. The present study, which was at a much finer spatial resolution than the Desktop Assessment, largely supports the results of the Desktop Assessment, but found that certain areas within C12D are more important and sensitive than suggested by the Desktop Assessment. Riparian wetlands and temporary oxbow lakes associated with the Waterval River and Bankspruit are of particular conservation importance on account of a their high diversity of aquatic invertebrates, particularly crustacea. There is also a possibility that the rare Rock Catlet (*Austroglanis sclateri)* could occur in at least the lower portion of the Waterval River.

4.2 River conditions at the time of sampling

Sampling was undertaken at the start of the dry season (March), at a time when many streams had already ceased flowing, or were flowing very slowly. Flows in the previous season had been good, and populations of invertebrates and fish are expected to have recovered from the previous significant flood, in February 2000. The Evanderspruit differed from the other streams in the area in that flows were strong, and were comprised entirely of treated sewage effluent. The level of water in the oxbow lakes was dropping, as would be expected at this time of year. Leeupan was close to capacity.

The water colour in most streams was clear, possibly due to flocculation caused by the generally high concentration of Total Dissolved Solids (300 to 720 mg/L). At Roodebank the water was an unnaturally grey in colour. The pH in the streams was neutral to alkaline (7.1 to 8.6), while the oxbow lakes were acidic (6.6 and 6.8). Water temperature ranged from 17 to 28C (Table 5).

Table 5: Conditions at the sampling sites on 21-23 March 2002, and the Overall Present Ecological State (PES) (Class A-F).

	Site	Approx Flow (m^3/s)	Water colour	TDS (mg/L)	pH	Water temperature (^oC)	PES
Pans							
1	**Leeu**	N/A	Clear	>10 000	7.4	22	E
Oxbow Lakes							
13	**OX1**	N/A	Clear	170	6.8		B
7a	**OX2**	N/A	Clear	100	6.6	22	C
Streams							
2	**KS1**	0	Clear	310	7.1	17	B
3	**KS2**	≈0.01	Slightly brown	350	7.4	22	C
4a	**BS1**	0	Clear	300	7.5	17	A
4	**BS2**	≈0.01	Slightly brown	360	7.6	24	C
7c	**WVT**	≈0.01	Moderately brown	380	8.6	28	C
6	**WV1**	≈0.1	Clear	480	7.5	20	D
5	**WV2**	≈0.2	Slightly Brown	590	7.5	-	D
Roo	**WV3**	0.5	Turbid/Grey	620	7.6	24	D
9	**GS1**	0	Clear	690	8.0	25	C
8	**GS2**	0	Clear	670	7.1	24	D
12	**EV1**	0	Mod Brown	580	7.9	22	C
10	**EV2**	≈0.3	Very Clear	530	8.1	-	E
11	**EV3**	≈0.3	Clear	670	8.1	23	E
14	**TS**	0	Clear	720	8.2	-	C

4.3 Present Ecological State

The Desktop Ecological Classification considers the Present Ecological State of quaternary catchment C12D to be largely modified (Class D). However, within this area, the Present Ecological State of the aquatic ecosystems ranges from near pristine in the west (Class A), to highly degraded in the east (Class E) (Table 5, Figure 1).

Detailed Habitat Integrity assessments for each stream site are presented in Appendix A, while the detailed SASS biomonitoring results are presented in Appendix B. The following section discusses the overall Present Ecological State Classification of aquatic ecosystems in the area, in order of increasing state of degradation.

Class A

The upper reaches of the Bankspruit (BS1) are considered to be in a near pristine ecological state (Class A), both in terms of Habitat Integrity and fish species composition. All three species of indigenous fish that were expected in the stream were recorded. There was no flow at the time of sampling, so biomonitoring scores were low, as would be expected (Class C). Furthermore, the TDS was higher than expected for such a small stream. However, there were no exotic fauna in the stream, and there was negligible incision of the main channel. Overall, this section of stream is one of the few remaining streams in the area that is considered close to pristine.

Class B

The overall Present Ecological State of the upper reaches of the Kaalspruit (KS1), and the middle reaches of the Bankspruit, are considered to be largely natural (Class B). Three species of indigenous fish species were expected in the upper Kaalspruit, yet only one species was recorded. There was no flow at the time of sampling, so biomonitoring scores were low, as would be expected (Class C). It is not certain whether the Kaalspruit is historically seasonal, but a number of farm dams in the upper reaches are likely to have aggravated seasonal cessation of flows. The aquatic vegetation at this site created ideal pool habitat for fish. Although two of the three expected fish species where absent the third species occurred quite abundantly (Table 6). This species is most likely the most sensitive of the three species. The absence of the other two species is difficult to explain. The condition of the fish assemblage (Table 7) in this part of the river is considered largely natural, with few modifications.

Class C

Several sections of stream in the study area were classified as moderately modified (Class C) (Figure 1). These were the upper reaches of the Waterval River, the upper reaches of the Grootspruit, the upper reaches of the Evanderspruit, the upper reaches of an unnamed tributary of the Trichardspruit, the lower reaches of the Bankspruit, and the lower reaches of the Kaalspruit.

Aquatic vegetation in the lower reaches of the Kaalspruit (KS2) was markedly reduced compared to the upper reaches (KS1), and only one the three expected fish species where present in low numbers (Table 6).

The aquatic vegetation in the lower reaches of the Bankspruit (KS2) was relatively well developed in some of the pools, and created good habitat for fish. A small riffle area was present which created some suitable habitat for juvenile Yellowfish (*Barbus aeneus*). All species expected where present but the abundance of some species where low (Table 6)

The upper reaches of the Grootspruit (GS1) consisted mainly of a few deep pools, which may be perennial. The only fish caught at this site were juveniles and low numbers of *Barbus anoplus,* suggesting stressed conditions (Table 6). The condition of the fish assemblage in this part of the river is considered moderately modified (Class C) (Table 7).

The site sampled in the upper reaches of the Evanderspruit (EV1) was between dams and represented quite a structurally modified site with marginal vegetation in stagnant pools available as habitat for fish. Two of the three expected fish species where present in low numbers but the presence of Sharptooth Catfish (*Clarias gariepinus*) suggest that the dams has created the opportunity for this and possibly other exotic species to colonise the upper catchment of the stream (Table 6). The condition of the fish assemblage in this part of the river is considered moderately modified (Class C) (Table 7).

Class D

Most of the Waterval River and Grootspruit were classified as largely modified (Class D) (Figure 1). The most significant feature of these streams is severe incision of the main channel, and associated bank slumping. This appears to have been caused by stream crossings, which have constricted flows, and increased erosion downstream. The deepening of the main channel has reduced the level of the riparian water table, and in doing so, the survival of remaining riparian wetlands is at stake. Carp are expected to occur throughout most of the Waterval River, although they were recorded in the lower reaches only, at Roodebank (VW3).

Class E

Flow in the middle and lower Evanderspruit at the time of sampling consisted entirely of treated sewage effluent, and was classified as highly modified (Class E). No fish were recorded immediately downstream of the sewage outlet (EV2), and two out of three species expected, were recorded further downstream (EV3). Here, low numbers of two of the three expected fish species where present only in aerated riffle areas, suggesting that dissolved oxygen is most likely a problem in the water at this site (Table 6). The invertebrate fauna in this stream comprised fauna typically associated with highly polluted conditions, although there was a noticeable recovery with distance downstream.

Leeupan was also classified as highly modified (Class E), on account of the unnaturally high and stable water levels, the high concentration of Total Dissolved Solids, and the depauperate fish and invertebrate fauna.

4.4 Fish

4.4.1 Reference Conditions

Based on the available information, it is likely that three indigenous fish species historically occurred in the upper reaches of the study area (Table 6) while as many as eight species could potentially occur in the lower reaches of the Waterval River. Fish were historically (naturally) absent from most pans in the highveld.

Table 6: Fish species and the numbers collected in the Middelbult Block 8 mining area in March 2002 and fish species that are expected to occur (E) at these sites.

	SAMPLING SITES																
	1	**13**	**7a**	**2**	**3**	**4a**	**4**	**7c**	**6**	**5**	**Roo**	**9**	**8**	**12**	**10**	**11**	**14**
	Lee	**OX1**	**OX2**	**KS1**	**KS2**	**BS1**	**BS2**	**WVT**	**WV1**	**WV2**	**VW3**	**GS1**	**GS2**	**EV1**	**EV2**	**EV3**	**TS**
FISH SPECIES																	
Austroglanis sclateri											E						
Barbus anoplus				27	12	26	36	4	56	42	E	4	2	E	E	5	2
Barbus paludinosus	29			E	E	11	3	E	E	8	70	E	3	6	E	E	E
Clarias gariepinus	1									E	E			3			
Labeo capensis											18						
Labeo umbratus											E						
Labeobarbus aeneus							1			3	12		E				
Pseudocrenilabrus philander	31			E	E	5	25	E	87	36	92	E	32	5	E	4	16
No of indigenous species	**3**	**0**	**0**	**3**	**3**	**3**	**4**	**3**	**3**	**5**	**8**	**3**	**4**	**4**	**3**	**3**	**3**
Exotics																	
Cyprinus carpio	2							E	E	E	1			E			
Gambusia affinis											1						
Ctenopharygodon idella	E																
Micropterus salmoides	E																
No of exotic species	3										2						

4.4.2 Present Conditions

Most of the sites surveyed contained three or less fish species (Table 6), consisting mainly of chubbyhead barb (*Barbus anoplus*), Straightfin Barb (*Barbus paludinosus*) and/or southern mouthbrooder (*Pseudocrenilabrus philander*). The presence of these three species probably represents the natural fish biodiversity in these streams as they favour the slow flowing streams with marginal vegetation cover, typical of these areas. These three species is not dependent on riffle areas to complete any part of their life cycles and can be quite tolerant to reductions in flow and water quality. It is therefore expected that invertebrates will be more sensitive indicators than fish of habitat change in the area. However, at site EV2 the water quality is clearly a problem as no fish was present at the site (Table 6). Likewise the concentration or restriction of fish in the aerated riffle areas at VW3 and EV3 may also be indicative of reduced oxygen levels in the water, while the presence of low numbers of only juveniles of one species could suggest highly stressed conditions at GS1.

In the upper Waterval River (WV1), the banks of the river were slumping and this reduced the available habitat for fish. Two of the three expected fish species where present at this site (Table 6). A larger fish, most likely the exotic carp (*Cyprinus carpio*) was observed at this site. The condition of the fish assemblage in this part of the river is considered moderately modified (Class C) (Table 7).

Further downstream (WV2), the river was deeply incised and the banks were slumping, and this greatly reduced the available habitat for fish. Some marginal vegetation and a small riffle were the most important habitat available for fish at this site. Four of the five expected fish species where collected and adequate habit for the exotic carp (*Cyprinus carpio*) is also present at this site (Table 6). The condition of the fish assemblage in this part of the river is considered moderately modified (Class C) (Table 7).

In the lower reaches of the Waterval River (VW3) a larger diversity of species (eight species) is expected to occur (Table 6). At least two of the expected species is dependent on riffle to complete parts of their life cycles such as the smallmouth yellowfish (*Labeobarbus aeneus*) and rock catfish (*Austroglanis sclateri*). This assemblage will also be more susceptible to changes in flow and water quality. Only four indigenous and two exotic species were recorded and represents a lower than expected fish biodiversity (Table 6). Three of the indigenous species the *Barbus paludinosus*, *Labeobarbus aeneus* and *Labeo capensis* was concentrated and/or restricted to the aerated riffles, suggesting low oxygen levels in the river.

Sites BS2, GS2 and WV2 probably represent a transitional zone between these two above-mentioned fish assemblages and the presence of at least smallmouth yellowfish (*Labeobarbus aeneus*) is expected at these sites. The reasons for this are the availability of some suitable habitats (i.e. deep, wide pools with adequate cover). However, these areas are unlikely to sustain large adult populations of this fish species. Furthermore, this species needs riffle areas for spawning, early life-stages and feeding. The limited availability of riffle habitats in most of the study area may therefore limit the numbers of this species.

The presence of sharptooth catfish (*Clarias gariepinus*) at site EV1 suggest that the dams above and below the site has created the opportunity for this and possibly other exotic species to colonise the upper catchment of the stream.

No threatened (Red Data) fish species was recorded in study area. However there is a possibility that the rare *Austroglanis sclateri* (rock catfish) could occur in at least the lower portion of the Waterval River (VW3). Two exotic species, Carp (*Cyprinus carpio*) and mosquitofish (*Gambusia affinis*), has been recorded in the lower Watervals River (WV3). Suitable habitat for *Cyprinus carpio* was also present in WV1, WV2 and EV1.

Less than 2% of the recorded individuals were infected with parasites (the metacecaria of a digenetic trematode) and no other anomalies were present in fish sampled. The occurrence of parasites such as the above-mentioned is not uncommon in healthy fish communities. The health of the fish assemblage was therefore rated as good.

Table 7: Qualitative assessment of the fish assemblage integrity at the sampling sites in Middelbult Block 8 mining area. Sites are arranged in order of decreasing Present Ecological State with respect to fish.

	SAMPLING SITE																
INDICATORS	**BS1**	**KS1**	**BS2**	**GS2**	**TS**	**WV1**	**KS2**	**WV2**	**VW3**	**EV1**	**GS1**	**WVT**	**EV3**	**Lee**	**EV2**	**OX1**	**OX2**
Native Species Richness	5	3	5	4	4	4	3	4	3	4	3	3	3	2	0	N/A	N/A
Presence of Native intolerant species	5	3	5	5	4	3	3	4	4	3	3	3	3	2	0	N/A	N/A
Abundance of native species	4	4	3	3	3	4	3	3	3	3	2	2	2	2	0	N/A	N/A
Native species Frequency of Occurrence	4	4	3	3	3	4	3	3	3	3	2	2	2	2	0	N/A	N/A
Health/condition; native & introduced species	5	5	5	5	5	5	3	5	5	5	5	5	4	5	0	N/A	N/A
Presence of introduced fish species	5	5	5	5	5	4	5	4	4	4	5	5	5	3	5	N/A	N/A
Instream habitat modification	4	5	3	5	3	3	5	2	3	2	3	2	1	2	2	N/A	N/A
	32	29	29	2	27	27	25	25	25	24	23	21	20	18	7	N/A	N/A
SCORE	**91**	**83**	**83**	**77**	**77**	**77**	**71**	**71**	**71**	**69**	**66**	**60**	**57**	**51**	**20**	**N/A**	**N/A**
CLASS	**A**	**B**	**B**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**D**	**D**	**E**	**N/A**	**N/A**

Site 1: Leeupan

Although most highveld pans do not have natural fish populations, the artificial permanence and overtopping of Leeupan into adjacent streams could have created the opportunity for these fish to colonise Leeupan. The two indigenous fish species (Table 6), the straightfin barb (*Barbus paludinosus*) and southern mouthbrooder (*Pseudocrenilabrus philander*), collected from this pan could have occurred naturally in the pan, as several small streams enter the pan and this may have created suitable conditions for these species. Even though the present indigenous fish population may not be representative of the natural condition the absence of the third species typical of the upper catchment in the area, namely the chubbyhead barb (*Barbus anoplus*), may be indicative of the water quality problem in the pan. Several exotic species such as carp (*Cyprinus carpio*), Grasscarp (*Ctenopharygodon idella*) and largemouth bass (Micropterus salmoides) has also been introduced into the pan.. The condition of the fish assemblage (Table 7) in the pan is therefore considered largely modified (Class D). It is also likely that fish are naturally absent from the oxbow lakes in the area.

4.5 Aquatic Invertebrates

4.5.1 Reference Conditions

The only available historical information on aquatic invertebrates in the study area was collected in the Waterval River at Roodebank in 1959 and 1960 (Chutter 1967). The Waterval River at the time was already impacted by gold mining activities at Kinross and Leslie, and sewage effluent from Evander, and was considered to be the most polluted river in the entire Vaal River Catchment (Chutter 1967). The invertebrate fauna in the stones-in-current biotope was dominated numerically by Oligocheata (*Nais* sp.), blackflies (*Simulium adersi*, *S. damnosum*, *S. medusaeforme* and *S. nigritarse*), non-biting midges (Chironomidae), and two filter-feeding species of Hydropsychid caddisflies (*Amphipsyche scottae* and *Chematopsyche thomasseti*). The numbers of hydropsychid caddisflies were so high that the stones were bound together and almost entirely covered by their cases (Chutter 1967). Numbers of flatworms (Tricladida) and Elmid beetles (*Stenelmis thusa*), were also notably high. At all seasons there was an abundant drift of Cladocera and Copepoda which supported the large numbers of filter-feeding invertebrates (Simuliidae and Hydropsychid caddisflies).

4.5.2 Present Conditions

Site 1: Leeupan

During this study, the invertebrate fauna at Leeupan was characterised by a low numbers and low numbers of species, dominated mainly by bugs (hemiptera), particularly Notonectidae (Appendix B). One species of mayfly was recorded, and a single freshwater shrimp (*Caridina africana*) was collected. The water column contained low populations of zooplankton (copepoda). The taxa present were hardy and highly tolerant of polluted conditions. The low numbers of invertebrates may reflect severe predation by fish, as refuges from predation in the pan by way of habitat diversity, are limited. Overall, and based on professional judgement, the present condition of the invertebrate assemblage at this site is considered poor (Class E) (Table 8).

Table 8: Summary results of SASS5 biomonitoring data in the Middelbult Block 8 mining area in March 2002. Sites are arranged in order of decreasing Present Ecological State with respect to invertebrates.

	SAMPLING SITE																
	OX1	**KS1**	**BS1**	**WVT**	**OX2**	**TS**	**WV2**	**BS2**	**GS1**	**KS2**	**WV1**	**EV1**	**LEE**	**VW3**	**GS2**	**EV3**	**EV2**
SASS Score	N/a	89	103	108	N/a	69	67	70	82	88	86	90	N/a	55	58	44	20
No. of taxa	N/a	17	21	23	N/a	14	14	15	18	19	19	20	N/a	13	14	11	7
ASPT	N/a	5.2	4.9	4.7	N/a	4.9	4.8	4.7	4.6	4.6	4.5	4.5	N/a	4.2	4.1	4.0	2.9
CLASS	**B**	**C**	**C**	**C**	**C**	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**E**	**E**	**E**	**E**	**F**

Oxbow lakes

Aquatic vegetation in both oxbow lakes that were sampled provided excellent habitat conditions for aquatic invertebrates (Score=5). The diversity of crustacean species in the oxbow lakes was high, but this would not be detected by the SASS method. The fauna was characterised by a wide variety of taxa typically associated with temporary ponds, including Anostraca, Conchostraca, Copepoda, Ostrocoda and Cladocera. Crabs were notably absent from these lakes. Baetid mayflies were abundant and comprised more than two species. Fish were absent from both ponds, and this may partly explain the high numbers of invertebrates. It is likely that fish are naturally absent from these systems. Shrimps were also absent, as would be expected. Overall, the invertebrate fauna at these sites comprises an interesting group of taxa that justifies special conservation measures to protect these habitats. This is particularly so for the oxbow lake adjacent to the Bankspruit (OX1), which based on professional judgement, was considered to be in an excellent Present Ecological State in terms of invertebrates (Class B) (Table 8).

Streams

A total of 39 SASS5 taxa was recorded in streams during this survey. The highest number of taxa recorded at a single stream site was 23 (at WVT). The spatial diversity of invertebrate composition was high, although SASS5 score were generally low (Class C to F). The low diversity of stream invertebrates was partly because flows at the time of sampling were very low, and several streams had no flow at all. Low SASS scores were also attributed to the naturally low diversity of biotopes suitable for aquatic invertebrates, in particular, the general absence of riffles and rapids. It was therefore not surprising that SASS scores were generally low.

Highest SASS scores were recorded in the upper Kaalspruit (KS1), upper Bankspruit (BS1), and an unnamed tributary of the Waterval River (VWT), although the faunal composition at these sites was very different. The upper Kaalspruit (KS1) was characterised by the absence of non-biting midges (Chironomidae), and high numbers of Emerald Damsels (Lestidae) and dixid midges (Dixidae). The upper Bankspruit (BS1), on the other hand, was characterised by high numbers of shrimps (Atyidae), limpets (Ancylidae), bulinus snails (Bulininae) and Emerald Damsels, and a high diversity of water mites (Hydracarina). The tributary of the Waterval River (WVT), by contrast, was noted for high numbers of squaregills (Caenidae) only. These differences highlight the spatial diversity among the aquatic fauna.

Very low SASS scores were recorded in the Evanderspruit downstream of the Evander Sewage Works (EV2). Here the fauna was characterised by high numbers of non-biting midges (*Chironomus sp.*) and very little else besides.

The fauna in the Waterval River was more uniform in composition than the tributaries, but there was a noticeable reduction in the number of taxa with distance downstream, indicating a deterioration of conditions downstream. The river was characterised by high numbers of baetid mayflies and freshwater shrimps, and the notable absence of Gerridae, Hydracarina and Pleidae. Freshwater sponges (Porifera) were recorded in the middle reaches of the Waterval River (WV2), and nowhere else in the study area.

Five species of blackfly were recorded in study area during the survey, all of which are widespread, tolerant species (*Simulium adersi, S. damnosum, S. nigritarse, S. ruficorne and S. hargreavesi).*

The stones-in-current biotope in the Waterval River at Roodebank supported only five SASS5 taxa. Collections by Chutter in 1959 and 1960 consistently recorded between 11 to 12 SASS5 taxa in the stones-in-current at this site. Although the methods of collection were not exactly the same, the data suggest that about half the taxa that were recorded by Chutter over 40 years ago have disappeared. Taxa that were noticeably absent compared to Chutter's surveys were flatworms, oligocheata, elmid beetles and the caddisfly *Amphipsyche scottae*. Clearly, Roodebank has a water quality problem, and this was born out by numerous dead caddisflies and crabs that were noticed during this survey.

Water quality at this site has deteriorated significantly over the years: The median concentration of Total Dissolved Solids has increased from 186mg/L in the 1950's (Malan 1960) to around 500mg/L in the 1980's (DWAF 1990).

4.6 Best Attainable Ecological Classification

The Desktop Assessment of Best Attainable Ecological Class considered the area to be Largely Modified (Class D). We consider this to be an appropriate management class for the Waterval River, Grootspruit and Evanderspruit, but we suggest that the Kaalspruit and Bankspruit should be place in a higher protection category. The potential for rehabilitation of the last two streams is high, so we suggest that a Class B would be an appropriate level of classification.

5. CONCLUSIONS

Aquatic ecosystems in the vicinity of Middelbult Block 8 comprise a wide diversity of ecological conditions, ranging from near pristine (Class A) to highly degraded (Class E).

The Kaalspruit and Bankspruit are both in reasonable to excellent condition, and should receive priority status in terms of environmental protection.

Temporary oxbow lakes in the area contain an interesting and diverse crustacean fauna, which warrants a more detailed taxonomic investigation.

The Waterval River and Grootspruit are both degraded and incised to such an extent that it would be extremely difficult and costly to rehabilitate them.

The most important impacts on the aquatic ecosystems in the area include river crossings (bridges) that restrict flows and increase erosion and associated bank slumping downstream, and poor water quality from mines and the Evander sewage works.

6. RECOMMENDATIONS

6.1 Classification

We suggest that the Best Attainable Ecological Class for most of the streams in the area should be "Largely Modified" (Class D), but we suggest that the Kaalspruit and Bankspruit should be classified as Largely Natural" (Class B). These streams should therefore be given priority conservation status.

6.2 Stream Rehabilitation

We suggest that the Bankspruit and Kaalspruit should be rehabilitated to prevent these rivers and associated riparian wetlands and oxbow lakes from following the same trajectory of degradation that is currently seen in the adjacent Waterval River and Grootspruit. Rehabilitation would require significant modification and widening of bridges, which are considered to be the main factor affecting the degradation of streams and riparian wetlands in the area. The widening of bridges may need to be supplemented by construction of gabions and/or introduction of straw bales at key points.

6.3 Specialist Studies

We recommend that a specialist survey be undertaken of the crustacean species inhabiting the temporary oxbow lakes (OX1 and OX2). The aim of the survey would be to assess the conservation and biodiversity importance of these waterbodies, and based on this, to make recommendations for their future management. We suggest that the survey should comprise seasonal sampling for one year to ensure that a full complement of taxa is collected.

6.4 Biomonitoring

It is suggested that biomonitoring of fish and invertebrates should be conducted annually. Ideally biomonitoring should be conducted in winter, but because many streams in the area are seasonal, we suggest that the surveys should be conducted after the first rains in spring (September). We do not consider it necessary to monitor all 17 sites that were sampled during the baseline survey, and suggest that monitoring should be restricted to the following eight sites only:

- Kaalspruit: KS1 and KS2
- Bankspruit: BS1 and BS2
- Waterval: WV1 and WV2
- Groostpruit: GS1 and GS2

6.5 Remove Alien Vegetation

Alien vegetation that colonises areas disturbed by mining should be removed before it has a chance to seed. (This recommendation need not apply to Willow Trees).

7. REFERENCES

Chutter, F. M. (1967). Hydrobiological studies of the Vaal River and some of its tributaries, including an introduction to the ecology of *Simulium* in its lower reaches. PhD thesis, Rhodes University, Grahamstown.

Chutter, F. M. (1998). Research on the rapid biological assessment of water quality impacts in streams and rivers. Report to the Water Research Commission WRC Report No. 422/1/98.

Department of Water Affairs and Forestry (1990). Surface water quality of South Africa 1979-1988. Volume 3: Drainage region C and D. Technical Report No. TR145.

Department of Water Affairs and Forestry (1999*).* *Resource Directed Measures for Protection of Water Resources. Volume 3: River Ecosystems Version* 1, September 1999. Pretoria. Report Number N/29/99.

Dickens, C., & Graham, M. 2001. South African Scoring System (SASS) Version 5. Rapid bioassessment method for river. Umgeni Water. Unpublished report.

Jubb, R. A. (1967). Freshwater fishes of southern Africa. Balkema, Cape Town. 248 pp.

Kleynhans, C. J. & J. S. Engelbrecht, (2001). The use of ecological information on fish in the specification of the flow component of the reserve (desktop, rapid, intermediate and comprehensive determinations). In: MacKay, H (ed.): Water resources protection policy implementation. Resource directed measures for protection of water resources. River Ecosystems Revised Version . DWAF, Pretoria.

MacMillan, P. H. (1998). An Integrated Habitat Assessment System (IHAS version 2), for the rapid biological assessment of rivers and streams. A CSIR research project, Number ENV-P-I 98132 for Water Resources Management Programme, CSIR, ii + 44 pp.

Palmer, R. W. (2000). Aquatic invertebrates, Appendix E in Palmer R. W. (Ed): Olifants River Ecological Water Requirements Assessment: Upper Olifants Comprehensive Ecological Reserve (water quantity). Department of Water Affairs and Forestry Report No. PB 000-00-5699.

Skelton, P. (1993). A complete guide to the freshwater fishes of southern Africa. Southern Book Publishers. Halfway House.

Vos, P., Wepener, V & Cyrus, D. P. 2002. Efficiency of the SASS4 rapid bioassessment protocol in determining river health: A case study on the Mhathuze River, KwaZulu-Natal, South Africa. Water SA 28(1): 13-22.

8. APPENDICES

8.1 Appendix A: Habitat Integrity Results.

Site 2: KS1 - Kaalspruit upstream

Habitat Integrity

CRITERIA	Weight	Score	Confidence 0=0 3=high	Notes
Instream				
Water abstraction	14	3	2	A number of farm dams upstream
Flow modification	13	8	2	A number of farm dams upstream
Bed modification	13	2	2	
Channel modification	13	4	2	
Water quality	14	2	2	
Inundation	10	0	3	
Exotic macrophytes	9	0	3	
Exotic fauna	8	0	3	
Solid waste disposal	6	0	3	
TOTAL SCORE (%)		**90**	**A**	
Riparian				
Indigenous vegetation removal	13	0	3	
Exotic vegetation encroachment	12	2	3	*Populus alba, Salix babylonica*
Bank erosion	14	3	3	
Channel modification	12	3	3	
Water abstraction	13	3	2	
Inundation	11	0	3	
Flow modification	12	2	2	
Water quality	13	0	2	
TOTAL SCORE (%)		**93**	**A**	

Site 3: KS2 - Kaalspruit downstream

Habitat Integrity

CRITERIA	**Weight**	**Score**	**Confidence** 0=0 3=high	**Notes**
Instream				
Water abstraction	14	3	2	
Flow modification	13	2	2	
Bed modification	13	4	2	Cattle crossing & erosion
Channel modification	13	2	2	
Water quality	14	4	1	
Inundation	10	0	2	
Exotic macrophytes	9	0	3	
Exotic fauna	8	0	2	
Solid waste disposal	6	0	2	
TOTAL SCORE (%)		**92**	**A**	
Riparian				
Indigenous vegetation removal	13	0	3	
Exotic vegetation encroachment	12	2	3	*Salix babylonica*
Bank erosion	14	6	2	Local collapsing of banks and cattle trampling
Channel modification	12	2	2	
Water abstraction	13	0	2	
Inundation	11	0	2	
Flow modification	12	0	2	
Water quality	13	0	2	
TOTAL SCORE (%)		**95**	**A**	

Site 4a: BS1 - Bankspruit upstream

Habitat Integrity

CRITERIA	**Weight**	**Score**	**Confidence** 0=0 3=high	**Notes**
Instream				
Water abstraction	14	1	3	
Flow modification	13	1	3	Small dam upstream
Bed modification	13	0	3	
Channel modification	13	0	3	
Water quality	14	3	3	TDS higher than expected
Inundation	10	0	3	
Exotic macrophytes	9	0	3	
Exotic fauna	8	0	3	
Solid waste disposal	6	0	3	
TOTAL SCORE (%)		**97**	**A**	
Riparian				
Indigenous vegetation removal	13	0	3	
Exotic vegetation encroachment	12	1	3	*Salix babylonica* (single)
Bank erosion	14	1	3	Limited erosion at bridge
Channel modification	12	0	3	
Water abstraction	13	0	3	
Inundation	11	0	3	
Flow modification	12	0	3	
Water quality	13	2	3	?Nutrients from cattle
TOTAL SCORE (%)		**98**	**A**	

Site 4: BS2 - Bankspruit downstream

Habitat Integrity

CRITERIA	**Weight**	**Score**	**Confidence** 0=0 3=high	**Notes**
Instream				
Water abstraction	14	2	1	
Flow modification	13	1	1	Small dams
Bed modification	13	3	2	Siltation
Channel modification	13	7	2	Bank erosion & slumping
Water quality	14	3	1	Turbid, TDS higher than expected
Inundation	10	1	1	Small weirs upstream
Exotic macrophytes	9	0	3	
Exotic fauna	8	0	2	Possibly carp
Solid waste disposal	6	1	2	
TOTAL SCORE (%)		**91**	**A**	
Riparian				
Indigenous vegetation removal	13	0	3	
Exotic vegetation encroachment	12	1	3	*Salix babylonica*
Bank erosion	14	5	3	Bank slumping in places
Channel modification	12	5	3	Loss of margins from slumping
Water abstraction	13	0	3	
Inundation	11	0	3	
Flow modification	12	0	3	
Water quality	13	0	3	
TOTAL SCORE (%)		**94**	**A**	

Site 7c: WVT - Tributary of the Waterval River, upstream

Habitat Integrity

CRITERIA	**Weight**	**Score**	**Confidence** 0=0 3=high	**Notes**
Instream				
Water abstraction	14	1	2	Probable local use
Flow modification	13	1	2	Small dams
Bed modification	13	10	2	Scouring at bridge
Channel modification	13	6	2	Incision of main channel
Water quality	14	4	2	Some turbidity and elevated TDS and water temperature
Inundation	10	2	2	Small dams
Exotic macrophytes	9	0	3	
Exotic fauna	8	0	3	
Solid waste disposal	6	3	2	Rubble from bridge
TOTAL SCORE (%)		**87**	**B**	
Riparian				
Indigenous vegetation removal	13	0	3	
Exotic vegetation encroachment	12	1	3	*Salix babylonica*
Bank erosion	14	5	2	Slumping of banks
Channel modification	12	5	2	Incision of channel
Water abstraction	13	0	2	
Inundation	11	0	2	
Flow modification	12	0	2	
Water quality	13	0	2	
TOTAL SCORE (%)		**94**	**A**	

Site 6: WV1 - Waterval River upstream

Habitat Integrity

CRITERIA	Weight	Score	Confidence 0=0 3=high	Notes
Instream				
Water abstraction	14	3	1	Local use
Flow modification	13	2	1	Small dams
Bed modification	13	11	2	Bridge caused incision
Channel modification	13	8	2	Incision
Water quality	14	7	2	Elevated TDS & turbid
Inundation	10	0	1	
Exotic macrophytes	9	0	2	
Exotic fauna	8	0	2	
Solid waste disposal	6	0	2	
TOTAL SCORE (%)		**83**	**B**	
Riparian				
Indigenous vegetation removal	13	0	2	
Exotic vegetation encroachment	12	4	3	*Salix babylonica*
Bank erosion	14	15	3	Erosion & slumping – loss of vegetation
Channel modification	12	15	3	Deeply incised
Water abstraction	13	3	1	
Inundation	11	0	2	
Flow modification	12	0	2	
Water quality	13	3	1	
TOTAL SCORE (%)		**79**	**C**	

Site 5: WV2 - Waterval River downstream

Habitat Integrity

CRITERIA	**Weight**	**Score**	**Confidence** 0=0 3=high	**Notes**
Instream				
Water abstraction	14	5	1	Land owners
Flow modification	13	3	1	Small dams
Bed modification	13	3	2	Sedimentation
Channel modification	13	10	2	Incision of channel
Water quality	14	5	1	Turbid & elevated TDS
Inundation	10	0	2	
Exotic macrophytes	9	0	2	
Exotic fauna	8	5	2	Possibly carp
Solid waste disposal	6	12	2	Rubbish in river
TOTAL SCORE (%)		**82**	**B**	
Riparian				
Indigenous vegetation removal	13	0	3	
Exotic vegetation encroachment	12	3	3	*Salix babylonica*
Bank erosion	14	8	2	Bank erosion and slumping
Channel modification	12	8	2	Incision
Water abstraction	13	0	2	
Inundation	11	0	2	
Flow modification	12	0	2	
Water quality	13	3	1	?nutrients
TOTAL SCORE (%)		**87**	**B**	

WV3 - Roodebank Gauging Weir

Habitat Integrity

CRITERIA	Weight	Score	Confidence 0=0 3=high	Notes
Instream				
Water abstraction	14	5	2	Local use
Flow modification	13	3	2	Small dams
Bed modification	13	6	3	Siltation
Channel modification	13	2	3	
Water quality	14	13	3	Water colour grey, fungus etc.
Inundation	10	10	3	
Exotic macrophytes	9	0	3	
Exotic fauna	8	5	3	Carp & *Gambusia*
Solid waste disposal	6	8	3	Dumping
TOTAL SCORE (%)		**77**	**C**	
Riparian				
Indigenous vegetation removal	13	0	3	
Exotic vegetation encroachment	12	5	3	*Populus alba*
Bank erosion	14	3	3	
Channel modification	12	0	3	
Water abstraction	13	0	3	
Inundation	11	4	3	
Flow modification	12	3	3	
Water quality	13	5	3	
TOTAL SCORE (%)		**90**	**B**	

Site 9: GS1 - Grootspruit upstream

Habitat Integrity

CRITERIA	Weight	Score	Confidence 0=0 3=high	Notes
Instream				
Water abstraction	14	0	3	
Flow modification	13	5	3	Dams & runoff from Kinross
Bed modification	13	4	3	
Channel modification	13	2	3	
Water quality	14	10	3	Elevated TDS
Inundation	10	0	3	
Exotic macrophytes	9	0	3	
Exotic fauna	8	0	3	
Solid waste disposal	6	5	3	
TOTAL SCORE (%)		**87**	**B**	
Riparian				
Indigenous vegetation removal	13	0	3	
Exotic vegetation encroachment	12	1	3	
Bank erosion	14	3	3	
Channel modification	12	2	3	
Water abstraction	13	0	3	
Inundation	11	0	3	
Flow modification	12	0	3	
Water quality	13	3	3	
TOTAL SCORE (%)		**95**	**A**	

Site 8: GS2 - Grootspruit downstream

Habitat Integrity

CRITERIA	**Weight**	**Score**	**Confidence** 0=0 3=high	**Notes**
Instream				
Water abstraction	14	2	1	
Flow modification	13	5	1	Return flows from slimes dams
Bed modification	13	8	2	Siltation
Channel modification	13	12	2	Incised
Water quality	14	8	2	Elevated TDS
Inundation	10	0	2	
Exotic macrophytes	9	0	3	
Exotic fauna	8	0	2	
Solid waste disposal	6	5	2	
TOTAL SCORE (%)		**80**	**B**	
Riparian				
Indigenous vegetation removal	13	0	2	
Exotic vegetation encroachment	12	4	2	*Sesbania*
Bank erosion	14	10	3	Bank slumping & loss of vegetation
Channel modification	12	14	2	Incised
Water abstraction	13	0	2	
Inundation	11	0	2	
Flow modification	12	2	1	
Water quality	13	4	1	Nutrients ?
TOTAL SCORE (%)		**83**	**B**	

Site 12: EV1 - Evanderspruit (between two dams: upstream)

Habitat Integrity

CRITERIA	**Weight**	**Score**	**Confidence** 0=0 3=high	**Notes**
Instream				
Water abstraction	14	5	1	Abstraction from dams
Flow modification	13	15	3	Large dams
Bed modification	13	20	3	Artificial stream
Channel modification	13	20	3	Diverted
Water quality	14	8	3	Elevated TDS
Inundation	10	12	3	Large dams
Exotic macrophytes	9	0	0	
Exotic fauna	8	5	3	Dams create artificial habitat
Solid waste disposal	6	2	3	
TOTAL SCORE (%)		**57**	**D**	
Riparian				
Indigenous vegetation removal	13	0	3	
Exotic vegetation encroachment	12	0	3	
Bank erosion	14	0	3	
Channel modification	12	15	3	Diverted stream
Water abstraction	13	3	3	
Inundation	11	5	3	Increased *Typha* stands
Flow modification	12	12	3	No flow variation
Water quality	13	10	3	Dense *Potamageton*
TOTAL SCORE (%)		**78**	**C**	

Site 10: EV2 - Evanderspruit downstream of Sewage Works

Habitat Integrity

CRITERIA	**Weight**	**Score**	**Confidence** 0=0 3=high	**Notes**
Instream				
Water abstraction	14	3	1	Big dams
Flow modification	13	20	3	Perm sewerage flow and dams
Bed modification	13	2	2	
Channel modification	13	2	2	
Water quality	14	25	3	Sewerage
Inundation	10	2	3	Evander Dam
Exotic macrophytes	9	8	3	*Rorippa*
Exotic fauna	8	0	3	
Solid waste disposal	6	0	3	
TOTAL SCORE (%)		**68**	**D**	
Riparian				
Indigenous vegetation removal	13	0	3	
Exotic vegetation encroachment	12	0	3	
Bank erosion	14	5	2	
Channel modification	12	2	1	
Water abstraction	13	0	3	
Inundation	11	3	2	
Flow modification	12	15	2	
Water quality	13	15	3	
TOTAL SCORE (%)		**80**	**B**	

Site 11: EV3 - Evanderspruit downstream

Habitat Integrity

CRITERIA	Weight	Score	Confidence 0=0 3=high	Notes
Instream				
Water abstraction	14	2	1	
Flow modification	13	20	3	Permanent sewage outflow
Bed modification	13	7	2	Armoured
Channel modification	13	6	3	Incised
Water quality	14	20	3	Sewage
Inundation	10	3	3	
Exotic macrophytes	9	0	3	
Exotic fauna	8	0	3	
Solid waste disposal	6	0	3	
TOTAL SCORE (%)		**69**	**D**	
Riparian				
Indigenous vegetation removal	13	0	3	
Exotic vegetation encroachment	12	0	3	
Bank erosion	14	12	3	Slumping & loss of vegetation
Channel modification	12	3	3	
Water abstraction	13	3	3	
Inundation	11	3	3	
Flow modification	12	8	3	Armouring & loss of vegetation
Water quality	13	8	2	Nutrients ?
TOTAL SCORE (%)		**81**	**B**	

Site 14: TS - Unnamed tributary of the Trichardspruit

Habitat Integrity

CRITERIA	Weight	Score	Confidence 0=0 3=high	Notes
Instream				
Water abstraction	14	0	3	
Flow modification	13	10	2	Large dams
Bed modification	13	3	3	Siltation
Channel modification	13	4	3	Incised
Water quality	14	12	3	Elevated TDS
Inundation	10	2	2	
Exotic macrophytes	9	0	3	
Exotic fauna	8	0	3	
Solid waste disposal	6	10	3	Dumping site
TOTAL SCORE (%)		**81**	**B**	
Riparian				
Indigenous vegetation removal	13	0	3	
Exotic vegetation encroachment	12	0	3	
Bank erosion	14	3	3	
Channel modification	12	3	3	
Water abstraction	13	0	3	
Inundation	11	0	3	
Flow modification	12	3	3	
Water quality	13	8	1	Nutrients ?
TOTAL SCORE (%)		**91**	**A**	

8.2 Appendix B: Results of aquatic invertebrates biomonitoring, using the SASS5 method.

Abundance was ranked using a 5-point scale: 1=1, A=2-10, B=10-100, C=100-1000, D=>1000. The suitability of each biotope to invertebrates was assessed on a 5-point scale (1=poor, 5=excellent).

Site 1: Leeupan

Taxa	SASS5 Score	STONES	VEG	SED	Total
HABITAT SCORE			**4**	**2**	
Shrimps	8		1		
Baetidae 1 sp	4		A		
Coenagrionidae	4		B		
Aeshnidae	8		A		
Belostomatidae	3		A	A	
Corixidae	3		A	B	
Notonectidae	3		C	B	
Pleidae	4		A		
Dytiscidae	5			1	
Chironomidae	2		A		
Sample Score			N/A	N/A	**N/A**
Number of families			N/A	N/A	**N/A**
Average Score per Taxon			N/A	N/A	**N/A**

Other taxa identified: Water column with low populations of Copepoda.

Site 13: OX1 - Oxbow Lake along Bankspruit

Taxa	SASS5 Score	STONES	VEG	SED	Total
HABITAT SCORE			**5**	**3**	
Turbellaria	3		A	A	
Oligochaeta	1		A	C	
Leeches	3			1	
Baetidae >2spp	12		C		
Gerridae	5		A		
Notonectidae	3		B		
Dytiscidae	5		B		
Chironomidae	2		A	A	
Sample Score			N/A	N/A	**N/A**
Number of families			N/A	N/A	**N/A**
Average Score per Taxon			N/A	N/A	**N/A**

Other taxa identified: Anostraca
Conchostraca
Copepoda
Cladocera
Ostrocoda
Kassina senegalense
Azolla

Site 7a: Oxbow Lake along Waterval River

Taxa	SASS5 Score	STONES	VEG	SED	Total
HABITAT SCORE			**5**		
Hydracarina	8		A		
Baetidae >2spp	12		C		
Coenagrionidae	4		A		
Libellulidae	4		1		
Belostomatidae	3		A		
Corixidae	3		A		
Gerridae	5		A		
Dytiscidae	5		B		
Chironomidae	2		A		
Bulininae	3		A		
Sphaeridae	3		A		
Planorbiidae	3		A		
Sample Score			N/A		**N/A**
Number of families			N/A		**N/A**
Average Score per Taxon			N/A		**N/A**

Other taxa identified: Cladocera (large)
Ostrocoda (abundant)

Site 2: KS1 - Kaalspruit upstream

Taxa	SASS5	STONES	VEG	SED	Total
HABITAT SCORE	Score		**4**	**2**	
Oligocheata	1			A	
Crabs	3		A		
Shrimps	8		B	1	
Hydracarina	8		1		
Baetidae 1 sp	4			1	
Baetidae 2 spp	6		B		
Baetidae >2spp	12				
Coenagrionidae	4		B		
Lestidae	8		B	1	
Aeshnidae	8		A		
Belostomatidae	3		A		
Corixidae	3			1	
Gerridae	5		A		
Notonectidae	3		A	A	
Pleidae	4		1		
Veliidae	5		A		
Dytiscidae	5		A		
Gyrinidae	5		B		
Dixidae	13		B		
Sample Score			85	27	**89**
Number of families			15	6	**17**
Average Score per Taxon			5.7	4.5	**5.2**

Other taxa identified: Cladocera
Copepoda

:

Site 3: KS2 - Kaalspruit downstream

Taxa	SASS5 Score	STONES	VEG	SED	Total
HABITAT SCORE		**1**	**3**	**2**	
Shrimps	8	A	B		
Hydracarina	8		A		
Baetidae 1 sp	4			1	
Baetidae 2 spp	6	A	A		
Baetidae >2spp	12				
Coenagrionidae	4		A		
Lestidae	8		1		
Aeshnidae	8		A		
Libellulidae	4		1		
Belostomatidae	3		1		
Corixidae	3	A		A	
Gerridae	5		A		
Nepidae	3		A		
Notonectidae	3		A		
Dytiscidae	5		A		
Gyrinidae	5		A		
Simuliidae	5	C			
Chironomidae	2	A	A	B	
Culicidae	1		1		
Ancylidae	6		A		
Sample Score		24	79	12	**88**
Number of families		5	16	4	**19**
Average Score per Taxon		4.8	4.9	3.0	**4.6**

Other taxa identified: *Simulium adersi*
Simulium ruficorne
Simulium nigritarse
Cladocera

Site 4a: BS1 - Bankspruit upstream

Taxa	SASS5 Score	STONES	VEG	SED	Total
HABITAT SCORE			**5**	**3**	
Oligocheata	1		1	A	
Shrimps	8		C	1	
Hydracarina	8		B	B	
Baetidae 1 sp	4			1	
Baetidae >2spp	12		B		
Coenagrionidae	4		B		
Lestidae	8		B		
Aeshnidae	8		1		
Belostomatidae	3		A		
Corixidae	3			A	
Gerridae	5		A		
Notonectidae	3		B	A	
Pleidae	4		A		
Hydropsychidae 1 sp	4		1		
Dytiscidae	5		A	1	
Gyrinidae	5		1		
Hydrophilidae	5		A		
Ceratopogonidae	5			1	
Chironomidae	2		A	B	
Culicidae	1		1		
Bulininae	3		C		
Ancylidae	6		C		
Sample Score			95	39	**103**
Number of families			19	9	**21**
Average Score per Taxon			5.0	4.3	**4.9**

Other taxa identified: Hydracarina (abundant)

Site 4: BS2 - Bankspruit downstream

Taxa	SASS5 Score	STONES	VEG	SED	Total
HABITAT SCORE		**2**	**3**	**1**	
Shrimps	8	B	A		
Baetidae 1 sp	4	1			
Baetidae 2 spp	6		A		
Baetidae >2spp	12				
Caenidae	6		A	A	
Coenagrionidae	4	1	A	1	
Gerridae	5		A		
Nepidae	3		1		
Notonectidae	3		A	1	
Hydropsychidae 1 sp	4	A			
Dytiscidae	5		1		
Hydrophilidae	5		1		
Simuliidae	5	A			
Chironomidae	2	A	A	A	
Physidae	3		1		
Ancylidae	6	A	1		
Sample Score		30	56	23	**70**
Number of families		7	12	5	**15**
Average Score per Taxon		4.3	4.7	4.6	**4.7**

Other taxa identified: *Simulium adersi*
Simulium nigritarse
Physa acuta
Plumatella

Site 7c: WVT - Tributary of the Waterval

Taxa	SASS5 Score	STONES	VEG	SED	Total
HABITAT SCORE		**2**	**3**	**3**	
Oligocheata	1	A	A	B	
Crabs	3	1	1	A	
Shrimps	8		1		
Hydracarina	8		A	1	
Baetidae 1 sp	4			A	
Baetidae 2 spp	6		B		
Baetidae >2spp	12	B			
Caenidae	6	B	A	A	
Coenagrionidae	4		A		
Lestidae	8		1		
Libellulidae	4			1	
Corixidae	3	A		A	
Gerridae	5		A		
Notonectidae	3		A	A	
Pleidae	4		B		
Hydropsychidae 1 sp	4	A			
Dytiscidae	5		B		
Hydraenidae	8		A		
Hydrophilidae	5		A		
Ceratopogonidae	5			1	
Muscidae	1		1		
Simuliidae	5	B			
Chironomidae	2	A		A	
Culicidae	1		A		
Bulininae	3		1		
Sample Score		36	79	39	**108**
Number of families		8	17	10	**23**
Average Score per Taxon		4.5	4.6	3.9	**4.7**

Other taxa identified: *Simulium adersi* (mostly)
Simulium ruficorne
Caenidae (noticeably common)

Site 6: WV1 - Waterval River upstream

Taxa	SASS5	STONES	VEG	SED	Total
HABITAT SCORE	Score	**4**	**4**	**3**	
Turbellaria	3	A			
Oligocheata	1	A		B	
Crabs	3	B	A	A	
Shrimps	8	B	C	A	
Hydracarina	8				
Baetidae 1 sp	4	B		A	
Baetidae >2spp	12		B		
Caenidae	6	1			
Coenagrionidae	4		B		
Belostomatidae	3		1		
Corixidae	3			A	
Notonectidae	3		A		
Veliidae	5		A		
Hydropsychidae 1 sp	4	B		1	
Dytiscidae	5		A		
Gyrinidae	5	A	A		
Ceratopogonidae	5	1			
Simuliidae	5	C	A		
Chironomidae	2	B	A	B	
Ancylidae	6		1		
Sphaeridae	3	A			
Sample Score		49	61	25	**86**
Number of families		12	12	7	**19**
Average Score per Taxon		4.1	5.1	3.6	**4.5**

Other taxa identified: *Baetis harrisoni*
Simulium adersi (mostly)
Simulium nigritarse
Simulium hargreavesi
Potamonautes unispina

Site 5: WV2 - Waterval River Downstream

Taxa	SASS5 Score	STONES	VEG	SED	Total
HABITAT SCORE		**4**	**3**	**4**	
Porifera	5	A			
Oligocheata	1			A	
Crabs	3	A		1	
Shrimps	8		C	1	
Hydracarina	8				
Baetidae 1 sp	4			A	
Baetidae >2spp	12	A	B		
Caenidae	6	1		1	
Coenagrionidae	4		A		
Belostomatidae	3		A		
Notonectidae	3		A		
Hydropsychidae 1 sp	4	A			
Dytiscidae	5		A		
Gyrinidae	5	A			
Chironomidae	2	A		A	
Ancylidae	6	A			
Sample Score		43	35	24	**67**
Number of families		8	6	6	**14**
Average Score per Taxon		5.4	5.8	4.0	**4.8**

Other taxa identified: *Simulium adersi* (mostly)
Simulium damnosum
Simulium hargreavesi
Simulium nigritarse
Potamonautes unispina

WV3 - Roodebank Weir

Taxa	SASS5 Score	STONES	VEG	SED	Total
HABITAT SCORE		**4**	**4**	**3**	
Leeches	3			1	
Shrimps	8		C	A	
Baetidae 1 sp	4	1			
Baetidae 2 spp	6		B		
Coenagrionidae	4		C		
Belostomatidae	3		A		
Nepidae	3		A		
Veliidae	5		A		
Hydropsychidae 1 sp	4	B			
Simuliidae	5	C			
Chironomidae	2	B	A	A	
Lymnaeidae	3		1		
Bulininae	3		1		
Ancylidae	6	A			
Sample Score		21	37	13	**55**
Number of families		5	9	3	**13**
Average Score per Taxon		4.2	4.1	4.3	**4.2**

Other taxa identified: *Lymnaea ?natalensis*
Bulinus ?africanus
Simulium damnosum
Simulium adersi
NB: Numerous dead crabs and Hydropsychid caddisflies

Site 9: GS1 - Grootspruit upstream.

Taxa	SASS5 Score	STONES	VEG	SED	Total
HABITAT SCORE			**3**	**2**	
Crabs	3		A		
Hydracarina	8		A		
Baetidae 2 spp	6		C		
Coenagrionidae	4		B		
Aeshnidae	8		A		
Libellulidae	4		A		
Belostomatidae	3		B		
Corixidae	3		A	1	
Gerridae	5		A		
Hydrometridae	6		A		
Notonectidae	3		B	1	
Pleidae	4		B		
Veliidae	5		A		
Dytiscidae	5		B		
Gyrinidae	5		A		
Hydrophilidae	5		A		
Chironomidae	2		A	A	
Bulininae	3		A		
Sample Score			82	8	**82**
Number of families			18	3	**18**
Average Score per Taxon			4.6	2.7	**4.6**

Other taxa identified: Cladocera

Site 8: GS2 - Grootspruit downstream

Taxa	SASS5 Score	STONES	VEG	SED	Total
HABITAT SCORE		**4**	**3**	**3**	
Oligocheata	1	B		B	
Crabs	3	A			
Shrimps	8	B	B	1	
Baetidae 1 sp	4		A	A	
Baetidae 2 spp	6	A			
Baetidae >2spp	12				
Caenidae	6	A		1	
Coenagrionidae	4		B		
Libellulidae	4			1	
Belostomatidae	3		A		
Nepidae	3		A		
Notonectidae	3		A		
Hydropsychidae 1 sp	4	A			
Gyrinidae	5		A		
Chironomidae	2	A	1	1	
Ancylidae	6	1			
Sample Score		36	32	25	**58**
Number of families		8	8	6	**14**
Average Score per Taxon		4.5	4.0	4.2	**4.1**

Other taxa identified:

Site 12: EV1 - Evanderspruit upstream

Taxa	SASS5 Score	STONES	VEG	SED	Total
HABITAT SCORE			**3**	**3**	
Oligocheata	1			A	
Crabs	3		1		
Shrimps	8		B		
Hydracarina	8		A		
Baetidae 2 spp	6		B		
Coenagrionidae	4		B		
Libellulidae	4			1	
Belostomatidae	3		C		
Corixidae	3		D	C	
Gerridae	5		A		
Hydrometridae	6		1		
Nepidae	3		A		
Notonectidae	3		A		
Pleidae	4		B		
Gyrinidae	5		A		
Hydrophilidae	5		A		
Simuliidae	5		A		
Chironomidae	2		B	B	
Bulininae	3		A		
Planorbidae	3		A		
Sample Score			85	8	**90**
Number of families			18	3	**20**
Average Score per Taxon			4.7	2.7	**4.5**

Other taxa identified: *Simulium ruficorne* (mostly)
Simulium adersi
Simulium nigritarse
Nostochopsis

Site 10: EV2 - Evanderspruit sewage outfall

Taxa	SASS5 Score	STONES	VEG	SED	Total
HABITAT SCORE		**3**	**4**	**1**	
Oligocheata	1	B		A	
Leeches	3		1		
Crabs	3	A			
Belostomatidae	3		B		
Nepidae	3		1		
Simuliidae	5	A			
Chironomidae	2	C	C	A	
Sample Score		11	11	3	**20**
Number of families		4	4	2	**7**
Average Score per Taxon		2.8	2.8	1.5	**2.9**

Other taxa identified:

Site 11: EV3 - Evanderspruit downstream

Taxa	SASS5 Score	STONES	VEG	SED	Total
HABITAT SCORE		**2**	**4**	**2**	
Oligocheata	1	A		A	
Shrimps	8		1		
Baetidae 2 spp	6		A		
Coenagrionidae	4		A		
Belostomatidae	3		A		
Corixidae	3		1		
Pleidae	4		A		
Dytiscidae	5		A		
Hydrophilidae	5		A		
Simuliidae	5	A	A		
Chironomidae	2	A	A		
Sample Score		8	43	1	**44**
Number of families		3	10	1	**11**
Average Score per Taxon		2.7	4.3	1	**4.0**

Other taxa identified: *Simulium adersi*

Site 14: TS - Tributary of the Trichardspruit

Taxa	SASS5 Score	STONES	VEG	SED	Total
HABITAT SCORE			**3**	**3**	
Oligocheata	1		A		
Crabs	3		1		
Shrimps	8		B		
Hydracarina	8		C		
Baetidae 1 sp	4			1	
Baetidae 2 spp	6		B		
Baetidae >2spp	12				
Coenagrionidae	4		A		
Lestidae	8		A		
Belostomatidae	3		1		
Notonectidae	3		A		
Pleidae	4		1		
Veliidae	5		A		
Ceratopogonidae	5		1		
Chironomidae	2		B	C	
Sphaeridae	3			B	
Sample Score			60	9	**69**
Number of families			13	3	**14**
Average Score per Taxon			4.6	3.0	**4.9**

Other taxa identified: Copepoda
Benthic filamentous algae abundant

APPENDIX 5.13(A)

SPECIALIST REPORT
NOISE

Ben van Zyl PhD MSc (Eng)
ACOUSTIC CONSULTING ENGINEER
T/A Acusolv

P O Box 70596
Die Wilgers
0041

Tel: 012 807 4924
Fax: 086 508 1122
ben@acusolv.co.za
542 Verkenner Ave ▸ Die Wilgers ▸ Pretoria

Sasol Mining Middelbult (Block 8)	Report G830-R2
Shondoni Project	
Noise Study for Environmental Impact Assessment	
For: Sasol Mining (Pty) Ltd	Date Issued: 13-Aug-2010

Declaration of independence

I am a single proprietor, independent acoustic consulting engineer. I have no commercial interest in Sasol Mining (Pty) Ltd, or the above-mentioned project.

A personal curriculum vitae in support of my qualifications, expertise and experience to undertake studies of this nature, is attached in Appendix B of this report.

Executive Summary

This report presents the results of a specialist noise study that was carried in support of a comprehensive Environmental Impact Assessment of the proposed Middelbult (Block 8) Shondoni Shaft project conducted by JMA Consulting (Pty) Ltd. The study finds that the project will have a significant noise impact on residents at the Chicken Farm near the shaft, in Brendan Village, at Siyalinga and in parts of Embalenhle Township. The two main sources of noise responsible for this impact will be the ventilation fans at the shaft complex and the conveyor.

It is possible to mitigate the impact and reduce noise to acceptable levels by implementation of practically viable noise control measures. This must be ensured by stipulating appropriate minimum acoustical requirements in fan and conveyor supplier specifications.

Ben van Zyl PhD MSc (Eng)
Acoustical Engineer

Index

1 Introduction

1.1 Location and description of the proposed activity

Sasol Mining operates a number of underground coal mines in the Secunda Area. As part of ongoing development, Sasol Mining is investigating options to replace the existing West Shaft of Middelbult Colliery with a new shaft (Shondoni) in the Block 8 reserves in order to increase its reserve utilisation of the existing Middelbult operations (original Middelbult Reserves and Block 8 Reserves). The Shondoni Shaft in the Block 8 Reserves of Middelbult Colliery will be located in the Mpumalanga Province of South Africa. The regional setting of the proposed development is shown in Figure 1.1.

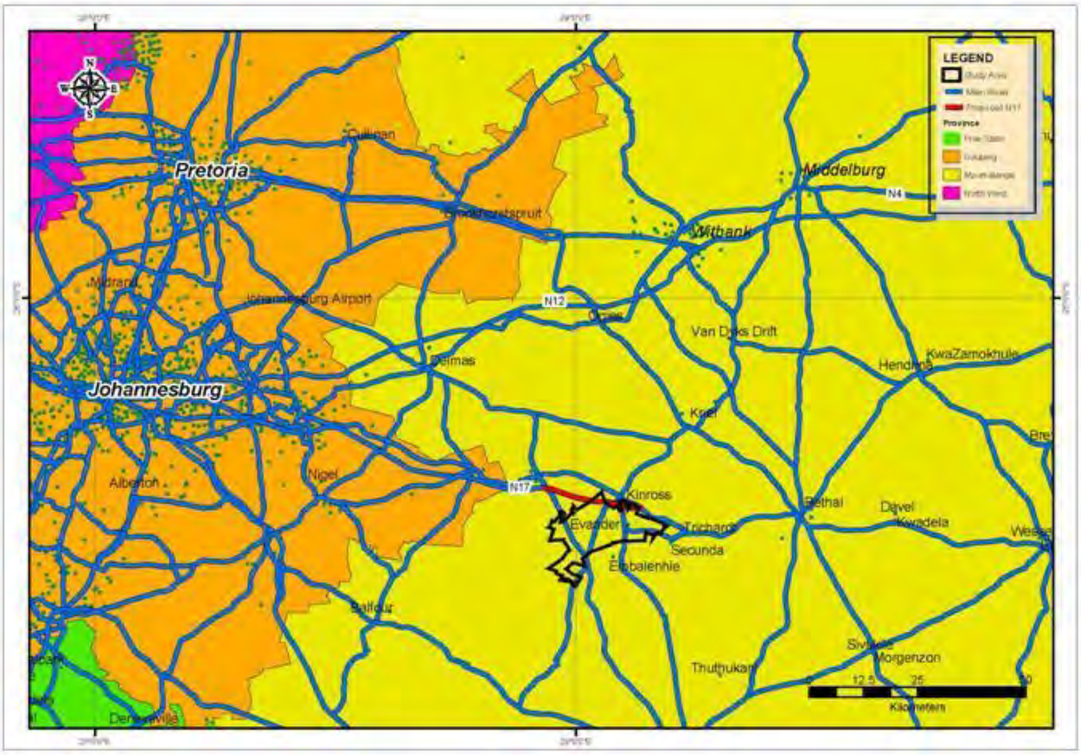


Figure 1.1

Regional Setting of the Shondoni Project

In addition to the underground mine, the proposed infrastructure expansion of the Middelbult operations comprise one additional shaft complex (Shondoni Shaft) with associated infrastructure in the Block 8 Reserves and a new overland conveyor to transport coal to the Middelbult Main Shaft and then onto an existing conveyor to the Sasol Mining central coal stockpile area (Sasol Coal Supply or SCS).

1.2 Terms of reference and scope of work

The acoustic specialist's brief was to investigate the noise impact of the proposed development on the surrounding area and, where applicable, to consider the requirements and options for mitigation. Figure 1.2 shows the project area with the location of the shaft and the conveyor route to which the findings of this noise study apply.

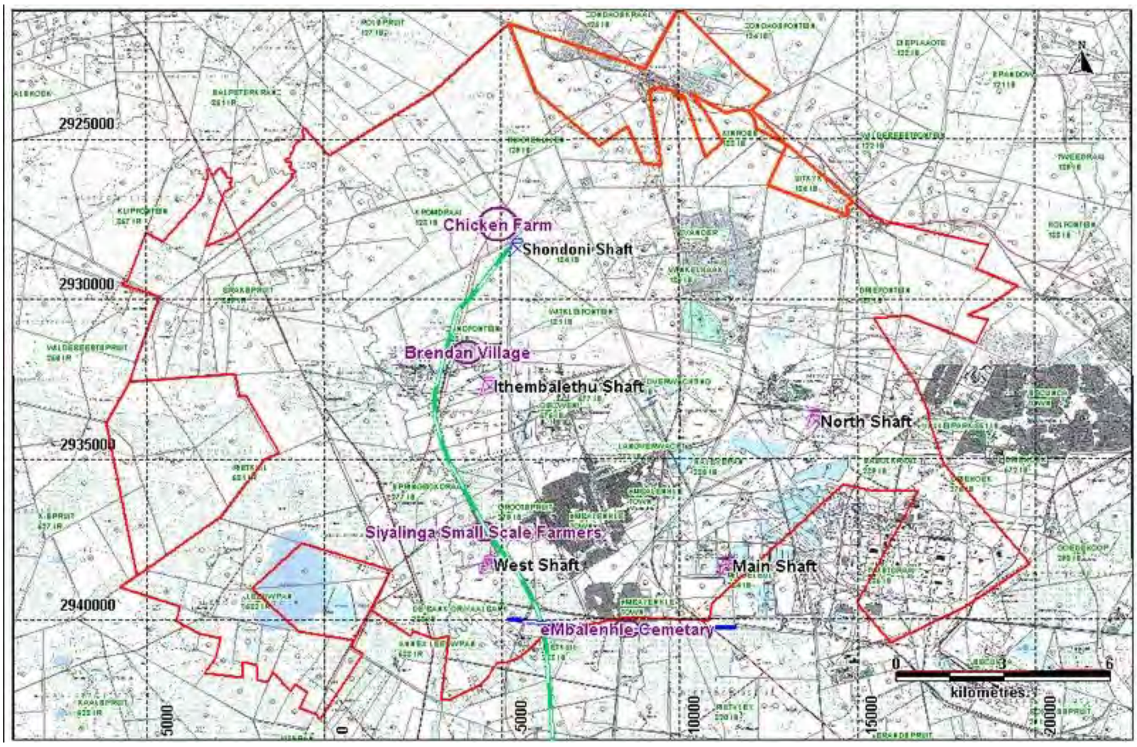


Figure 1.2

Shondoni noise study area and location of the shaft and conveyor route

The scope of work required to carry out this study, involves the following two main tasks:

Scoping and baseline study

Carry out a physical scoping and a measurement survey to assess the nature of the existing noise environment and to determine typical existing, i.e. predevelopment outdoor ambient sound levels in the area.

Predictive noise impact study

Carry out a study in which the expected impact of the development is quantified and assessed by means of computer modeling of the emission and atmospheric propagation of noise expected to be generated by mining-related surface operations at and around the shaft and along the conveyor route.

This report presents the results of the baseline ambient survey and of the predictive noise study as part of the overall project Environmental Impact Assessment (EIA) conducted by JMA Consulting (Pty) Ltd.

2 Methodology

2.1 General

The Shondoni Project noise study was carried out in accordance with SANS 10328 [1], a South African Standard presenting guidelines on procedures to conduct noise assessments.

2.2 Baseline Study

2.2.1 Baseline field survey

Selection of noise monitoring locations

Criteria and practical considerations which influence the selection of suitable locations for noise monitoring, include the following:

- **Community concerns:** In selecting locations for noise monitoring, concerns raised by interested and affected parties should be taken into account.
- **Worst-case impact:** Focus on areas where maximum noise impact is expected.
- **Suitability for future surveys:** As far possible, select locations likely to be accessible in future surveys.
- **Avoid interference:** As far as practically possible, stay clear of and avoid interference by localised noise sources which may distort the data. Examples are power distribution boxes, barking dogs, speech interference by curious visitors and insects in close proximity of the microphone.
- **Equipment safety:** Measurement procedure, integration periods and sample size depend on the availability of facilities for safeguarding equipment. Long duration samples are only possible at locations where facilities are available to lock away recording equipment connected via a cable to a microphone positioned outdoors at a point clear of vertical reflecting surfaces and protected from the elements.

Meteorological considerations

Outdoor noise measurement is not permitted under certain weather conditions. Rain, drizzle or fog affects the conductivity of measurement microphones, resulting in faulty readings. It may also damage the microphone and measuring equipment. Secondly, although measurement often has to be performed in the presence of wind, care should be taken to verify that wind turbulence noise on the microphone capsule is negligible compared to the sound level being measured. There is no fixed upper limit for permissible wind speed, it all depends on the level being measured. Another weather phenomenon which may cause interference and spoil measurement data, is thunder.

Meteorological conditions also affect the acoustic environment and the actual sound levels without causing interference or measurement error. Normal fluctuations in atmospheric conditions may cause large variations in noise level which cannot and should not be avoided in the planning and execution of noise monitoring surveys. These variations constitute the natural variance in both background and intrusive noise levels. Noise levels at a distance from large sources are highly dependent on meteorological conditions. In fact, the difference in characteristic day and night meteorological patterns is one reason why 24-hour mining or industrial operations always have much greater noise impacts at night[1].

It should be noted that, for the reasons explained above, the monitoring of meteorological conditions, such as temperature, wind and humidity on the ground can at best only serve to avoid errors and distortion of measurement data. Knowledge of cloud cover, temperature, humidity and wind which prevailed during the course of a noise survey has little if any value in the post-processing and interpretation of data.

Sampling considerations

To be of any use as an environmental management tool, noise monitoring has to produce accurate and relevant data. As a minimum requirement, the right equipment should be used and measurements performed with the necessary precision and accuracy, as laid down in SANS 10103 [2]. Just as important, no matter how accurate the measurements, the data is only as good as the sample. What complicates noise sampling, is that ambient noise is all but constant. As a rule, it is the net result of contributions from various constant, cyclic and randomly fluctuating sources.

To account for the intrinsic 24-hour cyclic variation, measurements should be taken within the relevant period of interest, e.g. daytime, night-time or a 24-hour cycle. Noise regulations require that the noise investigated must be measured (averaged) over a period of at least 10 minutes; i.e. 10 minutes or longer. Occasionally, in the investigation of noise complaints, a 10 minute sample may be sufficient to obtain the data needed to make a finding. For purposes of predictive noise studies and monitoring surveys, however, much longer averaging periods are required to determine baseline or operational noise levels. Noise levels have to be averaged over periods long enough to ensure that the sample is representative of the true average.

Where this is possible, in addition to measuring the average over the day or night-time period of interest, equipment may be programmed to simultaneously determine averages in a contiguous series of short sub-intervals of say 10-minute, 30-minute, or 1 hour duration, covering the main survey period. In this way, a picture can be obtained of the noise pattern over that period. For practical reasons, it is often not possible to attend measurements for the full duration of such long recordings.

Noise survey conducted in the Shondoni study

In a baseline investigation carried during the period 02-Jul-2010 to 07-Jul-2010, ambient noise surveys were conducted at locations shown in Figure 2.1.

At M1 and M2, noise recording equipment was programmed to measure averages in sequences of 10-minute intervals for a total duration of 24 hours or longer. At M3 where facilities suitable for long-duration unattended recordings were not available, shorter duration samples of 20 minutes were taken. In all recordings, A-weighted, equivalent continuous sound pressure levels L_{Aeq} (dBA) were measured, using an integrating sound analyser. For purposes of identifying sources of noise, third-octave spectra were examined during attended sessions, as

1 *The other main reason is the increased community sensitivity at night due to a natural decline in road traffic and human activity noise.*

well as in post-processing of data. This made it possible to distinguish between background ambient and mining-related noise.

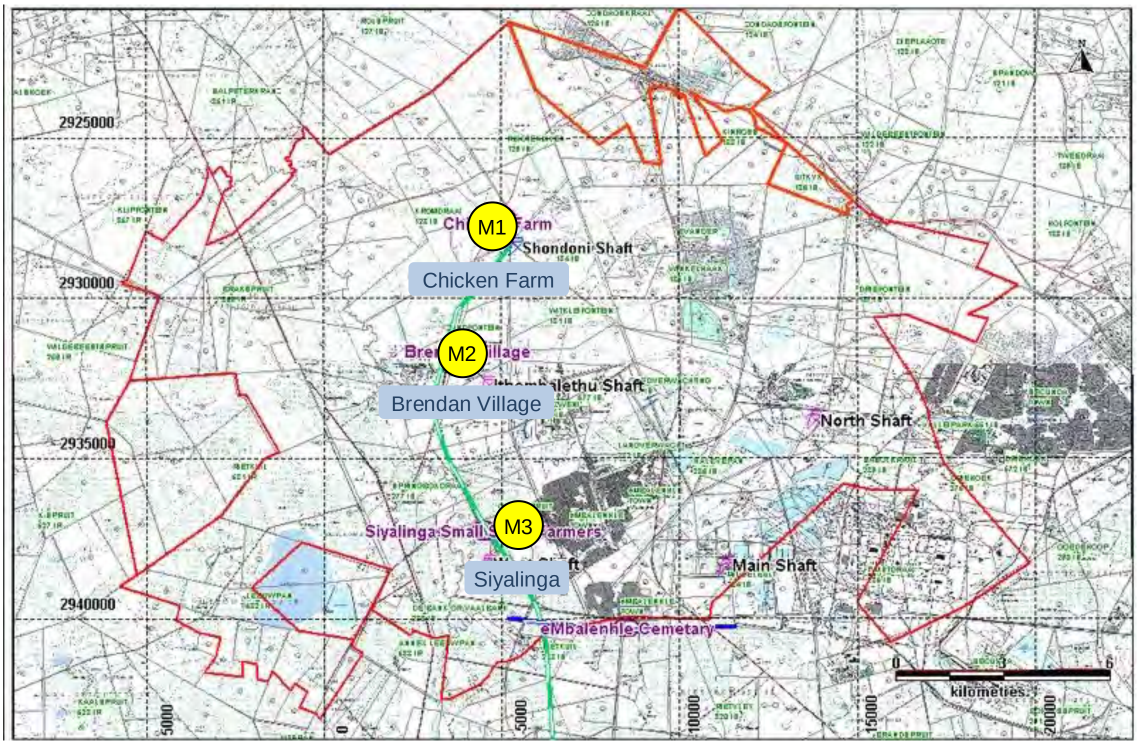


Figure 2.1

Noise monitoring locations

M1 Chicken farm

M2 Brendan Village

M3 Near Siyalinga small scale farmers and Embalenhle Township

2.2.2 Test equipment

Noise measurements were carried out using the following equipment:

(a) Brüel & Kjaer Type 2260 Modular Precision Sound Analyser (Ser no. 1875497)

(b) Brüel & Kjaer Type 4189 Measurement Microphone (Ser no. 1858498)

(c) Brüel & Kjaer Type 4231 Sound Calibrator (Ser no. 2606011)

Equipment conformed to IEC 61672-1 Electro-Acoustics – Sound Level Meters – Part 1: Specifications.

Calibration: De Beer Calibration Services Certificates No's 2009-336 & 2009-337

2.3 Predictive noise impact study

2.3.1 Noise modelling

Estimates of future noise levels to be generated by the development in the study area were derived with the aid of a model simulating noise emission from all major noise-generating components and activities of the development. To this end, it was required to quantify the acoustic emission (sound power) levels, as well as the frequency and directional characteristics of individual or groups of sources. This data was available from measurement data obtained in previous shaft, ventilation fan and conveyor noise studies and from in-house noise data archives.

Calculation of geometric dispersion and atmospheric propagation of noise is broadly based on the principles of the Concawe method SANS ARP 014 [3], extended to deal with more complex source configurations, as well as to simulate the effect of wind.

2.3.2 Project Infrastructure

As currently planned, the surface infrastructure of the Shondoni Shaft Complex will closely resemble that of the iThemba Lethu Shaft. The provisional layout is shown in Figure 2.2.

The Shaft Complex, which will be accessed along a newly constructed tar road with a T-junction from the provincial secondary road R547, will contain the following infrastructure:

- Offices, workshops, wash bays, stores and change houses
- Internal Roads and Parking Areas
- Electrical Substations
- Fuels Storage
- Soils/Overburden Stockpiles
- People and Material Shafts
- Ventilation Shafts
- Surface Bunker/ROM Emergency Stockpile
- Raw/Potable Water Supply and Storage
- Process Water Supply and Storage
- Storm Water Management System (bunds/berms/canals/outlets)
- Pollution Control Dams
- Sewage Treatment Plant
- Domestic Waste Disposal Facilities
- Industrial/Hazardous Waste Disposal Facilities
- Salvage Yard
- Overland coal conveyor

In terms of noise impact, most of the abovementioned components are irrelevant, as they do not contribute significantly to the overall noise emitted from the shaft complex. Components which do contribute significantly, are indentified in Section 2.3.3.

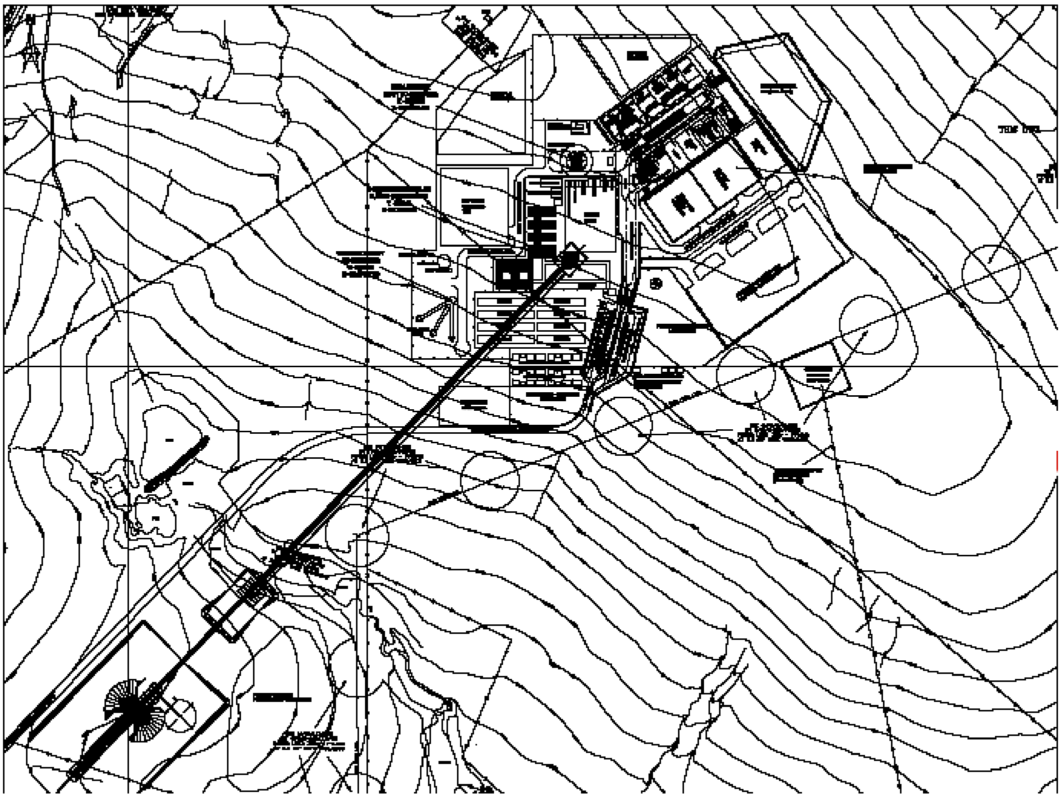


Figure 2.2

Provisional Surface Layout Plan for the Shondoni Shaft

2.3.3 Sources of noise during the various phases

The following is an outline of project activities, equipment and operations expected to be potential sources of audible noise and the main contributors to overall project activity noise. The findings of the impact assessments for the various phases are presented in Section 3.

A Construction phase

Construction activities will take place at the Shaft Complex and its access route from the R547, as well as along the coal conveyor servitude. The construction phase will run for approximately three years and is scheduled to commence in 2011 with completion in 2013.

Construction will commence with site clearance and will primarily comprise civil and building construction works of the access road, the shaft complex buildings, water pollution control measures, service water dams, as well as the vertical people and materials shaft, the incline coal conveyance shaft and the vertical ventilation shaft. Activities will be restricted to within the different servitude areas for the access road, the shaft complex, and the conveyor route.

Blasting will occur during the vertical and incline shaft construction. The excavated materials from the shaft will be used to construct berms and embankments around and within the shaft complex.

Activities in the construction phase do not constitute a constant source of noise quantifiable in the same way as noise in the operational phase of the proposed activity. With changing activities and moving sources of noise, noise levels vary considerably in magnitude and over time. Hence, the assessment of noise in the construction phase is based on qualitative considerations. Activities and equipment which can be expected to contribute to construction noise, are summarised in Table 2.1.

Table 2.1

Sources of noise in the construction phase

Construction Activity	Sources of Noise
• Power generation at construction site	Generator set – Diesel Engine
• Site preparation: Clearing, soil stripping	Bulldozer, loading, truck movement
• Blasting	Air blast noise
• Road construction	Bulldozer, grader, compactor, trucks
• Drilling	Drill rig engine and drilling
• Building construction	Cutting, sawing, grinding, hammering
• Delivery – Equipment and materials	Trucks & other vehicles on access road
• Conveyor construction	Low intensity construction & vehicles

B Operational Phase

The mine will go into production in 2014 and will have an expected life of approximately 27 years. The mine will operate on a 24-hour per day basis.

During the operational phase most activities will occur underground. The two coal seams will be mined with continuous miners and therefore no routine mining related blasting will occur. However, when dolerite structures need to be penetrated to access the coal seams, limited underground blasting will occur from time to time. The coal is cut at the mining faces, loaded automatically onto the shuttle cars from which it is loaded onto the conveyor system which takes the coal along the incline shaft to surface.

On surface the coal goes directly into the surface bunker from where it is transferred onto the overland conveyor which transports the ROM coal to Middelbult Main shaft and Sasol Coal Supply. The surface coal bunker also has an emergency surface throw out area in the event that the conveyor system cannot handle the volume of coal as a result of maintenance. Surface activities at the shaft relate to general administration and management. Underground personnel access the mine through the vertical people and material shaft.

The ventilation shaft is operated at the shaft complex and comprises the operation of extraction fans to drive the up-cast ventilation system.

Underground operations will not contribute to audible noise in the area surrounding a mine and have no direct effect on ambient noise levels. As for surface operation noise, although there will always be a measure of fluctuating and sporadic noises, this will be negligible compared to the overall noise. The bulk of surface operation noise is expected to emanate from the ventilation fans and the conveyor line, each of which will emit a steady flux of acoustic power[2]. Table 2.2 gives a breakdown of components in these groups taken account of in the noise model and simulation of noise in the operational phase.

Table 2.2

Primary sources of noise in the operational phase
All sources operating 24 hours/day; 7 days/week

Primary Group	Component	Noise source
Shaft Surface Infrastructure	Shaft	Cage alarms, sirens, small fans
	Buffer storage	Throw-out
	Internal roads, parking	On-site vehicle movements
	Access road	Vehicles, road noise
	Electrical substations	Transformers
	Water treatment plants	Pumps
Ventilation Fans	Fan house	Motor and fan noise breakout
	Fans	Noise emitted from fan outlets
Coal Conveyor Line	Conveyor	Idler and belt noise

C Decommissioning and Closure Phase

During decommissioning buildings will be renovated for alternative use or be demolished. Access roads, if not used, will be scarified and re-vegetated. Work activity will be of low intensity and of relatively short duration.

2 *Note that it is the noise emission at source, i.e. the source strength, which may be assumed to be constant, not the noise levels produced in the external surroundings. Noise levels at a distance from large industrial sources such as the proposed activity under consideration, not only depend on the emission at source, they are also modulated along the propagation path from source to receiver by variable atmospheric and meteorological conditions.*

2.4 Noise regulations and assessment criteria

2.4.1 South African noise regulations

In 1994, with the devolution of regulatory power from governmental to provincial level, the authority to promulgate noise regulations was ceded to provinces. Each province could henceforth decide whether to develop their own regulations, or to adopt and adapt existing regulations. As yet, however, only three provinces (Gauteng, Free State and Western Cape) have promulgated such regulations. Elsewhere, including Mpumalanga Province, no provincial noise regulations have been put in place.

Consequently, in noise studies undertaken in provinces lacking official noise regulations, specialists usually consider the old national noise regulations [4] to apply by default. For further guidance, it is noted that noise criteria in all previous national and current provincial regulations, as well as current metropolitan noise policies, are all derived from SANS 10103. SANS 10103 defines the relevant acoustic parameters that should be measured, gives guidelines with respect to acceptable levels and assessment criteria and specifies test methods and equipment requirements. In this noise study, the provisions of the old national noise regulations are taken into account, but noise assessment is based by and large on the principles, guidelines and criteria of SANS 10103.

Prohibitions

Prohibition of disturbing noise

In accordance with international and South African standard practice, noise impact assessments are made with respect to outdoor noise levels. Noise regulations prohibit any changes to existing facilities, or uses of land, or buildings or the erection of new buildings, if it will house activities that will cause a disturbing noise, unless precautionary measures to prevent disturbing noises have been taken to the satisfaction of the local authority. Noise is deemed to be disturbing, if it exceeds certain limits. Depending on what data is available, SANS 10103 allows for different formulations of the excess.

- **If the actual residual ambient level is known:** The excess is taken to be the difference between the noise under investigation and the residual noise measured in the absence of the specific noise under investigation. This definition, based on the *noise emergence criterion,* finds application in both predictive and noise monitoring assessments, if baseline noise data is available.

- **If the actual residual ambient level is unknown:** Alternatively, the excess may also be defined as the difference between the ambient noise under investigation and the acceptable ambient rating for the type of district under consideration in accordance with SANS 10103. This definition, based on the *acceptable level criterion,* is employed in predictive noise studies and in noise monitoring assessments, if there is no baseline data available or if an existing source of intrusive noise cannot be switched off for purposes of measuring the residual background level.

In terms of the old national noise regulations, a disturbing noise means a noise that causes the ambient sound level to increase by 7 dB or more above the designated zone level, or if no zone level has been designated, the ambient sound level measured at the same point. Noise regulations also require that the measurement and assessment of ambient noise comply with the guidelines of SANS 10103.

It should be cautioned, however, that the legal limit of 7 dB should not be construed as the upper limit of acceptability. SANS 10103 (See Table 2.4 in this report) warns that an increase of 5 dB is already significant and that an increase of 7 dB can be expected to evoke widespread complaints from the community. Hence, although the applicant would be within legal limits if the noise impact is prevented from exceeding 7 dB, that would not prevent a community from being disturbed and to complain about the noise. In the EIA phase, i.e. in the design and planning stage of a new development, it is advised the target be set much lower at 3 dB, with 5 dB considered to be a significant impact.

Prohibition of a noise nuisance

Noise regulations also prohibit the creation of a noise nuisance, defined as any sound which disturbs, or impairs the convenience or piece of any person. The intent of this clause is to make provision for the control of types of noise not satisfactorily covered by measurement and assessment criteria applicable to disturbing noises. These are noises which are either difficult to capture[3], or noises for which the readings registered on sound level meters do not correlate satisfactorily with the annoyance it causes, when assessed against standard criteria. Noise regulations list specific activities which are prohibited if exercised in a manner to cause a noise nuisance, such as[4]:

- The playing of musical instruments and amplified music;
- Allowing an animal to cause a noise nuisance.
- Discharging fireworks;
- Discharge of explosive devices, firearms or similar devices which emit impulsive sound, except with the prior consent in writing of the local authority concerned and subject to conditions as the local authority may deem necessary;
- Load, unload, open, shut or in any other way handle a crate, box, container, building material, rubbish container or any other article, or allow it to be loaded, unloaded, opened, shut or handled, (if this may cause a noise nuisance).
- Drive a vehicle on a public road in such a manner that it may cause a noise nuisance.
- Use any power tool or power equipment used for construction work, drilling or demolition work in or near a residential area, (if this may cause a noise nuisance).
- Except in an emergency, emit a sound, or allow a sound to be emitted, by means of a bell, carillon, siren, hooter, static alarm, whistle, loudspeaker or similar device (if it may cause a noise nuisance).

3 *For example, barking dogs. Not only is the occurrence of the noise unpredictable and erratic, but the presence of a person investigating the problem with a noise meter is likely to attract attention and trigger incessant barking.*

4 *See Noise Regulations for the full list of prohibited activities.*

One or more of these activities may occur on industrial sites and in project activities. A common cause of noise nuisance are reverse hooters, the last item listed above.

The essential difference between a disturbing noise and a noise nuisance is as follows:

Noise disturbance – Is quantifiable and its assessment is based on estimated or measured sound levels, expressed in decibel (dBA). Investigation and assessment of existing noise disturbance problems involve the measurement of ambient levels in the presence of a specific source under investigation and comparison of this level with either the level measured in the absence of the source, or a table value deemed to be an acceptable level for the type of district under consideration.

Noise nuisance – Is difficult to quantify and is not confirmed or assessed by measurement. Judging whether a noise qualifies as a nuisance is based purely on its character and audibility, in conjunction with subjective considerations such as the perceived intent of the noise maker and connotations attributable to the source of noise. Where measurement is possible, measured data may serve as supplementary information.

SANS 10103

As mentioned before, noise regulations require that the measurement and assessment of noise comply with the guidelines of in SANS 10103. The concept of noise nuisance, however, only features in the regulations. SANS 10103 only deals with quantifiable noise (noise disturbance), without any guidelines for, or reference to noise nuisance whatsoever.

It is normally expected of EIA noise studies as well as EMP surveys to make findings based on quantitative assessment of predicted or actual noise levels, i.e. based on noise disturbance considerations. But once an industrial site or mine starts operating, predictable as well as unexpected sources of noise nuisance may emerge. If present, they often constitute a major cause of complaints. It is therefore imperative that, in addition to quantitative predictions and measurements, noise studies as well as monitoring surveys also identify potential and actual sources of noise nuisance.

2.4.2 SANS 10103 - Acceptable ambient levels

Noise regulations require that the rating level of the ambient noise be compared with the rating level of the residual noise (where this can be measured), or alternatively (where the noise source cannot be switched off or interrupted), with the appropriate rating level given in Table 2 of SANS 10103. Neither the noise regulations, nor SANS 10103 defines or refers to the term noise impact. It is however generally understood and defined for purposes of this study, as the amount in dB by which the total noise level exceeds the nominal or the measured ambient level rating, whichever is applicable, for the area under consideration.

Table 2.3 in this report summarises SANS 10103 criteria for acceptable ambient levels in various districts. Note that ratings increase in steps of 5 dB from one to the next higher category and that, in general, regardless of the type of district, ambient noise levels tend to decline by typically 10 dB from daytime to night-time. It follows that, for the same level of intrusive noise, the noise impact would typically increase by 10 dB from daytime to night-time.

Table 2.3

Typical outdoor ambient noise levels in various districts (SANS 10103)

Type of district	Noise level Equivalent continuous level L_{Aeq} (dBA)		
	Day-Night L_{dn}	**Day-time** L_d	**Night-time** L_n
(a) Rural	45	45	35
(b) Suburban – With little road traffic	50	50	40
(c) Urban	55	55	45
(d) Urban - With some workshops, business premises & main roads	60	60	50
(e) Central business districts	65	65	55
(f) Industrial districts	70	70	60

A 24 hour cycle is divided into the following periods:

Day-time (06:00 – 22:00)
Night-time (22:00 – 06:00)
Day-Night (24-hour day-night period)

The day-night level L_{dn} represents a 24-hour average of the ambient noise level, with a weighting of +10 dB applied to night-time levels, yielding numerically equal values for daytime and day-night levels.

SANS 10103 also gives guidelines in relation to expected community response to different levels of noise impact (increase in noise level), as summarized in Table 2.4.

Table 2.4

Expected community response to an increase in ambient noise level
(SANS 10103)

Increase in ambient level [dB]	**Expected community reaction**
0 - 10	Sporadic complaints
5 - 15	Widespread complaints
10 - 20	Threats of community action
More than 15	Vigorous community action

2.4.3 Practical considerations

By defining the actual predevelopment ambient sound level as the reference, noise regulations applicable in Mpumalanga effectively apply what is known as *noise emergence criteria*. An alternative approach (as employed in the Gauteng Noise Regulations), is to use nominal table values recommended in SANS 10103. This is known as *acceptable level criteria.* Both methods have advantages and disadvantages.

Caution should be exercised in applying noise criteria, bearing in mind that no single principle or criterion will perfectly fit and be adequate or fair in all applications. The sensibility and fairness of any given criterion depend on the nature and origin of the existing ambient noise. In situations where existing ambient levels are on the high side, it is of crucial importance in the assessment of noise impact of a new development, to establish whether the existing ambient sound is primarily a result of interior or domestic activity (self-noise), or whether it is primarily caused by external sources of noise (intrusive noise).

Where the predevelopment ambient sound is dominated by noise emanating from external sources, such as industrial plants, mining activity and road traffic on external main roads, special precaution needs to be exercised not to aggravate conditions. If the existing ambient level is already higher than what is regarded as typical or recommended, specific noise from a proposed new development should not be allowed to exceed the nominal value regarded as acceptable for the type of district under consideration. It would be more fitting in such instances, to apply acceptable level criteria; e.g. setting the daytime limit for specific noise from the development at the lower nominal limit.

Noise criteria should never be applied without due consideration of the practical consequences. Finally, whatever guidelines are followed, it should always be investigated if there is a specific period (daytime or night-time) during a 24-hour cycle during which the noise impact will be at its worst. For constant 24-hour operations, this would normally occur at night-time.

2.4.4 Note on animal response to noise

The author is not qualified to comment or speculate on animal behaviour in response to noise. Moreover, it should be cautioned that any assessment or statement made with regard to the possible impact of project activity noise on animals in the surrounding area should take cognizance of the following:

Assessment in any scientific noise study of the impact of noise on humans, is based on well defined scientific criteria. Based on decades of statistic data, international and national standards provide consistent guidelines with respect to noise disturbance and community reaction. If the measured or predicted elevation caused by an intrusive noise exceeds certain reference levels, the response of humans to such noise can be quantified. The noise contours calculated in this study define ranges of acceptable and significant impact noise as perceived by humans.

As for animals, however, not only are human criteria not applicable at all, but there simply are no national or international standards pertaining to animal response to noise - Not in terms of audibility or disturbance, let alone the effect of noise on their well-being, health or production. It should be pointed out that not even in the case of humans, can the effect of noise on human health be quantified (except for hearing damage) and no standards or criteria exist in that regard.

It is completely understandable that farmers would be concerned about the effect of intrusive noise on their livestock. But in the lack of standards or criteria, any statements made in the findings and recommendation of a noise study in that regard, would be speculative, unscientific and irresponsible. Hence in this report, we refrain from making any such unfounded statements either confirming or rejecting popular views on the matter.

2.4.5 Assessment of blast noise

In the assessment of general industrial or community noise, the disturbing noise is measured and averaged over a period considered to be relevant for the source under assessment, which could be a limited period of an on-off operation, or, in the case of an on-going noise, such as road traffic, or mining noise, the relevant sub-interval of a 24-hour day, such as daytime, night-time or the day-night period.

The measurement and assessment of high-energy impulsive noise, as produced by blasting, is much more complicated. There are no regulatory limits and SANS 10103 does not provide any guidelines or criteria in this regard. It only states that advice from a specialist should be obtained. A suggestion in SANS 10103 that the procedures of SANS 10843 may be used, is of no help either, since the latter have been specifically developed for and only apply to the assessment of risk of hearing damage for persons exposed to gun shots or explosions involving peak levels above 140 dB. These methods and associated criteria have no bearing on, or relevance to noise disturbance assessment.

As in general continuous noise assessment, any test method and criteria employed in noise disturbance assessment of single-event impulsive noise, must take both amplitude and duration into account. In the lack of any SANS test standards, assessment criteria, or national regulatory limits, the assessment of blast noise disturbance in this assessment is based on calculation techniques developed by the specialist in studies conducted for the SANDF. These techniques adhere to accepted scientific methodology and principles. Blast magnitude is quantified by the determination of impulse energy, by time integration of the amplitude over the duration of the impulse. The equivalent continuous level of the blast impulse, calculated by spreading the energy over the span of a 12-hour day period, is used to assess the noise disturbance impact against acceptable levels for various districts in terms of SANS 10103 for general noise. This principle is also adopted by international standards currently under development. In the experience of the author, at or below these levels, blast noise is normally hardly noticed by residents and not regarded as disturbing.

3 Results and findings

3.1 Baseline study

3.1.1 Current state of the environment - Background ambient noise levels

General

The Middelbult study area is located in a district where the initial rural ambient noise character has been affected over time by an increase in ambient levels as a result of scattered mining activity and increased traffic on the main roads. On the whole, considering the level of industrial activity and road traffic, the area in its current state cannot be considered a pure rural environment any more.

Noise at M1 (Chicken Farm)

Ambient noise at the Chicken Farm at M1 is determined primarily by farming activity, such as manual work activities, tractor movements, motor vehicles and speech communication. Another significant source of ambient noise, especially after working hours, is domestic activity in and around residences located on the premises. As the survey was carried out just after harvesting, there were no chickens in the buildings. It stands to reason that the presence of chickens is likely to elevate rather than decrease the ambient level; although the effect may be small.

With the premises located in close proximity to the R547 main road, traffic noise is also a source contributing to the ambient level. However, because of low traffic volumes on this road, the contribution to the average ambient level at the Chicken Farm is relatively small compared to work and domestic activity noise.

Depending on atmospheric conditions, mining noise is occasionally audible in the distance, but had no measureable effect on the readings. There are no mining activities in close proximity of the premises and general mining activities in the district are barely audible, if at all.

Average daytime and night-time ambient levels recorded in a 24-hour survey during the course of this investigation, were 48 dBA (day) and 46 dBA (night), respectively. These levels are approximately 10 dB higher than typical Rural District levels in accordance with SANS 10103, but perfectly natural, considering that it is self-noise generated by in-house working and living activities, rather than intrusive noise originating from outside the property boundaries.

Noise at M2 (Brendan Village)

Local traffic, maintenance work and domestic activity are the primary sources of ambient noise in Brendan Village. As in the case of the Chicken Farm, it also borders on the R547 main road on the western side. The contribution of traffic noise from the main road is relatively small.

The nearest source of mining noise is Sasol iThemba Lethu Shaft approximately 750 m south of the village. Visually and acoustically, the village is partially screened off from the shaft by the topography and as far as could be established, noise from the shaft is not audible in the village. Noise from other mining activity in the district could not be heard and did not affect readings obtained in the course of this investigation.

For practical reasons, position M2 where a long-duration (4 x 24-hours) survey was conducted, was located at the reception building approximately 200 m from the R547 main road. Night-time average levels recorded during four nights varied between 36 and 38 dBA. Closer to the main road, levels at houses nearest to the road and also nearest to the proposed conveyor route, are 2 to 3 dB higher with a typical night-time level of 40 dBA.

Noise at M3 (Siyalinga and western outskirts of Embalenhle Township)

In addition to domestic activity, wind, birds and insect sounds, ambient noise in and around the Siyalinga small farmers settlement is to a minor extent affected by noise from Sasol Middelbult West Shaft. Depending on atmospheric conditions and wind direction, the audibility of shaft noise varies.

Based on short duration samples taken near the boundary of the settlement, typical day and night-time ambient levels in the area are 44 and 40 dBA, respectively. Ambient noise levels inside Embalenhle Township correspond to typical Urban Districts, i.e. 55 dBA daytime and 45 dBA nighttime, in accordance with SANS 10103.

Summary

The results of the survey are summarised on the map in Figure 3.1. Daytime and night-time periods are as defined in SANS 10103 (See Section 2.4.2). Detailed results of the recordings made in 10-minute intervals at M1 and M2 are presented in Appendix A.

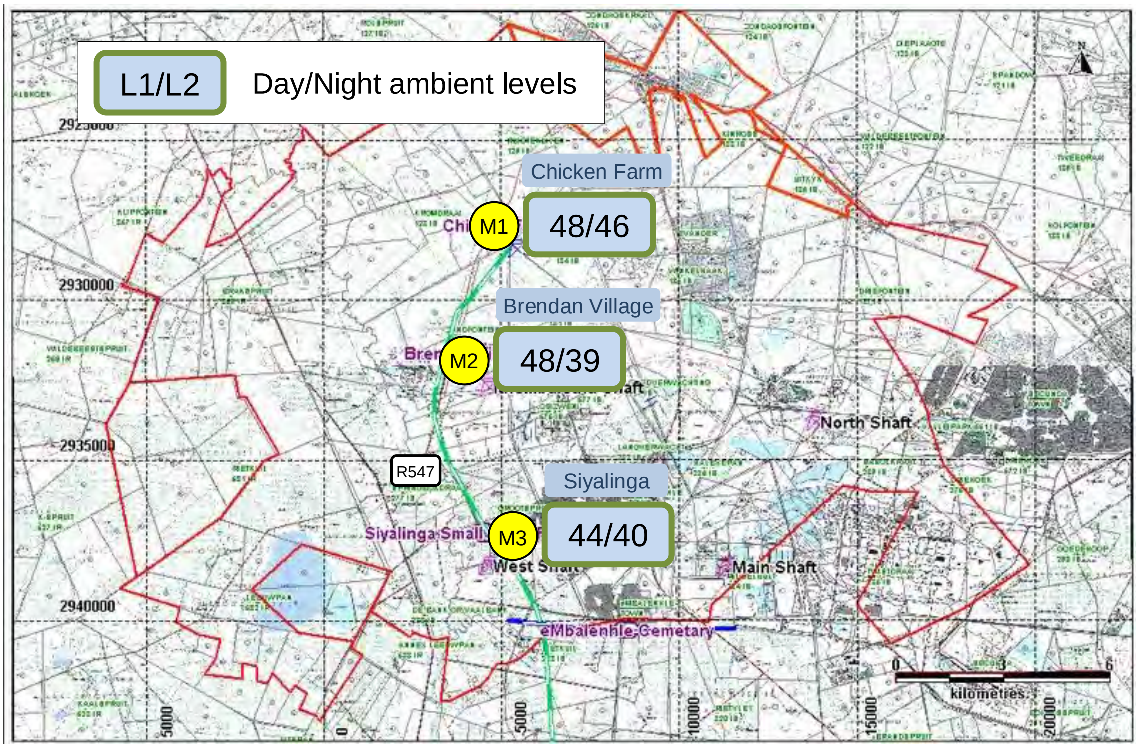


Figure 3.1

Results of baseline survey
Average daytime (06:00 to 22:00) and night-time (22:00 to 06:00) ambient levels

3.1.2 Baseline ratings

In allocating baseline ambient noise ratings, it should be borne in mind that the levels obtained in any particular survey do not represent absolute values, but samples only of what is a variable parameter. Ambient noise is not fixed and even relatively long-duration averages of day and night levels at any location will vary over time. This is in response to variances in noise source emission levels, as well as unpredictable day, night and seasonal fluctuations in atmospheric conditions.

It should also be noted that for purposes of noise impact assessment, noise contours are calculated at nominal intervals best suited for evaluation of specific locations of concern, as well as for the global study area.

With these considerations in mind, the ratings allocated in the study area were determined by rounding the levels obtained in the survey to the nearest 5 dB day or night interval of typical levels for district categories in accordance with SANS 10103 guidelines (See Table 2.3). The result is presented in Table 3.1. These are realistic best estimates of baseline ambient noise ratings for the area that will be used to define limits in the noise impact assessment to be carried out in terms of the EIA.

Table 3.1

Middelbult Shondoni Shaft Project
Baseline outdoor ambient noise levels derived from field surveys
Rounded to the nearest day and night ratings for districts according to SANS 10103 guidelines

Area		**Baseline ambient noise level** L_{Aeq} (dBA)	
		Day-time L_d	**Night-time** L_n
Specific locations	Chicken farm	50	45
	Brendan Village	50	40
	Siyalinga small farmers	45	40
	Embalenhle Township	55	45
Remainder of study area - Mostly unpopulated		50	40

3.1.3 Recommended limits

24-hour operation noise - Maximum impact occurs at night

Daytime intrusive noise levels created by distant industrial noise sources, such as the Shaft Complex under consideration, are as a general rule substantially lower than the levels created by the same sources at night. The reason is that typical daytime meteorological conditions result in skyward refraction of sound propagation, in contrast with downward diffraction caused by typical night-time temperature profiles (vertical gradients). During the day, most of the noise emitted by a large source does not reach the ground, while at night, both direct sound and a portion of the energy radiated skywards are focussed back to earth. This contrast between day and night levels is further accentuated by a considerable drop at night in the residual ambient level due to a decline in road traffic and human activity noise. As a consequence, not only are the levels of intrusive noise from distance sources much higher at night, but the sensitivity of the environment increases sharply, as well.

It implies that for continuous noise from a 24-hour operation, such as the ventilation fans and the conveyor, maximum impact will occur at night and that for all practical purposes, provided the night-time impact is contained to within acceptable levels, the daytime impact would not be of any consequence or concern at all.

Significant impact

With reference to the principles explained in Section 2.4, a significant impact in this noise study is deemed to occur if the specific level of an intrusive noise exceeds the existing ambient level by 5 dB or more.

3.2 Noise impact (unmitigated) – Construction phase

General construction noise

Construction activities will take place at the Shaft Complex and the access route from the R547, as well as along the coal conveyor servitude. Noise generating activities will be restricted to within the different servitude areas for the access road, the shaft complex, and the conveyor route.

Most of the work will occur during the day when the environment is relatively insensitive to noise. Noise levels produced by general construction activities at the shaft and on the access road will be low and are not expected to be noticeable at the Chicken Farm, which is the nearest noise-sensitive location to the shaft. On its own, it will be insignificant and of no consequence.

Construction of the conveyor is not expected to have noise consequences at any of the noise-sensitive locations along the conveyor route.

Blasting

Blasting will occur during construction of the vertical and incline shafts. The excavated materials from the shafts will be used to construct berms and embankments around and within the shaft complex.

Blasting during vertical and inclined shaft construction will be clearly audible and occasionally cause a significant impact at the Chicken Farm. It will however be an infrequent event and will only be audible during the brief period when shaft construction commences at surface level and then only if blasting is required during that stage.

3.3 Noise impact – Operational phase

3.3.1 Presentation of results

Operational noise footprints of the shaft complex and conveyor are presented with the aid of noise contour maps. The fact that the reference level and therefore also the significant impact level are different for the various noise-sensitive locations, as well as the fact that worst-case conditions for each location occurs for different wind directions, complicate the presentation and interpretation of the project's noise footprint on a single noise map. Such a map would require contours calculated for different wind directions and the reader will find it difficult to know which contour to applies to each location. To simplify reading and interpretation of the contours, three maps were generated. Noise Maps 3.1 and 3.2, each with a single contour and calculated for the applicable worst-case wind direction, have been generated for the Chicken Farm and for Brendan Village respectively. A third map, Noise Map 3.3 with two contours is presented for the area to the south. The 50 dBA significant impact contour on this map is applicable to the Embalenhle Township, which is an Urban District, while the 45 dBA contour is applicable to the Siyalinga small farmers settlement.

The contours delineate levels of specific project noise expected at night and were calculated for levels representing significant impacts (5 dB above the ambient level) for the areas under consideration. Specific noise means the noise produced by the project, the shaft complex and conveyor in particular, without the contribution of background ambient sound, i.e. without the residual ambient noise and noise from other existing sources such as the R547 main road. To understand the significance of the various contour levels with respect to noise impact, it has to be noted first of all, that if the specific level of shaft and conveyor noise at an observation point rises to the point where it equals the background level, the ambient level will rise by 3 dB above its initial level. This represents a noise impact of 3 dB, which is still acceptable in terms of noise regulations and SANS 10103 criteria. A significant impact is deemed to occur (See SANS 10103 criteria in Table 2.3) if the ambient level is exceeded by 5 dB or more.

3.3.2 Results and findings - Unmitigated operational noise

Depending on the time of day or night and on meteorological conditions in particular, noise levels produced by industrial sources over long distances vary by a considerable margin. Noise contours were derived from calculations intended to investigate probable worst-case conditions (Night-time levels and Concawe model Meteorological Category 6). On average, typical levels are expected to be lower. "Probable worst-case", in the context of this study, refers to levels that are higher than typical or average levels. Although less probable than typical levels, they are expected to occur from time to time during the course of the year, sometimes maybe for several days on end. Its occurrence is not simplistically related to weather conditions and not limited to any particular season of the year.

The noise impact at any location will of course depend on wind direction. In the Shondoni study area prevailing winds blow from the southwest and northwest in winter and from the east and northwest in summer. The wind direction which will result in worst-case noise impact will be different for each of the various noise-sensitive locations, depending on the direction of the noise source (mining activity) relative to the location. For example, at the Chicken Farm, considering only the aforementioned prevailing wind directions, worst-case impact of shaft and conveyor noise is expected when the wind is blowing from the east. At Brendan Village where the conveyor is the primary noise source of concern, it will be when the wind is blowing from the south-west. In Embalenhle Township it will also be when the wind blows from the south-west. The noise contours in Noise Maps 3.1 to 3.3 were calculated for the worst-case wind direction in each case.

Confidence in the predictions which are based on appropriately scaled data obtained in measurements at various existing shafts and in several conveyor noise studies, is high. It should nevertheless be cautioned that predicted noise levels and contours are not to be taken as absolute. Noise maps must be interpreted with caution. Although the confidence level in the acoustic model is high, predicted levels are valid for the assumptions made in respect of meteorological and other conditions. Since meteorological conditions in particular are highly variable, levels produced at a distance by a source at a constant acoustic output will vary considerably, even during the course of a single day-time or night-time period. Variance in noise level due to changes in atmospheric conditions increases with distance from the source. The contours represent best estimates of continuous project activity noise levels averaged over a relatively long duration, in this case the nominal night-time period of 8 hours.

Chicken Farm

Noise Map 3.1 shows that the chicken farm will fall well inside the 50 dBA noise footprint of shaft and conveyor noise. This means that the night-time noise impact at worker residences at that location will be significant. More detailed analyses show that both the conveyor and the ventilation fans individually will generate noise levels exceeding the acceptable level at this location.

Brendan Village

Noise Map 3.2 shows that conveyor noise will cause a significant noise impact in Brendan Village. Conveyor noise will be clearly audible at night and very disturbing in the entire village. Shaft noise will not be audible at this location.

Siyalinga small farmers and Embalenhle Township

As indicated on Noise Map 3.3, conveyor noise will also have a significant impact at night on the Siyalinga small farmers (45 dBA contour), as well as in the western part of Embalenhle Township (50 dBA contour).

3.4 Noise impact – Decommissioning phase

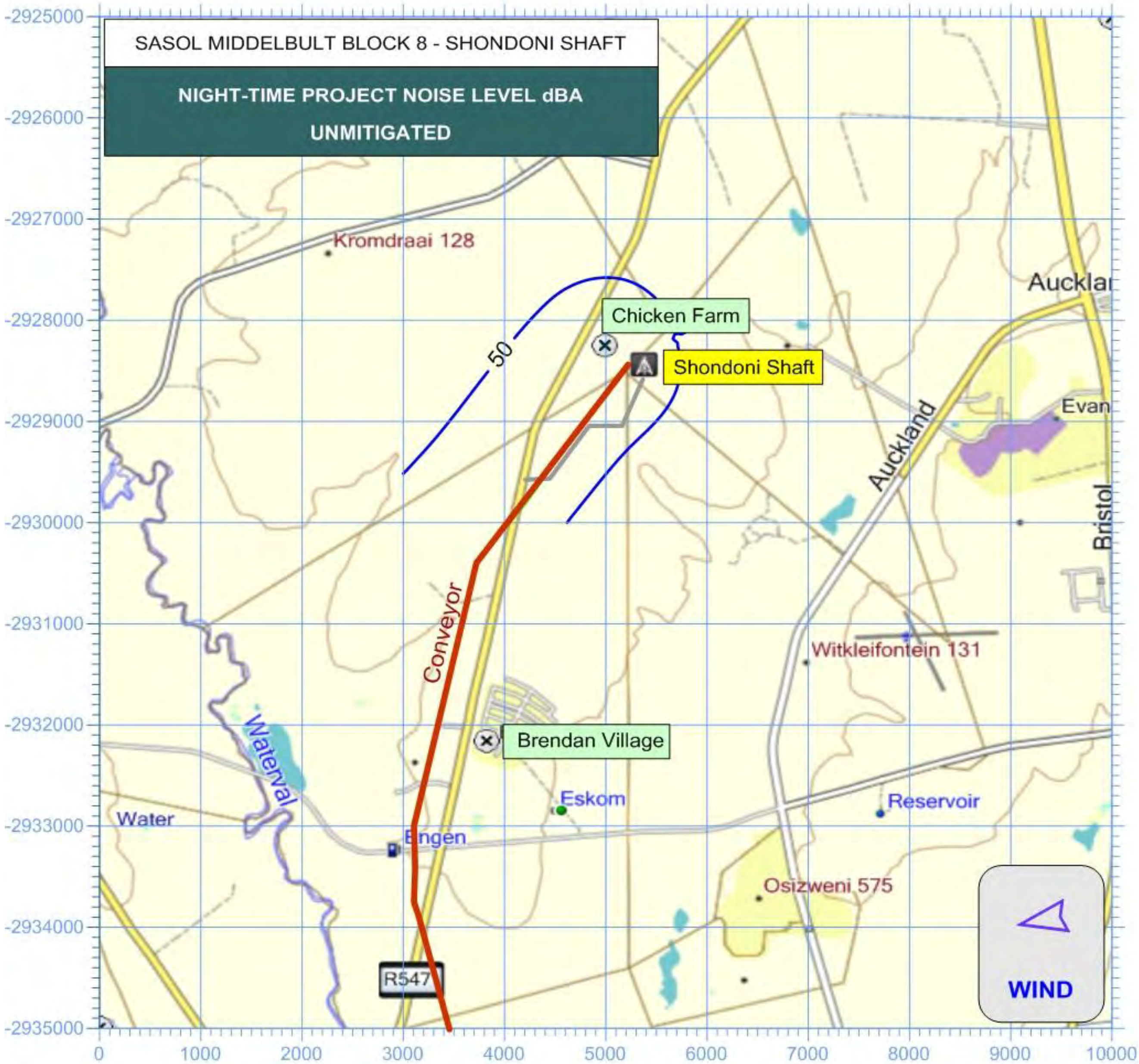
Noise in the decommissioning phase will be of a similar nature, but at a lower intensity and of shorter duration compared to noise in the construction phase. Decommissioning noise will be inaudible in noise-sensitive areas and the noise impact will be negligible.

3.5 Noise impact – Closure phase

No residual noise impacts will remain after decommissioning of the mine.

Noise Maps

Unmitigated Project Noise



Noise Map 3.1

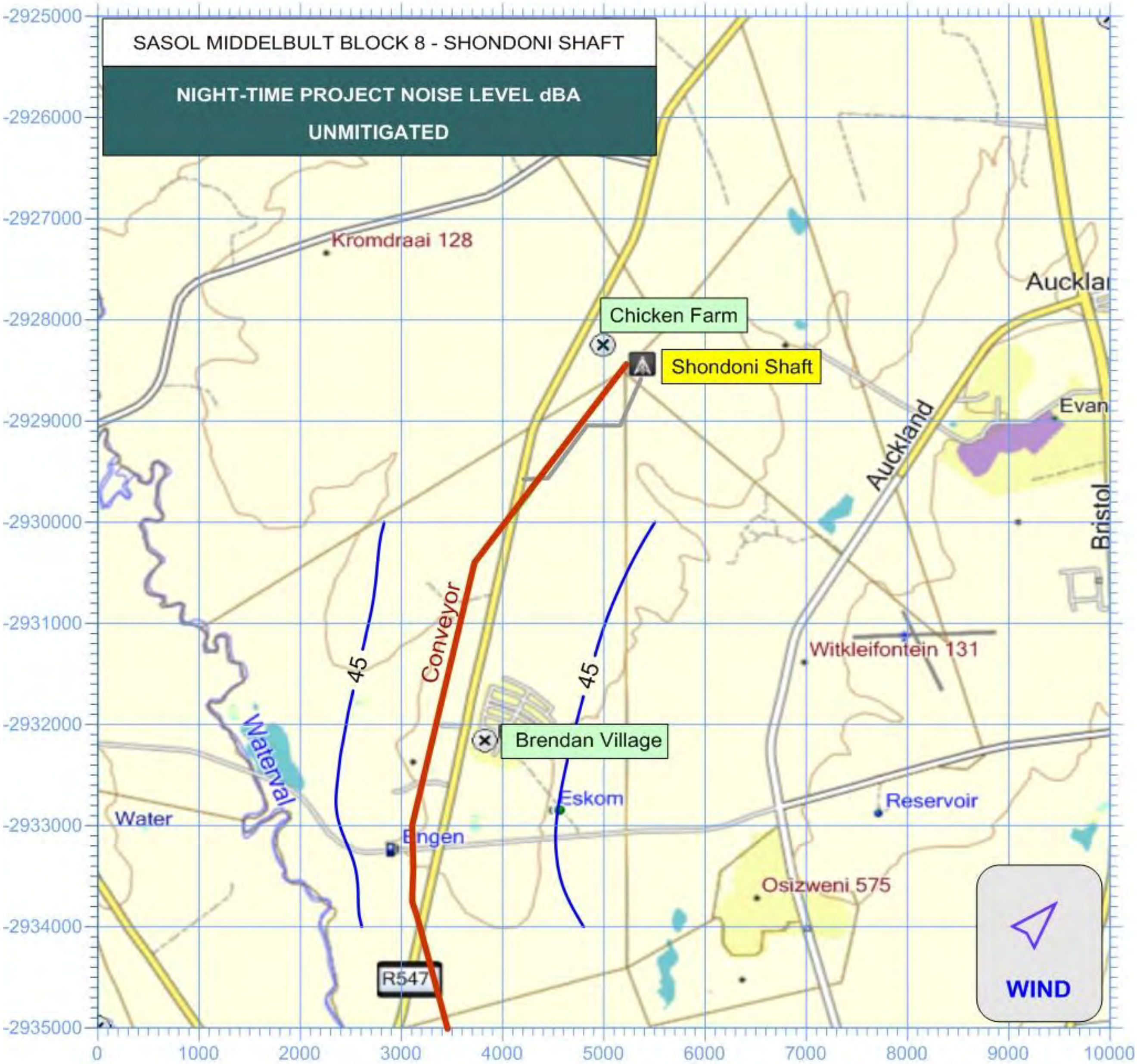
Middelbult Shondoni Shaft Project

Unmitigated Project Noise
Focus on northern area – Chicken Farm and surroundings

Project specific noise levels – Excluding background ambient noise
Night-time outdoor noise level dBA

Worst-case condition - Night-time with Wind blowing from the East

Significant impact in this area occurs inside the 50 dBA contour



Noise Map 3.2

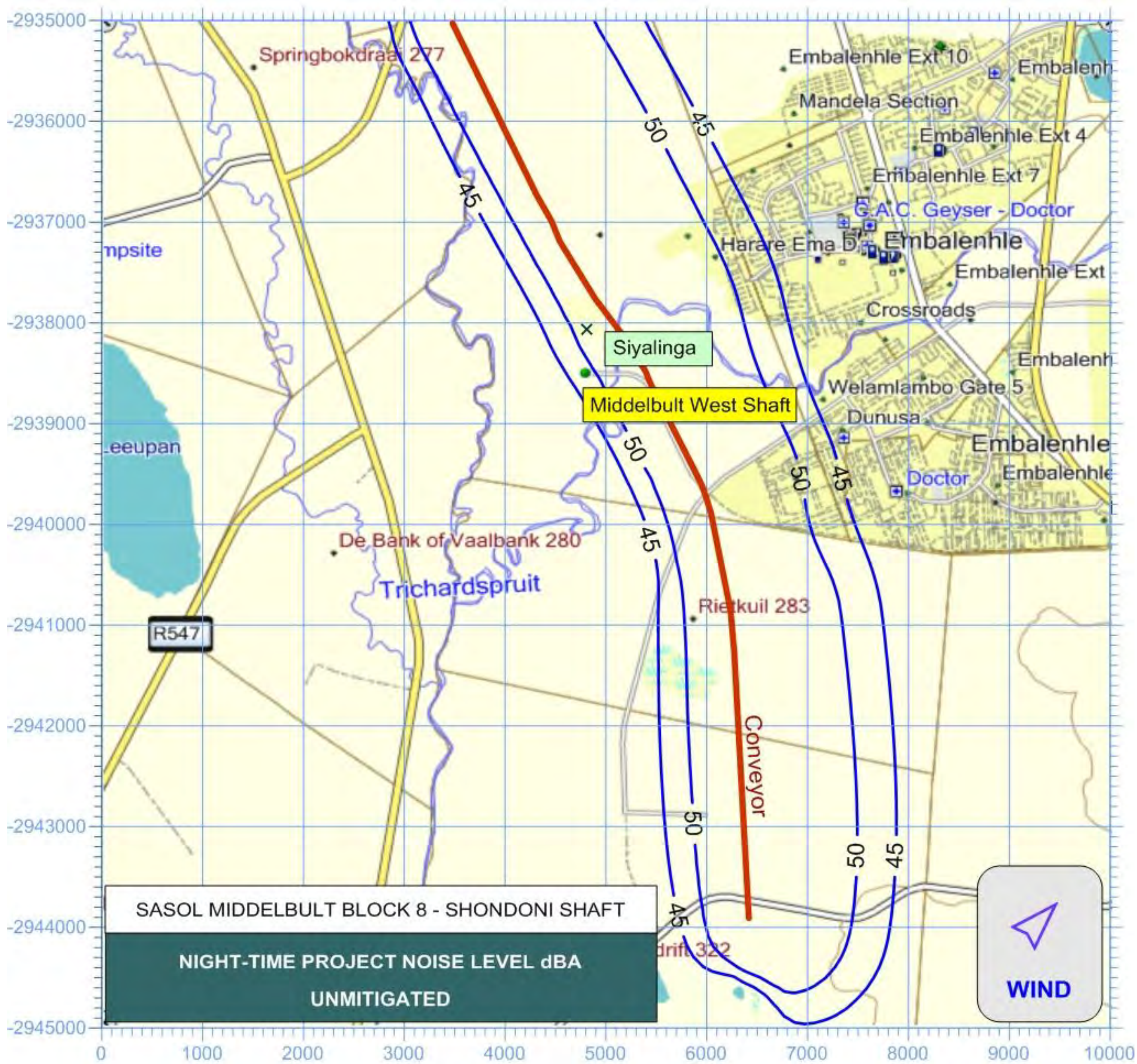
Middelbult Shondoni Shaft Project

Unmitigated Project Noise
Focus on central area – Brendan Village and surroundings

Project specific noise levels – Excluding background ambient noise
Night-time outdoor noise level dBA

Worst-case condition - Night-time with Wind blowing from the South-West

Significant impact in this area occurs inside the 45 dBA contour



Noise Map 3.3

Middelbult Shondoni Shaft Project

Unmitigated Project Noise
Focus on southern area – Embalenhle and Siyalinga

Project specific noise levels – Excluding background ambient noise
Night-time outdoor noise level dBA

Worst-case condition - Night-time with Wind blowing from the South-West

Significant impact in Embalenhle township occurs inside the 50 dBA contour
Significant impact in and around Siyalinga occurs inside the 45 dBA contour

4 Mitigation

4.1 Mitigation - Construction noise

General construction noise

As explained in Section 3.2, noise produced by general construction activities at the shaft and by construction of the conveyor are not expected to be noticeable at noise-sensitive locations within the study area. No mitigation is required.

Blast noise

Although blasting will be infrequent and of brief duration, it should nevertheless be treated with caution. To minimize the noise impact, it is recommended that blasting be scheduled to take place in the afternoon; under no circumstances during the morning hours of the day.

4.2 Mitigation - Operational noise

The noise impact at all noise-sensitive locations in the study area can be effectively mitigated by implementation of the following measures, each of which requires the involvement and design input of an acoustical engineer:

Conveyor

- Use low-noise HDPE[5] instead of standard steel idlers on conveyors, which gives a substantial reduction in conveyor noise. A reduction of 15 to 20 dB has been achieved elsewhere.

- In supplier specification, stipulate:

  The sound pressure level measured at 3 m distance from the conveyor (running at the specified speed) with or without load shall not to exceed 69 dBA at 3 m distance from the edge of the conveyor belt.

- Should this specification not be attainable at the operating speed of the Shondoni conveyor, construction of a noise barrier or noise screen designed in consultation with an acoustic specialist will be required in addition to using low-noise idlers.

Ventilation fans

- It will be necessary to install attenuators on the atmospheric side of all surface ventilation ducted fan outlets.

- It will also be necessary to soundproof each of the fan houses at the ventilation shaft.

- In supplier specification stipulate:

[5] *High Density Polyethylene*

Install attenuators in each fan outlet duct providing at least 11 dB attenuation at 250 Hz. In addition to and notwithstanding this requirement, also soundproof the fan house and take any additional design precautions necessary to ensure that the noise level produced by the fan outlet and the fan motor house collectively does not exceed 54 dBA at a radial distance 100 m from the fan.

Noise Maps 4.1 to 4.3 show the expected mitigated noise footprints of the shaft complex and conveyor if the above-mentioned measures are properly implemented. If thoroughly implemented, the noise generated by the project is expected to be reduced to acceptable levels. Noise from the ventilation fans or the conveyor will at times, depending on wind direction and atmospheric conditions, still be audible, but the impact in terms of SANS 10103 criteria will be insignificant.

4.3 Mitigation – Decommissioning phase

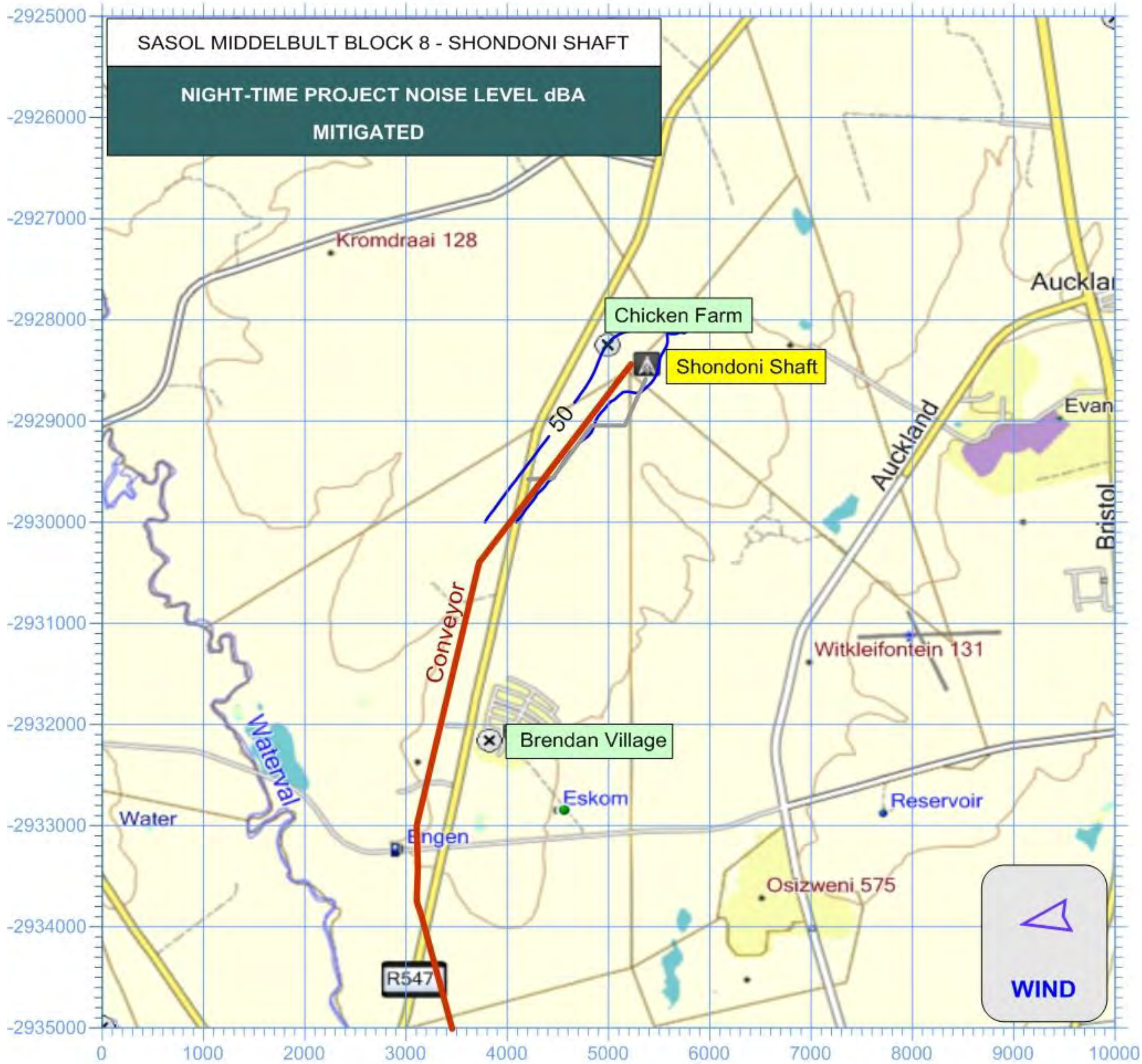
No mitigation will be required during decommissioning.

4.4 Mitigation – Closure phase

No mitigation will be required after decommissioning.

Noise Maps

Mitigated



Noise Map 4.1

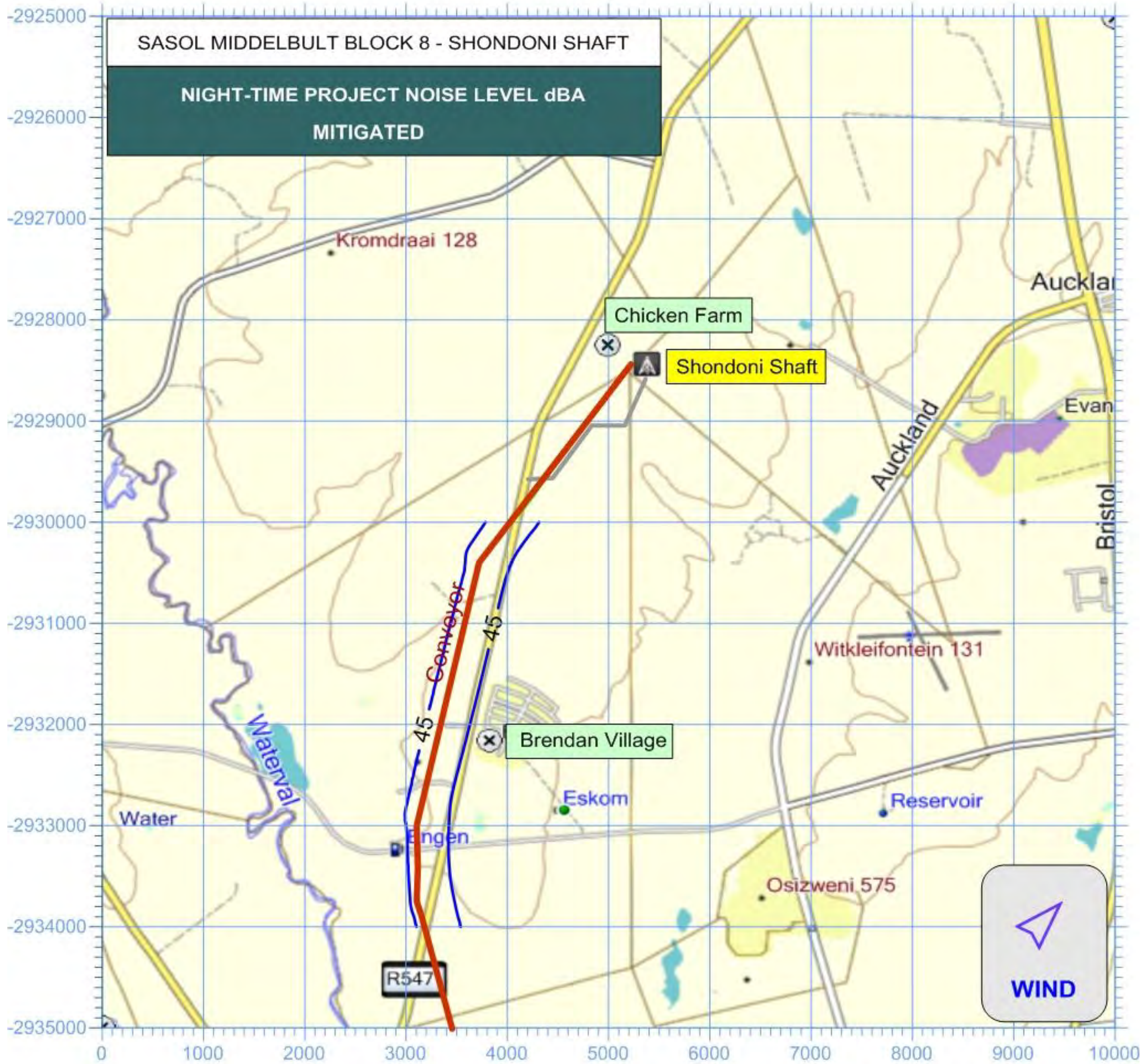
Middelbult Shondoni Shaft Project

Mitigated Project Noise
Focus on northern area – Chicken Farm and surroundings

Project specific noise levels – Excluding background ambient noise
Night-time outdoor noise level dBA

Worst-case condition - Night-time with Wind blowing from the East

Significant impact in this area occurs inside the 50 dBA contour



Noise Map 4.2

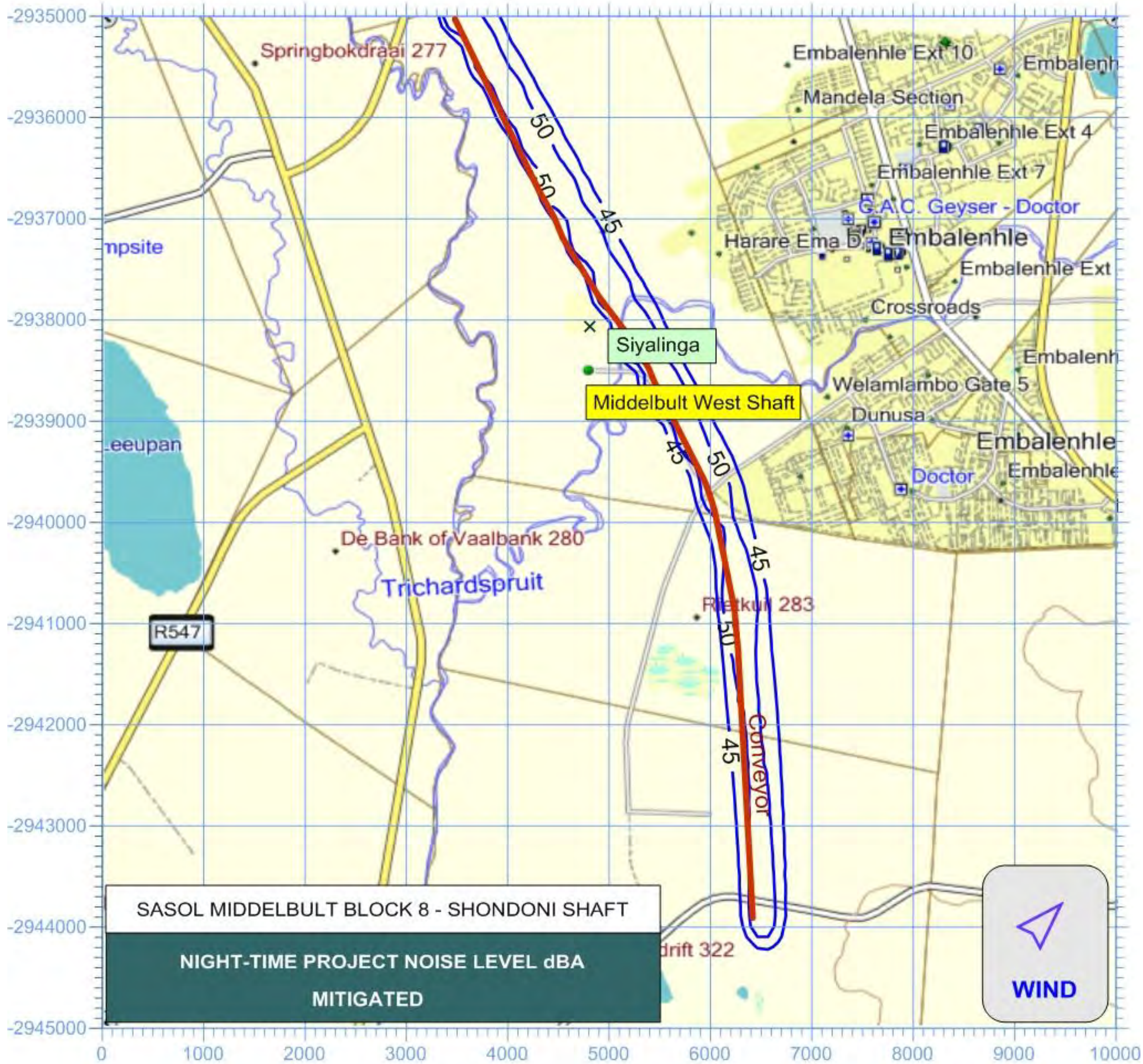
Middelbult Shondoni Shaft Project

Mitigated Project Noise
Focus on central area – Brendan Village and surroundings

Project specific noise levels – Excluding background ambient noise
Night-time outdoor noise level dBA

Worst-case condition - Night-time with Wind blowing from the South-West

Significant impact in this area occurs inside the 45 dBA contour



Noise Map 4.3

Middelbult Shondoni Shaft Project

Mitigated Project Noise
Focus on southern area – Embalenhle and Siyalinga

Project specific noise levels – Excluding background ambient noise
Night-time outdoor noise level dBA

Worst-case condition - Night-time with Wind blowing from the South-West

Significant impact in Embalenhle township occurs inside the 50 dBA contour
Significant impact in and around Siyalinga occurs inside the 45 dBA contour

5 Summary of noise impact implications

To the best of the information available and the accuracy of noise prediction methods, the noise impact implications of the Shondoni shaft project are as summarised in Table 5.1.

Table 5.1

Noise impact implications of the Middelbult (Block 8) Shondoni Shaft Project

Receptor	Activity	Impact	Before Mitigation						After Mitigation					
			Severity	Duration	Spatial Scale	Consequence	Probability	Significance	Severity	Duration	Spatial Scale	Consequence	Probability	Significance
Construction phase														
Any Location Within Study Area	Construction Shaft & Conveyor	L	L	L	L	L	L	L	L	L	L	L	L	L
Chicken Farm	Blasting	M	M	L	L	M	L	M	L	L	L	L	L	L
Operational Phase														
Chicken Farm Brendan Siyalinga Embalenhle	Ventilation Fans & Conveyor	H	H	H	H	H	H	H	L	H	L	L	L	L
Decommissioning Phase														
Any Location Within Study Area	Dismantling	L	L	L	L	L	L	L	L	L	L	L	L	L
Closure Phase														
Any Location Within Study Area	No residual noise	L	L	L	L	L	L	L	L	L	L	L	L	L

6 Monitoring

Construction phase

Noise during the construction phase is not expected to be audible at any of the noise-sensitive locations in the study area. No noise monitoring is required.

Operational phase

(a) A noise survey should be carried out immediately after commissioning of the surface ventilation fans and the conveyor.

(b) Follow up with annual surveys at the same locations.

(c) Measure noise levels at each of the reference points shown on the map in Figure 6.1.

(d) Measure the A-weighted equivalent continuous noise level in a sequence of 10-minute intervals covering a period of preferably 24 hours, but at least the night-time period from 22:00 to 06:00. If possible, arrange for the relevant noise source under investigation (ventilation fans or conveyor) to be stopped during night-time for a period of 30 minutes, after which it is started up again.

(e) Process the data and determine the increase in ambient level caused by fan or conveyor noise.

(f) Assess the noise impact of the mine and present the findings in a report. If applicable, make recommendations for steps required to mitigate excessive noise.

(g) Equipment, calibration and measurement procedures must comply with the requirements laid down in SANS 10103.

Decommissioning phase

Noise during the commissioning phase is not expected to be audible at any of the noise-sensitive locations in the study area. No noise monitoring is required.

Closure phase

Noise during the closure phase is not expected to be audible at any of the noise-sensitive locations in the study area. No noise monitoring is required.

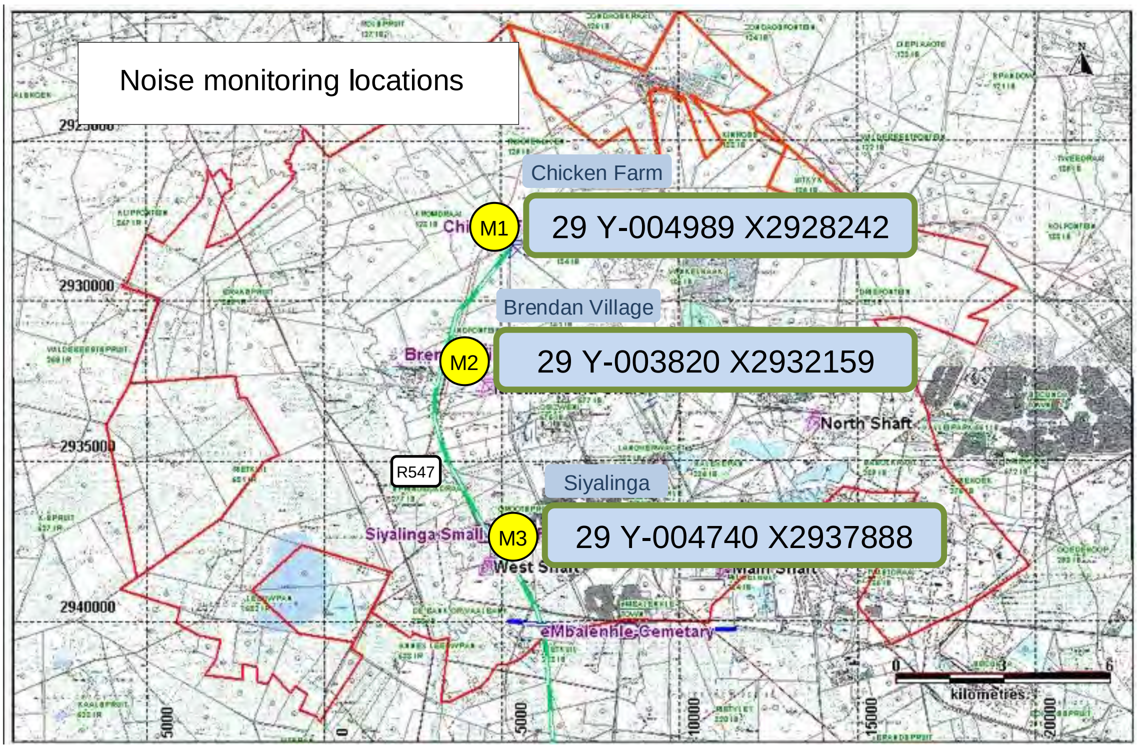


Figure 6.1

Locations where noise should be monitored
Initial survey after commissioning of ventilation fans and conveyor
Followed by annual surveys

7 References

[1] SANS 10328: *Methods for environmental noise impact assessments.*

[2] SANS 10103: *The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication.*

[3] SANS ARP 014 *The calculation of sound propagation by the Concawe method.*

[4] Department of environment affairs: *Noise control regulations under the environment conservation act***,** (Act No. 73 of 1989), Government Gazette No. 15423, 14 January 1994.

Ben van Zyl PhD MSc (Eng)
Acoustical Engineer

Appendix A

Noise survey complete data sets

Figure A.1 Monitoring Point M1 Chicken Farm 06 to 07 Jul-2010

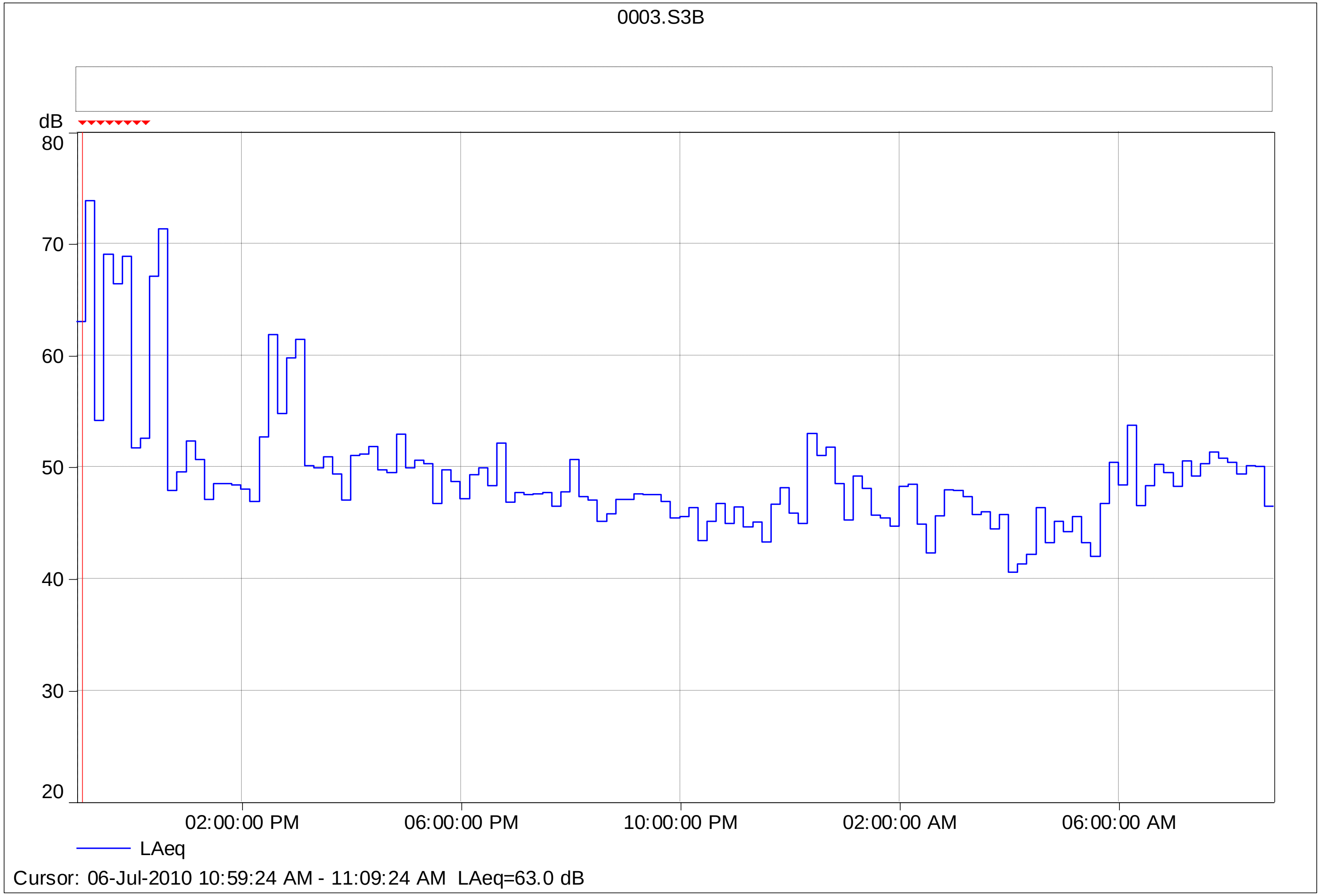
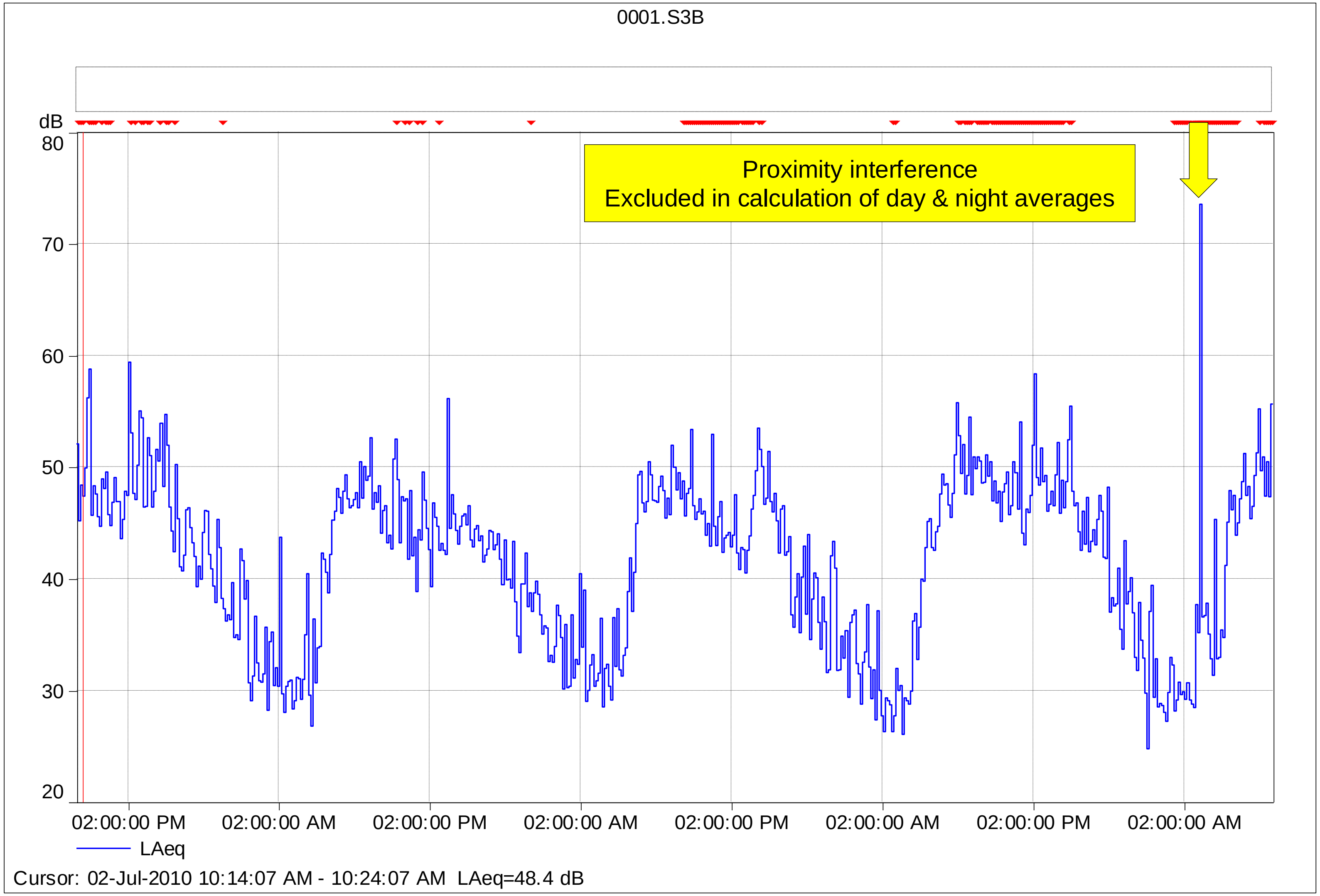


Figure A.2 Monitoring Point M2 Brendan Village 02 to 06 Jul-2010



Appendix B

Curriculum Vitae

Barend Gideon van Zyl - ID No 4605105089082
P O Box 70 596, Die Wilgers, 0041; 542 Verkenner Ave, Die Wilgers, Pretoria

Qualifications		Institution	Year Completed
(1)	BSc (Eng) Elec	University of Pretoria	1970
(2)	BSc (Eng) Hon Elec	University of Pretoria	1972
(3)	MSc (Eng) (Cum Laude)	University of Pretoria	1974
(4)	PhD	University of Natal	1986

MSc thesis: Sound intensity vector measurement
PhD thesis: Sound transmission analysis by measurement of sound intensity vector

Professional registration and membership

- Southern African Acoustics Institute Fellow (President 1994) Member since 1974

Career

CSIR
1971 – 1989

Join the Acoustics Division of the Council for Scientific and Industrial Research (CSIR) in 1971; Chief Specialist Research Engineer 1981 - 1989.

- Undertake basic and applied acoustic research & development projects;
- Pioneer technique and instrumentation for measurement of sound intensity vector, leading to sponsored research & consulting work in the Netherlands (TNO 1978) and Denmark (Brüel & Kjaer 1981).
- Acoustic consulting engineering services rendered in the fields of building acoustics, industrial noise control, acoustic materials development & environmental acoustics.

Advena
1989 – 1990

- SA Space Programme: Manager Systems Integration & Environmental Test Laboratories;
- Design and commissioning of ultra-high noise level simulation facilities for endurance testing of rocket launch vehicles, spacecraft, satellites, instrumentation and payload.

SABS
1991 – 1994

- Acoustic consulting engineering services rendered to industry
- Building acoustics, industrial noise control and environmental acoustics.

Private Practice
Since 1995

Private practice - Sole proprietor - Acoustic consulting engineering

- Noise studies; Environmental noise surveys; Blast noise measurement & assessment
- Design & problem solving: Building acoustics, Industrial & machinery noise reduction, Vehicle noise reduction (road, rail & air)
- Specialised services: Theoretical analysis & design of multi-layered acoustic panels.
- SABS Laboratory & field testing: Building systems and materials, Equipment & machinery noise

---

Papers and publications

- Several papers presented at international congresses and symposia.
- Several papers published in international acoustic journals, such as

Journal of the Acoustical Society of America; Applied Acoustics; Noise Control Engineering Journal.

- Several papers published in Southern African journals.

Other

- Part-time lecturer: Architectural acoustics, Department of Architecture, University of Pretoria;
- Associate of and specialist advisor to SABS Laboratory for Sound and Vibration

Ben van Zyl PhD MSc (Eng)
ACOUSTIC CONSULTING ENGINEER
T/A Acusolv
ben@acusolv.co.za
Tel: 012 807 4924 ▸ Fax: 086 508 1122
P O Box 70596 ▸ Die Wilgers ▸ 0041
542 Verkenner Ave ▸ Die Wilgers ▸ Pretoria

Practice Profile

Sole Proprietor: Dr Ben van Zyl

Practicing since 1995.

An independent sole proprietor acoustic consulting engineering practice with in-house expertise and experience in various acoustic disciplines, including building acoustics, noise impact studies, industrial noise control, test and evaluation and acoustic materials development. Based in Pretoria South Africa, specialist services have been rendered throughout the RSA, as well as in the United Kingdom, Taiwan, Pakistan, Madagascar, Mauritius and Botswana.

Equipped with state-of-the-art acoustic measuring instruments employed in noise monitoring surveys, measurement of blast noise, laboratory and field testing of systems and materials and as an aid in the investigation and solving of noise problems.

Ben van Zyl PhD MSc (Eng)
ACOUSTIC CONSULTING ENGINEER
T/A Acusolv
ben@acusolv.co.za
Tel: 012 807 4924 ▸ Fax: 086 508 1122
P O Box 70596 ▸ Die Wilgers ▸ 0041
542 Verkenner Ave ▸ Die Wilgers ▸ Pretoria

Examples of projects

Acoustic Field: Noise studies

Project	For	Aspects
• Gauteng Waste Plant	S E Solutions	Impact study: New waste plant
• Swartland	Centurus	Residential and commercial development - traffic
• Mapoch II	Marlin Granite	Quarry Impact study: Blasting, open cast mining
• Delmas Extension: mining dev	Ingwe Coal Corp	Noise study – Plant, conveyors, trains, roads
• Twistdraai new access roads	Sasol Coal	Noise study – Roads, conveyors
• Bosjesspruit shaft ventilation fans	Sasol Coal	Noise study; shaft & ventilation fan noise rural area
• Hillendale new mining development	Iscor Heavy Minerals	Noise study – Plant, road transport
• Empangeni Central Processing Plant	Iscor Heavy Minerals	Noise study – Large processing plant
• Rooiwater mining development	Iscor Mining	Noise study – Plants, road & rail transport
• Sigma overland conveyor	Sasol Mining	Conveyors: Analyse sources of conveyor noise
• Sigma overland conveyor	Sasol Mining	Noise study – Conveyors measurement survey
• Maputo steel project	Gibb Africa	Noise study peer review: trains, slurry pipe
• Pump station noise	Transvaal Suiker Bpk	Noise study & Design for noise reduction
• GPMC Environmental Resources Plan	GPMC	Noise policy & resources plan
• Damelin College Randburg	Titan Construction	Assess impact of traffic noise on college + design
• Atterbury Value Mart	Parkdev	Land use planning - City Council requirements noise
• Holmes Place HAC London	V Z de Villiers	Land use planning - City Council requirements noise
• Elmar College Pretoria	Iscor Pension Fund	Assess impact of traffic noise on college + design
• Sanae 4 Base Antarctica	Dept Public Works	Noise impact design for control - Plant rooms
• New truck fuel & service station	Bulktrans	Noise study & Design for noise control
• Country Lane	Country Lane Dev	Land use planning – Road traffic noise impact
• Randburg Water Front	Randburg City	Advisor & specialist court witness
• Syferfontein overland conveyor	Sasol Coal	Noise impact as function of idler properties
• Twistdraai East mining noise	Sasol Coal	Mitigation of noise impact on neighbouring farm
• Little Loftus – The Rest Nelspruit	TAP de Beer	Sports bar - Impact study
• Blast noise	Somchem	Blast noise impact assess & design noise control
• Syferfontein overland conveyor	Sasol Coal	Noise impact as function of conveyor design
• Leeuwpan Mine Delmas district	Iscor/Ticor	Noise study – Plant noise, loading
• Fairbreeze open cast mine KwaZulu	Iscor/Ticor	Noise study – Open cast mining; plant, transport
• Brandspruit mine	Sasol	Noise study - Ventilation fan noise rural area
• Irene Ext 47	Irene Land Dev Corp	Noise study - Mixed development; road traffic noise
• Irene Ext 55	Irene Land Dev Corp	Noise study - Residential; road traffic noise
• Lynnwood filling station & car wash	Town Planning Hub	Noise study: Filling station & car wash in residential
• Lyttleton 190	Ferero	Noise study: Residential next to N1 highway
• Twistdraai N-East Mine shaft	Sasol Mining	Noise study; shaft & ventilation fan noise rural area

Acoustic Field: Noise studies (Continued)

Project	For	Aspects
• Wesput open cast mine	Petmin	Noise study: Blasting, excavation & transport
• Gedex open cast mine	Petmin	Noise study: Open cast excavation & transport
• Kensington college	Centurus	Noise study: Sport grounds, roads
• Spandow mine shaft	Sasol Mining	Noise study; shaft & ventilation fan noise rural area
• Twistdraai Central Mine Shaft	Sasol Mining	Noise study; shaft & ventilation fan noise rural area
• Addington Hospital	Delen Oudkerk	Equipment outdoor noise impact & mitigation
• Fourways Gardens Country Club	Fourways Gardens	Music noise impact assess & design for mitigation
• Irene Ext 29	Irene Land Dev Corp	Noise study: New township & highway noise
• Pick 'n Pay Warehouse Meadowbrook	Pick 'n Pay	Truck movement & loading: Assessment
• Irene Sports Academy	Centurus	Impact assessment: Sports grounds & road traffic
• Jameson substation transformer	EThekwini Municipal	Transformer noise: Assess & design mitigation
• Eugene Marais Hospital	Eugene Marais Hosp	Plantroom & outdoor equipment impact & mitigate
• Klipspruit mine wash plant	Billiton & DRA	Coal wash plant infra-sound: design for mitigation
• Eagle Quarry	Mapochs Action	Quarry new application: peer review
• Blast Test Facility Somchem	Denel	Blast noise impact: assess & design for mitigation
• Virgin Active Sandton Gym	Virgin Active	Aerobics, squash & equipment: assess & mitigate
• Conveyor noise study	Bateman	Overland conveyor noise: Causes & parameters
• Zuid Afrikaans Hospital	Z A Hospital	Chiller outdoor noise: design for mitigation
• K54 Road	Tshwane	Noise Study: Future road through residential
• PWV6 Road	Gautrans	Noise Study: Future highway noise contours
• Zandfontein mine shaft	Sasol Mining	Noise Study: Mine shaft & fan noise outdoor impact
• Pierre van Ryneveld Ext 24	Van Vuuren Dev	Noise study: New township & highway noise
• PFG Glass new float plant	PFG Glass	Noise study: Future plant noise in residential area
• Sterkfontein residential development	M&T	Noise study: Road noise impact mitigation
• Sasol future Irenedale mine	Sasol	Noise study: Prediction of shaft & conveyor noise
• Ammunition demolition	SA Army	Noise study: Long distance noise impact assess
• Rietvlei Ridge residential development	M&T	Noise study: Road noise impact mitigation
• Mooiplaats / Hoekplaats	Chieftain	Noise study: Road noise impact mitigation
• Sasol Syferfontein conveyor	Bateman	Noise study: Noise complaints from farmers
• Madagascar Toliara Sands	Exxaro	Noise study: Future mining, plant, transport
• Rooipoort Mine	Sasol Mining	Noise study: Mining and conveyor noise
• Vlakplaats	Quantum	Noise study: Residential development
• Polokwane 2010 Soccer stadium	Africon	Noise study: Stadium noise in residential area
• New Clydesdale colliery	Exxaro	Noise study: Open cast mining, blasting and plant
• Grootfontein ventilation shaft	Sasol Mining	Noise study: Ventilation shaft & surface fan
• Cicada Pycna mating call study	Anglo Platinum	Cicada mating call – Mining noise interference
• Weltevreden ventilation shaft	Sasol Mining	Noise study: Ventilation shaft & surface fan
• Leandra North new colliery	Ingwe	Noise study: Mining development
• PTM new platinum mine	PTM Platinum	Noise study: Mining development
• Lyttleton X191	Pro-Direct	Noise study, new residential development
• Barking noise nuisance	Vd Merwe	Barking noise measurements, specialist report

Acoustic Field: Noise studies (Continued)

Project	For	Aspects
• Vanggatfontein	Exxaro/Metago	Noise study: Open-cast mine
• Forfar clay mining extension	Forfar/Zimbiwe	Noise study: Open-cast clay mining operations
• Luhfereng Doringkop development	Bigen	Noise study: Mixed development, train noise
• K113 Road noise study	Heartland/Bokamoso	Noise study: Road, mixed development
• Eland Mine	Exstrata/Metago	Noise study: New access road for product transport
• Sheraton Hotel	Pan Pacific Property	Noise study: Hotel impact on residential area
• Sishen Infrastructure Relocation	Kumba/Synergistics	Noise study: Railway route options evaluation
• Tharisa Mine noise monitoring	Tharisa/Metago	Baseline noise monitoring surveys
• Sishen Mine baseline monitoring	Kumba/Synergistics	Baseline noise monitoring surveys
• Sishen Mine Protea discard dump	Kumba/Synergistics	Discard dump location - Noise screening assess
• Eastplats	Barplats/Metago	Noise study: New vertical shaft
• Inyanda Mine noise disturbance	Exxaro	Noise surveys: Noise complaints investigation
• Irenedale Mine commissioning	Sasol Mining	Noise Monitoring: New shaft operational phase
• Honey Ridge indoor shooting range	Insul-Coustic	Design for noise reduction
• Sishen Mine expansion project 2	Kumba/Synergistics	Noise study: New processing plant Sishen mine
• Sishen Mine noise monitoring	Kumba Iron Ore	Peer review: Baseline survey
• Sishen Mine new 10 MTon plant	Kumba/AGES	Noise study: New 10 MTon processing plant
• Khameni Kalkfontein/Tamboti Mine	Khameni/Metago	Noise study: New opencast mine and plant
• Exxaro Kalbasfontein rail load-out	Exxaro	Noise survey: Assess impact of railway loud-out
• Sishen Mine Lylyveld development	Kumba/EGES	Noise study: New opencast mine & transport
• Haasfontein new opencast mine	Exxaro/Synergistics	Noise study: New underground mine + conveyor
• Westlake mixed development	Heartland/SEF	Noise study: New urban mixed development
• Marlboro road M60	Heartland/SEF	Noise study: New road traffic noise modelling
• Driefontein Mine	Goldfields	Noise scoping assessment and recommendations
• Bokfontein Chrome Mine	Hernic/Metago	Noise study: New furnaces and beneficiation plant
• Eland opencast mine extensions	Exstrata/Metago	Noise study: Opencast mine extensions
• Tharisa Mine EMP noise monitoring	Tharisa/Metago	EMP noise monitoring survey 1
• Dragline noise reduction Kriel	Anglo Coal	Dragline noise – Design for noise reduction
• Ivory Coast noise studies	Metago	Peer review
• Eskom Grootvlei Power Station	Insul-Coustic	Design for noise reduction - internal
• Inyanda Mine	Exxaro	Design for plant noise reduction - enviromental

Acoustic Field: Building acoustics & speech intelligibility

Project	Client	Main acoustic design aspects
• New Constitutional Court of SA	Dept Public Works	Court chambers, auditoria, library, offices, PAS
• Kroonstad Magistrate Courts	Dept Public Works	Speech intelligibility, acoustic comfort, noise control
• Mpumalanga Legislative Buildings	MPT Architects	Legislative assembly, translation booths, plantrooms
• Germiston Council Chamber	Ekurhuleni Municipal	Speech intelligibility, acoustic comfort, noise control
• Associate of SABS LVA	SABS	Specialist advisor for SABS Acoustics Laboratory
• Customer Service Branches	Telkom	Teller-customer speech intelligibility problem solving
• Sandton Convention Centre	LKA	Design peer review
• Hillside Aluminium Public Address Sys	Hillside Aluminium	Design specification Public Address System
• Telephone Hood	Symo Corporation Ltd	Speech intelligibility tests & assessment ITU-T P.32
• Telematic Learning Centre	University Pretoria	Open plan space speech privacy
• Sapos Mail Centres Pta & Kempton P	Sapos	Office & work area protection against aircraft noise
• Logan Conference Centre	Moneyline 718	Design for good acoustics & speech intelligibility
• Unisa Sunnyside Conference hall	Unisa	Variable acoustics: concert hall to conference hall
• PHC Synagogue	Pta Hebrew Comm	Design for good acoustics & speech intelligibility
• St Peters Lutheran Church Pretoria	St P Lutheran Comm	Public address system design
• T & M training centre	T & M Staff Hire	Design to rectify existing poor speech intelligibility
• Park City Railway Concourse	Spoornet	Building acoustics & public address system design
• Botswana TV & Broadcast centre	Atlantic Technology	Design re plantroom & air-con noise control
• Cape Town Main Station	Spoornet	Building acoustics & public address system design
• South African Airways training centre	SAA	Speech intelligibility, air-con & aircraft noise control
• Unisa lecture halls (Several)	Unisa	Speech intelligibility, noise control, PAS design
• Damelin College Randburg	Titan Construction	Impact study & acoustic design
• Wembley Stadion Johannesburg	Jhb Metro Council	Problem solving – total lack of speech intelligibility
• Sound recording studios Midrand	Solo	Studio design – speech intelligibility, low noise
• Sanae 4 Base Antarctica	Dept Public Works	Acoustic design – Plantroom noise control
• Certification of building systems	Agrement S A, CSIR	Acoustic evaluation of new building systems
• Health Land Gyms in UK (Several)	Health Land UK	Activity & equipment internal & external noise
• Evolution night club	Evolution night club	Problem solving re residential noise disturbance
• Caesars Palace – Casino	Global Resorts	Acoustic design, plantrooms & air-con noise control
• Telkom Call Centre Pretoria	TFMC	Solution for open plan area speech interference
• Botswana Bureau of Standards	Botswana B S	Metrology labs floating floors; conference room
• Germiston civic centre	Ekurhuleni Municipal	Legislative assembly hall and associated facilities
• E-TV Hyde Park	Anglo Ital	Television studio design
• Freestate Technicon Student Hall	Freestate Technicon	Hall sound system problem solving
• Eskom Meggawatt Park Offices	Eskom	Offices, boardrooms sound proofing & privacy
• Polokwane Community Hall	Polokwane Municipal	Acoustic design multipurpose hall - Speech & music
• Home Theatre House Alberts	Tempel & Associates	Home theatre design for music reproduction
• Polokwane Premiers Offices	Tempel & Associates	Atrium sound proofing & equipment noise reduction
• Atlas Studios Johannesburg	Anglo Ital	Television studios: Studio acoustics & air-con noise
• Longland Restaurant Fourways	Longland Investment	Restaurant internal acoustics & music breakout
• Ithala Restaurant Durban Waterfront	Ithala	Restaurant internal acoustics & music breakout
• Reddam School Hall	Centurus	School Hall – Design speech intelligibility

Acoustic Field: Building acoustics & speech intelligibility (Continued)

Project	Client	Main acoustic design aspects
• Lynnwoodrif NG Church Auditorium	Lynnw NG Church	Auditorium speech and music acoustic design
• Performer Theatre Pretoria	Dezzo	Noise breakout control
• Kentron Open Space Offices	Denel Kentron	Open space offices – Remedy speech privacy
• Unisa Music Practice Rooms	Unisa	Music room acoustics & prevent noise breakout
• Botswana Geological Survey Head Q	Botswana Govt	Offices and laboratories – Acoustics & noise intrus
• Unisa Student Centre	Unisa	Student centre – Study halls, boardrooms, offices
• Le Bocage Community Hall Mauritius	Mauritius Govt	Community Hall – Acoustic design
• Carltonville Conference Centre	Guido Willems Arch	Conference Centre – Acoustic design
• Virgin Active Gym Sandton	Virgin Active	Remedy noise breakout squash, aerobics & equipm
• Pullman Dance School	Pullman	Design control of music noise breakout
• Fourmall Office Building	Matrix	Offices, boardrooms – speech intelligibility & privacy
• Unisa East & West House	Unisa	Offices & boardrooms – Speech privacy & air-con
• SAA Airport Ramp Services Building	SA Airways	Airport Ramp services building soundproofing
• Mail sorting centre	Telkom Sapos	Next to airport - Control of aircraft noise intrusion
• Roodepoort Gholf Club Hall	Insul-Coustic	Design multi-purpose hall acoustics
• SAA Airport Hanger Offices	SAA	Offices in airport hanger - Soundproofing
• Bourbon Street Disco	Bourbon Street	Design control of music noise outbreak
• Abraxas New Office Building	EQF	New office building – Acoustics & traffic noise intrus
• Clover offices development	Clover SA	Private boardroom, executive & open plan offices
• Absa The Glen	Hyprop	Sound insulation between bank & cinemas
• Nooitgedacht Church	Nooitgedacht Church	Modifications to solve poor acoustics problems
• Axiz auditorium	PCN Projects	Auditorium acoustic design
• SARS Alberton assessment centre	Meyer Pienaar arch	Boardrooms & offices design
• Carlton Centre	Transtel	Emergency evacuation system
• BMW wax & seal test facility	BMW	Sound-proof test cell design
• The Sails Point	BFBA	Apartment air-conditioning noise
• Kwa-Zulu Premiers offices	BFBA	Assembly hall, auditorium, boardrooms, plantrooms
• Bolivia multi-purpose hall	Bolivia Lodge	Design for conference, music, sub-division of hall
• Unisa Buildings 13 & 14	Unisa	Upgrade of buildings into study and lecture halls
• Botswana College Applied Arts	Paledi Morison	Design acoustic doors and windows TV studio
• Unisa film theatre and concert hall	Unisa	Concert hall design
• PMokaba Soccer Stadium	Africon	Stadium roof and sound system acoustic design
• Unisa new entrance building	Unisa	Auditorium acoustics & plantroom noise control
• Montana Catholic Church	Montana Church	Acoustic design
• Zambesi Animal Hospital	Kollonade Animal	Animal hospital soundproofing design
• Brunstad conference hall	Brunstad	Conference hall acoustic design
• Mopani new council chamber	Africon	Council chamber acoustic design

Acoustic Field: Industrial, machinery & equipment noise control

Project	For	Aspects
• Iscor New Compressor House	Voest Alpine	Design for noise reduction, inspection & testing
• Botswana TV centre Air-con system	Atlantic Tech	Design for control of plantroom & ducted noise
• Granulation plant	DOW Plastics	Design for noise reduction, inspection & testing
• CS2 Xantate plant	DOW Chemicals	Design for noise reduction, inspection & testing
• Alkylate chemical plant	DOW Chemicals	Design for noise reduction, inspection & testing
• SAP 4 Acid plant	Sasol Agri Palaborwa	Design for noise reduction, inspection & testing
• Motor pump enclosures	Sulzer	Design of noise hoods for large motor-pump units
• Rite Value Refrigeration Plant	Rite Value	Problem solving & design for noise reduction
• Sugar mills pump station	TSB	Design for noise reduction – noise impact control
• Pferd factory noise reduction	Pferd SA	Problem solving & design factory noise reduction
• Alusaf Bayside compressor plant	Alusaf	Problem solving & design for noise reduction
• Alusaf Bayside blower plant	Alusaf	Problem solving & design for noise reduction
• Alusaf Bayside cold rolling mill	Alusaf	Problem solving & design for noise reduction
• Sinter plant Van der Bijl Park	Iscor	Noise reduction strategy & requirements
• Blast furnace fan noise	Universal Fans	Design for fan noise reduction
• Aircraft Engine test facility	Kentron	Design for noise control – environmental impact
• Sulphuric acid plant noise	Fedmis	Design for noise reduction, inspection & testing
• Automotive assembly line	Nissan	Design & commissioning noise reduction canopies
• Scrubber fan noise	RBM	Design for noise reduction
• Ship unloader machine room noise	Algroup Alusuisse	Design for noise reduction
• Paint plant noise	Daimler Chrysler	Design for noise reduction on skid cleaner
• Mail sorting centre plantroom noise	Telkom Sapos	Design for plantroom noise control
• Scrubber system and fan noise	Aquachlor	Design for noise reduction
• Power station turbine hall noise	Eskom	Design for noise reduction
• Mill noise	PPC	Design for noise reduction in control rooms & offices
• Plantroom noise	Vodacom	Design for noise control in offices
• G6 armoured veh power plant noise	SME	Design enclosure for noise control
• Carltonville hospital boiler plant noise	Gauteng Health Dept	Design for noise reduction
• Refinery noise	Rand Refineries	Diagnostic investigation & strategy for noise reduct
• Engine test facility ultra-high noise	Sasol	Design for sound proofing engine test facility
• Chiller plant noise	Dep Public Works	Design for noise reduction
• New Chipper Plant	Sappi Tugela	Plant building design for external noise control
• Transformers	Hawker Siddeley	Acoustic test and evaluation
• Sappi Enstra Paper Mill	Sappi SA	Noise reduction programme and design
• Blast noise	Somchem	Blast noise eval; test facility design for noise control
• Mill noise	Anglo Platinum	Bond mill & sieve shaker design for noise reduction
• Vibration screen infra-sound problem	Billiton	Problem analysis and design for infra-sound control
• Bucket repair workshop	S A Coal Estates	Design enclosures & screens for noise reduction
• LoadHallDump vehicle noise reduction	Anglo-Coal	Design ventilated hood for noise reduction
• PMR Precious metal refinery	Anglo Platinum	Excessive ventilation noise: design to reduce
• Pebble bed ball impact test facility	Necsa	Noise control booth design

Acoustic Field: Industrial, machinery & equipment noise control (Continued)

Project	For	Aspects
• Sasol Syferfontein conveyor	Sasol Mining	Design: Overland conveyor noise reduction
• SARS Alberton new building	SARS	Plantroom design for noise impact control
• Sulzer large flow bend	Insul-Coustic	Design bend treatment for flow noise control
• BMW wax & seal test facility	Insul-Coustic	Test facility soundproofing design - Metal cutting
• Kumba induction panel test facility	Kumba	Test facility soundproofing
• KZN P Maritz B new legislative offices	KZN Dept P Works	Plantrooms and machinery design for noise control
• Alstom 32 MVA Power transformer	Alstom	Power transformer noise output tests
• Waterfall Boven	Nkalanga Municipal	New water purification design for noise control
• Conveyor noise study	Bateman	Overland conveyor noise: Causes & parameters
• Harvest House Pretoria	Desmo Eng	Chiller & cooler plant design noise screening meas
• Ventilation fan noise problem	Anglo Coal	Surface ventilation fan - Design noise reduction
• Sasol Syferfontein conveyor	Sasol Mining	Diagnostic analysis: noise generating mechanisms
• Sasol Syferfontein conveyor	Sasol Mining	Design: Overland conveyor noise reduction
• Metal press noise	TRW	Design enclosures & screens for noise reduction
• Stone Duster Vehicle	Bird Machines	New vehicle – Design & achieve noise spec
• Gautrain	Insul-Coustic	Construction sites – Design noise enclosures
• Exxaro High-frequency generator	Insul-Coustic	Noise enclosure and soundproofing design
• Unisa new registration building	Unisa	Plantroom noise predictions and design inputs
• Columbus Steel	Insul-Coustic	Control room and pulpit soundproofing design
• Sesane TV studios	Insul-Coustic	Plantroom and machinery noise reduction design
• Safour air plant noise reduction	Insul-Coustic	Compressor enclosure and soundproofing design
• Rustenburg Mine Laboratories	Rustenburg Mine	Design for machine noise reduction
• Anglo Research Lab Mills	Anglo American	Research lab mills, design for noise reduction
• Safripol Blowers	Safripol	Blower noise, design for noise reduction

Acoustic Field: Specialised services

Project	For	Aspects
• Specialist advisor to SABS LVA	SABS	Specialist advisor for SABS Acoustics Laboratory
• Pakistan Airforce: Missile assessment	Dep Trade & Industry	Assessments non-proliferation treaty
• Taiwan push-pull loco bullet train	Union Carriage	Driver's cabin speech intelligibility & noise control
• NRZ rail coaches	Union Carriage	Acoustic design for noise reduction
• Locomotive Class 9E Electrical Sishen	Alstom	Design upgrade - Noise reduction for hearing safety
• Theoretical analysis sound insulation	CSIR & several other	Predict/analyse acoustical properties of materials
• Overland coal conveyor noise	Sasol	Diagnostic analysis: noise generating mechanisms
• G6 artillery vehicle – Gun shot noise	LIW	Acoustic measurements & assessment hearing risk
• Locomotive Class 11E Electrical	Spoornet	Design upgrade - Noise reduction for hearing safety
• Dakota aircraft upgrade	Aerosud	Design for noise reduction
• Hearing damage gunshot noise	SA Police	Hearing conservation programme
• New drywall product development	BPB Gypsum	Theoretical analysis of acoustical properties
• Power generators outside broadcast	Ontrack	Noise reduction and field tests
• Ermelo – Richards Bay Locomotive	Transwerk	Design upgrade speech intelligibility & noise control
• Indoor artillery test facility	Somchem	Design for environmental noise control
• MUF building systems	Chipboard Industries	System acoustic evaluation and development
• Locomotive Class 34GM Diesel-elec	Spoornet	Design upgrade - Noise reduction for hearing safety
• Locomotive Class 35GM Diesel-elec	Spoornet	Design upgrade - Noise reduction for hearing safety
• Locomotive Class 36GM Diesel-elec	Spoornet	Design upgrade - Noise reduction for hearing safety
• Locomotive Class 37GM Diesel-elec	Spoornet	Design upgrade - Noise reduction for hearing safety
• Locomotive Class 34GE Diesel-elec	Spoornet	Design upgrade - Noise reduction for hearing safety
• Locomotive Class 35GE Diesel-elec	Spoornet	Design upgrade - Noise reduction for hearing safety
• Locomotive Class 36GE Diesel-elec	Spoornet	Design upgrade - Noise reduction for hearing safety
• SABS acoustic test lab validation	SABS	Assess & validate SABS test laboratory & method
• Mobile partitioning system	L J Doors	Design input to improve insulation performance
• Locomotive Class 7E Elec	Spoornet	Design upgrade - Noise reduction for hearing safety
• Weapons and ammunition demolition	SA Navy	Measurement of hi-explosives detonation noise
• Locomotive Class 19E Elec	UCW	New Coal-link locomotive – Low noise design
• Locomotive Class 15E Elec	UCW	New Sishen iron ore loco - Low noise design
• Soshalowa power car	Transnet	Train set power car sound-proofing design
• Locomotive hooters	Transnet	Study hooter audibility at level crossings
• Aluglass building systems	Aluglass	Acoustic panel theoretical evaluation

APPENDIX 5.14(A)

SPECIALIST REPORT
VISUAL ASPECTS

FINAL

VISUAL ASPECTS
SPECIALIST STUDY REPORT

Sasol Mining – Middelbult-Shondoni
EMPR Addendum, EIA and IWULA

Date: 31 August 2010
JMA Project: JMA/10391
File Reference: Prj5430

COMPILED FOR

Sasol Mining (Pty) Ltd
Middelbult Colliery
Shondoni Shaft

COMPILED BY

JMA Consulting (Pty) Ltd
Sustainable Environmental Solutions
through
Integrated Science and Engineering

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

Page

APPENDICES

APPENDIX I	**:**	**Poster of Photographic Assessment**
APPENDIX II	**:**	**Impact Summary Tables**
APPENDIX III	**:**	**CV’s of Contributing Personnel**

EXECUTIVE SUMMARY

Introduction

Sasol Mining operates a number of underground coal mines in the Secunda Area. Middelbult Colliery represents one of the underground mines and has been in operation since 1981. During its existence Middelbult Colliery has gone through several expansions. Whilst some of the original shafts have already been closed and rehabilitated, new shafts have been developed to access coal within the Middelbult Reserves.

As part of this ongoing development to ensure access to exploitable reserves, Sasol Mining is now investigating options to replace the existing West Shaft with a new shaft (Shondoni) in the Block 8 reserves in order to increase its reserve utilisation of the existing Middelbult operations (original Middelbult Reserves and Block 8 Reserves). At the same time the current mine lease area is also extended to now include the Block 8 Northern Reserves, the Springbokdraai Reserves and the Leeuwpan Reserves.

The proposed infrastructure expansion of the Middelbult operations, comprise one additional shaft complex (Shondoni Shaft) with associated infrastructure in the Block 8 Reserves and a new overland conveyor to convey the coal to the Middelbult Main Shaft and then onto an existing conveyor to the Sasol Mining central coal stockpile area (Sasol Coal Supply or SCS), and of course the underground workings for the additional reserve blocks (Block 8 Northern Reserves, the Springbokdraai Reserves and the Leeuwpan Reserves).

Visual Aspects inputs are to be generated in support of the documentation required for the authorization processes associated with all the above. This report attempts to provide the required Visual Aspects information to facilitate the compilation of these different reports, but also to serve as scientific base line of the Visual environment at Sasol Middelbult Shondoni shaft area from which to evaluate the efficiency of the proposed visual management measures.

Actions Performed

Contextual analysis

A contextual analysis was done in order to establish the visual character “base line” for the site. The analysis was based on published information for the area available from public sources such as the internet. The information used is considered to be biased slightly towards a “marketing” perspective for the Mpumalanga province, which is good as it provides a conservative base line for the contextual analyses.

View Shed Analyses

A view shed analysis was performed prior to the site specific photographic analyses in order to determine the visibility of the site from priority access points/routes such as public roads and residential areas. The analysis was performed with both SURFER and ARCVIEW, creating 3-dimensional shaded relief, 3-dimensional topographical contour and preliminary viewshed maps, using the 1:50 000 published DTM information obtained from the Surveyor General. The resulting maps provided a sound basis from which to assess potential vantage points to the site and on which to base planning for the photographic assessment.

Photographic survey

A detailed photographic survey was also done of the study site and adjacent areas, from numerous surrounding vantage points. The photographic compilations are produced in 2D by taking a series of panoramic photographs of a 3D environment. These are then superimposed onto one another to complete a view of the study area. This is done to give a clearer indication of the visual nature of the areas that will visually be affected by the activities, which will in turn aid in the design and installation of visual mitigation measures.

Findings and Conclusions

A number of distinguishable visual impacts have been identified for the proposed Sasol Shondoni Shaft facilities and associated surface coal conveyor. The visual impacts identified are largely neutral, thus they neither reduce the visual quality of the landscape nor contrast significantly with the existing landscape character and aesthetic and the experience thereof. Even though some negative impacts were identified, they do not cause an unacceptable new character and will be overseen or altered by mitigation measures. The following conclusions can be reached with regard to visual impacts for the Shondoni project:

- The regional setting in which the Shondoni facilities will be located, provides a high level of **Visual Absorption Capacity** for mining activity. The site will be located in a mining area with several other shafts surrounding it.

- **Visibility:** The visibility of the Shondoni facilities will vary considerably. Long range views for the shaft area exist from elevated vantage points in the east and south-east. These long range views are softened due to the high VAC of the area. The visibility of the conveyor belt is very high on short to medium range, but once more blends into the surrounding activities. At road crossings the visibility impact is however more significant where the conveyor crosses above the road. This impact can be mitigated by letting the conveyor go underneath the road at road-crossings.

- **Visual Intrusion:** Visual intrusion deals with how well project components fit into the ecological and cultural aesthetic of the landscape as a whole. Whereas the Shondoni infrastructure represent mining components, which by their very nature and size represent significant visual components, their degree of visual intrusion in the specific setting in which they are located, are acceptable.

- **Visual Exposure:** The main factors that influence visual exposure at Shondoni are elevation and distance. Once again, visual exposure is considered acceptable due to the undulating surrounding landscape which benefits short range views, and the distance of the Shaft area away from public vantage points such as roads. The visual exposure of the conveyor belt is more significant, as it follows next to the R547, passing Brendan Village and crossing the road several times.

- **Alterations to site Morphology and Topography:** The only significant alterations to topography relate to the vertical shaft and ventilation shafts. These shafts will represent a significant alteration to the topography and could from certain vantage points alter the visual horizon line. The proposed coal conveyor will not have any significant morphological or topographical impact, mainly due to its low height.

- **Alterations to Vegetation and Land Cover:** The erection of large manmade structures and associated earthworks result in the complete removal of vegetation and a change of the land cover, detrimentally altering the visual character of the landscape. In this regard the impact will manifest when the Shondoni Shaft facilities will be constructed.

- **Alteration of Water Runoff and site Hydrology:** The runoff pattern and character of the catchment area within which the proposed Shondoni Shaft facilities will be located will be altered due to the shaft infrastructure and associated activities. More significant though is the stream crossing that may be required by the coal conveyor system. Depending on the selected conveyor route, a number of stream crossings may be required. At the incline shaft for the proposed shaft locality, a stream alteration may be required depending on the final design.

- **Alteration to Visual Character:** The proposed Shondoni facilities will contrast with the visual character of the immediate surroundings, and as such will constitute a visual impact on the visual character of the site context. It will however not contrast will the regional visual character as this area is characterised with mining activities. Post closure the situation will further improve due to the proposed rehabilitation and closure measures.

- **Alteration to Sense of Place or Genus Loci:** The sites of the existing and proposed Shondoni facilities are not unique in terms of their perceived character or the experiences that they evoke, neither does the introduction of the mining structures and activities negatively impact on the sensory and emotional experiencing of the affected sites and surrounding landscape, as they are of the same character. The manmade structures and associated activities will not visually disrupt the existing visual conditions any more as currently done by other mining facilities in the area. There is no disruption of existing cultural and land use continuity. The mining elements and structures are of the same character as that which is currently in the region.

- Management measures proposed should be seen as visual optimization measures to enhance other required management interventions on the Shondoni site.

- Appropriate mitigation measures should be implemented and managed and maintained during the Construction, Operational, Decommissioning and Post-Closure phases, with an emphasis being placed on mitigating short to medium-range views.

- The main visual management measures proposed can be divided into three categories which are shaping of use of vegetation, general housekeeping and road-crossings.

Respectfully submitted,

Jasper L Müller
(Pr.Sci.Nat.)

Genevieve Cloete
(Pr.Sci.Nat.)

Prj5430

1. INTRODUCTION

Sasol Mining operates a number of underground coal mines in the Secunda Area. Middelbult Colliery represents one of the underground mines and has been in operation since 1981.

During its existence Middelbult Colliery has gone through several expansions. Whilst some of the original shafts have already been closed and rehabilitated, new shafts have been developed to access coal within the Middelbult Reserves.

As part of this ongoing development to ensure access to exploitable reserves, Sasol Mining is now investigating options to replace the existing West Shaft with a new shaft (Shondoni) in the Block 8 reserves in order to increase its reserve utilisation of the existing Middelbult operations (original Middelbult Reserves and Block 8 Reserves). At the same time the current mine lease area is also extended to now include the Block 8 Northern Reserves, the Springbokdraai Reserves and the Leeuwpan Reserves.

The proposed expansions require Environmental Authorisations. As part of this, potential environmental impacts must be assessed and the Environmental Management Plan (EMP) must be amended in terms of the Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA). In order to achieve this, the current Environmental Impact Assessment (EIA) and Environmental Management Programme Report (EMPR) approved under the Minerals Act (Act 50 of 1991) must be amended.

Additionally, an Environmental Authorisation is required in terms of the National Environmental Management Act (NEMA) (Act 107 of 1998) for all listed activities related to the proposed expansion whilst an Integrated Water Use License Application (IWULA) is also required in terms of the National Water Act (NWA) (Act 36 of 1998) to authorize water uses related to the expansion.

The proposed infrastructure expansion of the Middelbult operations, comprise one additional shaft complex (Shondoni Shaft) with associated infrastructure in the Block 8 Reserves and a new overland conveyor to convey the coal and to link up with an existing conveyor running to the south of the Middelbult Mine (this existing conveyor runs to the Sasol Mining central coal stockpile area (Sasol Coal Supply or SCS)), and of course the underground workings for the additional reserve blocks (Block 8 Northern Reserves, the Springbokdraai Reserves and the Leeuwpan Reserves).

Visual Aspects inputs are to be generated in support of the documentation required for the authorization processes associated with all the above. This report attempts to provide the required Visual Aspects information to facilitate the compilation of these different reports, but also to serve as scientific base line of the Visual environment at the Middelbult-Shondoni shaft area from which to evaluate the efficiency of the proposed visual management measures.

2. TERMS OF REFERENCE

The terms of reference for this report are quite comprehensive in the sense that the work to be performed needs to support a number of environmental authorization processes, each with its unique requirements for Visual Aspects inputs.

The following formal documentation/processes must be supported with the information contained in this report:

Process/Document	Applicable Legislation
SASOL SHONDONI EMPR ADDENDUM	MPRDA
SASOL SHONDONI IWULA	NWA
SASOL SHONDONI EIA and EMP	NEMA

The Visual Aspects assessment must address the following material environmental process aspects:

- A comprehensive, site specific, Visual Aspects base line description that can be used for impact assessment and impact management measure design purposes and that will provide the monitoring base line from which to assess the efficiency of Visual Aspects management measures at the Shondoni Shaft and conveyor route.
- The identification of anticipated Shondoni project related Visual impacts.
- The description, assessment and rating of these impacts for all the life cycle phases with reference to aspects such as:
    - Description of Impact
    - Spatial Extent
    - Intensity or Severity
    - Duration
    - Acceptability
    - Degree of Certainty
    - Positive or Negative Status
    - Mitigatory Potential
    - Magnitude or Significance
- The assessment of cumulative impacts (Sasol Shondoni Shaft and conveyor route in context with its surrounds).
- The definition of visual management objectives.
- The identification, description and conceptualization of visual management measures to achieve the stated visual management objectives.

3. PROJECT TEAM

The following scientists were involved with the Visual Aspects investigation and in the compilation of this Visual Aspects Specialist Report. CV's are attached as APPENDIX III to this report.

Jasper Muller (Pr.Sci.Nat.)
(M.Sc. Geohydrology)

Genevieve Cloete (Pr.Sci.Nat.)
(B.Sc. Hons. Env. Management)

4. APPROACH & METHODOLOGY

JMA Consulting was appointed by Sasol Mining (Pty) Ltd - Secunda to complete a Visual Impact Assessment (VIA) specialist study in support of the overall EMP/ EIA process for the proposed Shondoni Shaft and conveyor route.

4.1 Introduction

The proposed Shondoni Shaft and associated conveyor route will be located approximately 5 km west of Evander. The landscape of the region is that of slightly undulating grassland. The region is known for its mining activities with five other shafts within a 5 km radius of the proposed shaft area.

Due to the nature of the proposed Shaft and its associated conveyor route, a degree of visual impact will occur, affecting observers in the vicinity of the site. It is therefore the aim of this assessment to determine the extent and significance of the visual impact and if necessary the mitigatory methods available.

The point of departure for the Visual Aspects Specialist Study Report was Hans Martens, the 19^{th} century German architect's, principle that the total aesthetic impression is related to the range and distance that a normal human eye can encompass (Higuchi, 1988).

His ideas with respect to distance and angle of elevation have become standard in the field of visual analysis and will also be considered for this report. Higuchi (Higuchi, 1988) proposes eight criteria or indices for determining the visual structure of landscape:

- **Visibility or invisibility.** This concerns the fundamental question of what can be seen and what cannot be seen from a given viewpoint.
- **Distance.** This has to do with the changes that take place in the appearance of an object as the distance between the observer and the object varies.
- **Angle of incidence.** When a landscape is conceived of as a group of surfaces, the angle at which the line of vision strikes each surface determines to a large degree what can be seen of it. This index evaluates the comparative visibility of the various surfaces in a given landscape.
- **Depth of visibility.** This gauges the degree of visibility in terms of the depth of the unseen section with respect to the line of vision.
- **Angle of depression.** This clarifies the viewer's sense of position as he/she looks at a scene from above.
- **Angle of elevation.** This indicates the nature of upward view and the limits of the visible space.
- **Depth.** This clarifies the degree of three-dimensionality of the landscape as it unfolds before the viewer.
- **Light.** The appearance of a landscape changes drastically in accordance with the manner in which the light strikes it. This index has to do with the transformation that take place as the position of the source of light moves from front to side to back.

Thus, the visual character of a landscape is measured in many different ways; each employed for a specific evaluation.

Whichever methods are used, the importance of being able to assess the long-term aesthetic effects of proposed landscape alteration is critical prior to a proposed area being constructed or activity undertaken. Keeping Martens' and Higuchi's principles in mind, specific methods have been taken from these and additional sources to ensure that appropriate answers to the standard requirements of the VIA Process are generated.

4.2 Structure of this Report

The report structure for this Visual Assessment was based on the requirements of the overall EIA/EMP study and was designed to support the seamless compilation of the motivational documentation for formal environmental authorization purposes.

The general introduction, terms of reference and project team are discussed in Chapters 1 through 3. The approach and methodology for the study, detailing the actions performed to support the Visual Assessment, are detailed in Chapter 4. A synoptic description of the project attributes and activities is given in Chapter 5.

The Visual Assessment commences with a Contextual Analyses in Chapter 6 which addresses visual interpretation by characterising the existing physical and visual conditions of the province, area and site, called respectively the **Macro Context** analysis, **Micro Context** analysis and **Site Analysis**. This component will function as an introduction to the understanding of the character of the site to conclude the information for the impact assessment.

Chapter 7 describes the current Visual and Landscape Character, whilst Chapter 8 deals with the actual Visual Impact Assessment for the proposed Shondoni Shaft and associated Surface Coal Conveyor.

The study concludes with suggestions for Visual Mitigation in Chapter 9.

4.3 Actions Performed

A synoptic discussion of the actions performed in order to conduct this visual assessment of the proposed Shondoni Project will now be given.

4.3.1 Contextual Analysis

A contextual analysis was performed in order to establish the visual character "base line" for the site. The analysis was based on published information for the area available from public sources such as the internet.

The information used is considered to be biased slightly towards a "marketing" perspective for the Mpumalanga province, which is good as it provides a conservative base line for the contextual analyses.

4.3.2 View Shed Analyses

A view shed analysis was performed prior to the site specific photographic analyses in order to determine the visibility of the site from priority access points/routes such as public roads and residential areas.

The analysis was performed with both SURFER and ARCVIEW, creating 3-dimensional shaded relief, 3-dimensional topographical contour and preliminary view shed maps, using the 1:50 000 published DTM information obtained from the Surveyor General.

The resulting maps provided a sound basis from which to assess potential vantage points to the site and on which to base planning for the photographic assessment. The 3-dimensional topographical relief and contour maps for the Shondoni Shaft site and its surroundings are shown in Figure 4.3.2 (a) and Figure 4.3.2(b).

The points eventually selected for the photographic survey are also indicated.

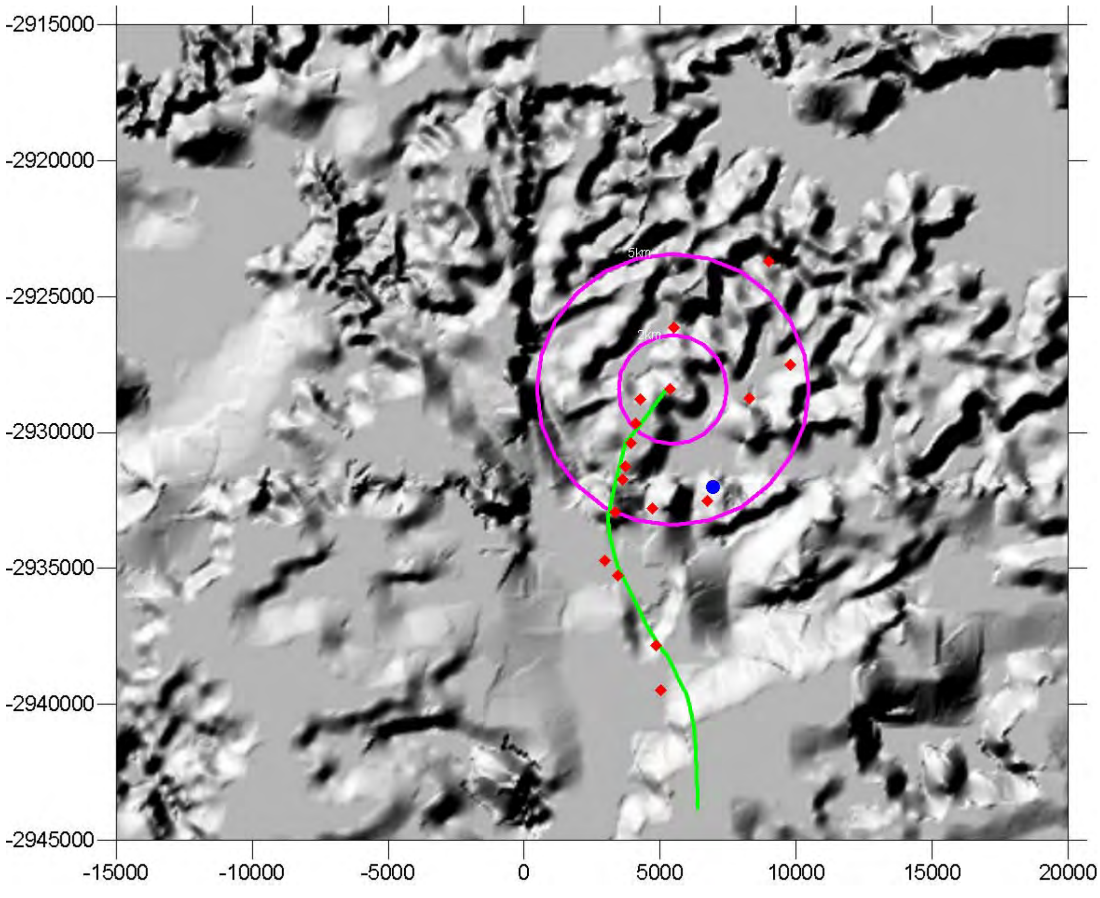


Figure 4.3.2 (a): Topographical Relief (Shaded Relief) Map for Shondoni Shaft and Conveyor Belt with a 2 km and 5 km buffer zone indicated around the Shaft

The photographical survey points were selected along public roads around the site.

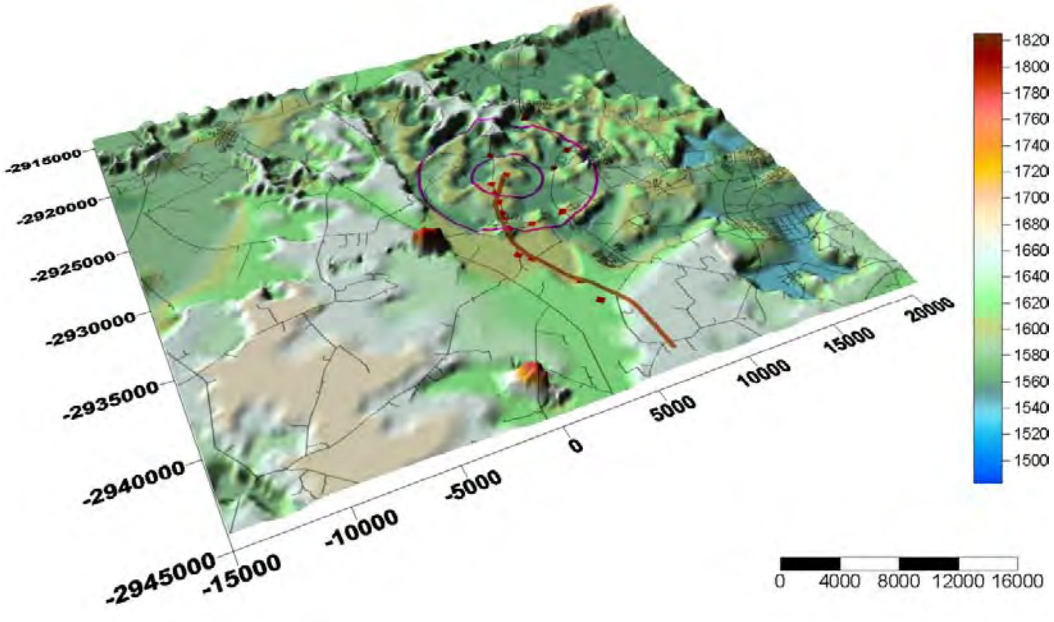


Figure 4.3.2(b): Topographical Relief (View Shed) Map for Shondoni Shaft area

The view shed done only considered the topography and not other visual barriers such as manmade structures and high vegetation. Because the view shed was done using only 20 m contour data it is a rough estimate of what could be expected in the field. The resulting view shed maps of the Shaft Area and Conveyor Route are shown in Figure 4.3.2(c) and Figure 4.3.2(d) respectively.

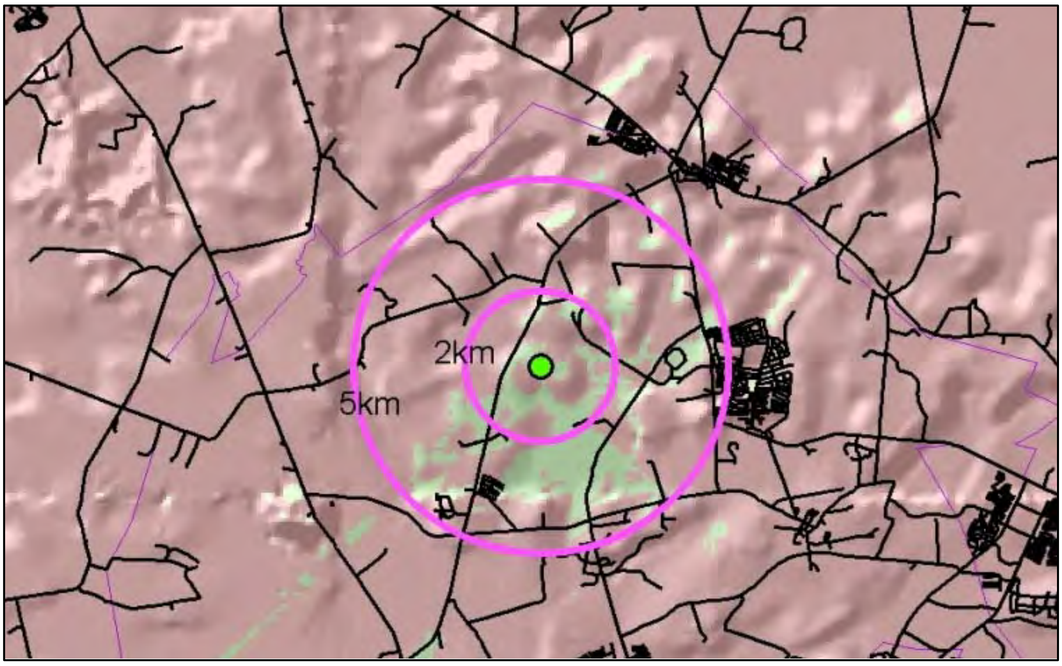


Figure 4.3.2(c): View Shed Analysis Map done with ArcView for Shondoni Shaft Area

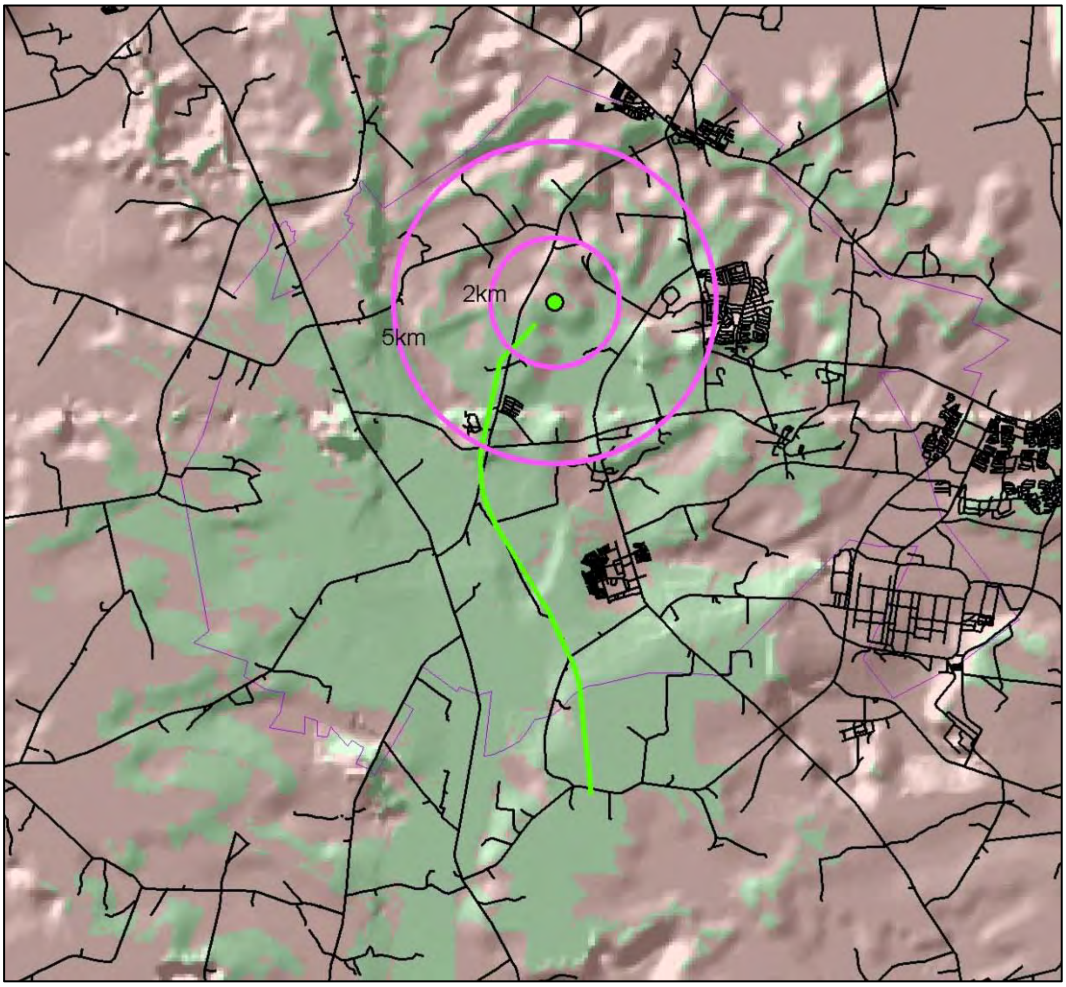


Figure 4.3.2(d): View Shed Analysis Map done with ArcView for Shondoni Conveyor Route

The green areas on the maps indicate vantage areas from which the relevant infrastructure will be visible from a vantage point on ground surface.

4.3.3 Photographic Survey

A detailed photographic survey was also done of the study site and adjacent areas, from numerous surrounding vantage points. The photographic compilations are produced in 2D by taking a series of panoramic photographs of a 3D environment. These are then superimposed onto one another to complete a view of the study area. This is done to give a clearer indication of the visual nature of the areas that will visually be affected by the activities, which will in turn aid in the design and installation of visual mitigation measures.

The points selected for the photographic survey were chosen along public roads surrounding the infrastructure for the Shondoni Shaft and Conveyor Route. The points are shown on the map in Figure 4.3.3(a).

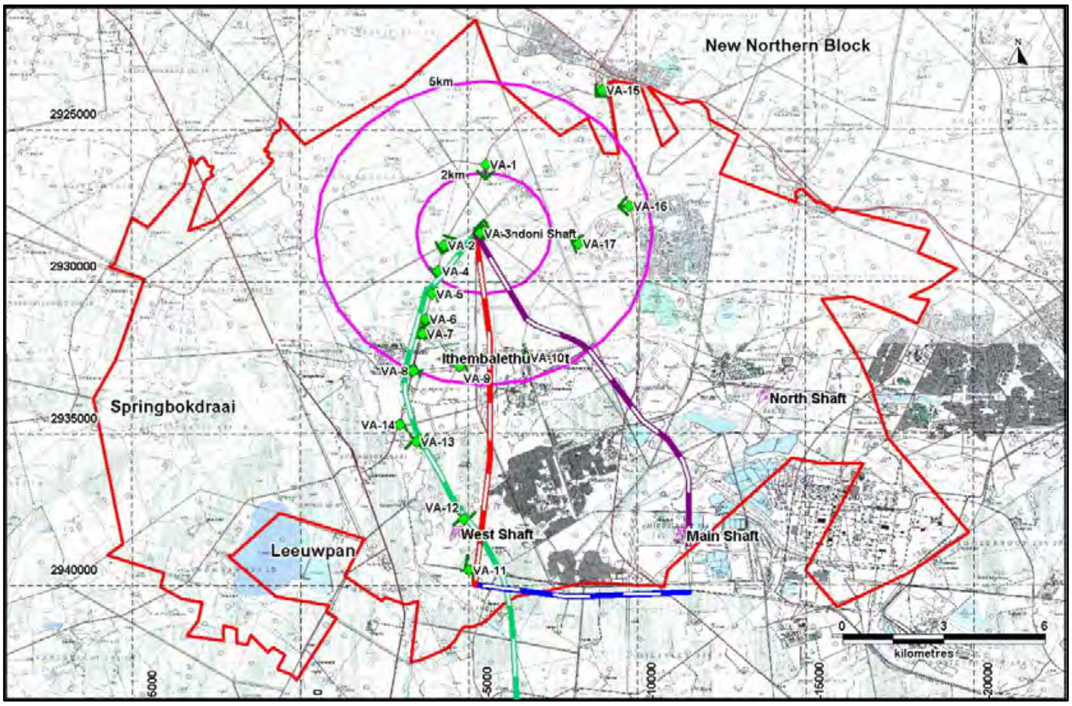


Figure 4.3.3 (a): Vantage Points from which Photographs were taken

The assessment distinguishes between long-range and short-range, as well as highly-, slightly-, and not-visible views. Showing, (**in magenta**), on the map a 2 km and 5 km radius around the Shondoni Shaft site, an understanding of scale is also established.

When discussing the assessment, the character of the area, a mining belt, will be noted. This is the specific character of the site and surrounding regions and should be the point of departure/terms of reference for the Shondoni Project visual assessment.

To avoid clustering of data and information, the photographic assessment will be discussed at the hand of 4 photographic compilations (Figure 4.3.3(b) – Figure 4.3.3(e)), each representing views from different vantage points.

The active vantage points are shown as **brown** dots (**green** dots are non-active vantage points). Note the view angles for each vantage point shown as highlighted arcs on the locality map portion of the compilation.

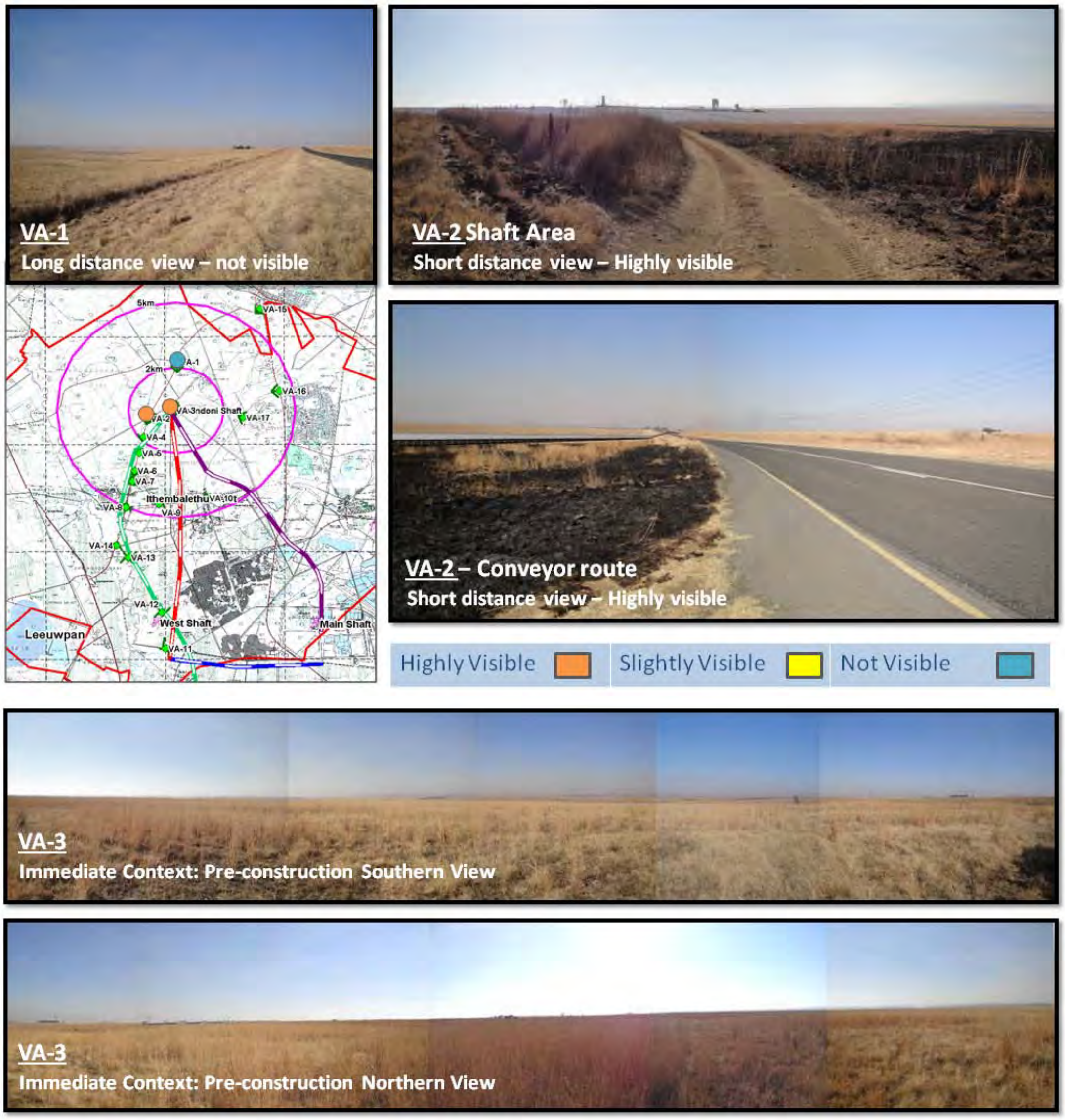


Figure 4.3.3 (b): Shondoni Visuals VA-1 through VA-3

Shondoni Visual VA-1 is a long range view in a southerly direction. The viewing locality is approximately 3kms from the Shondoni shaft area. The shaft is not visible from this locality.

Shondoni Visual VA-2 is a short range view from the entrance to the shaft area. The shaft and its associated infrastructure are highly visible.

Shondoni Visual VA-3 South and VA-3 North shows the character of the immediate context.

Figure 4.3.3 (c): Shondoni Visuals VA-4 through VA-8

Shondoni Visual VA-4 is a long range view of the conveyor route which is highly visible.

Shondoni Visuals VA-5, VA-7, VA-8 are short range views and the conveyor route is highly visible. The visual impact though is low despite the high visibility, because the conveyor does not provide the viewers with a negatively perceived landmark. VA-8 is an important viewing locality because the conveyor crosses the road here.

Shondoni Visual VA-6 is a short distance view of the conveyor route which is slightly visible. This is a perfect example of how local screening by shrubs and trees provide visual screening as objects close to the road

Shondoni Visual VA-8 Northern View is also a long range view of the Shaft which is not visible from this locality.

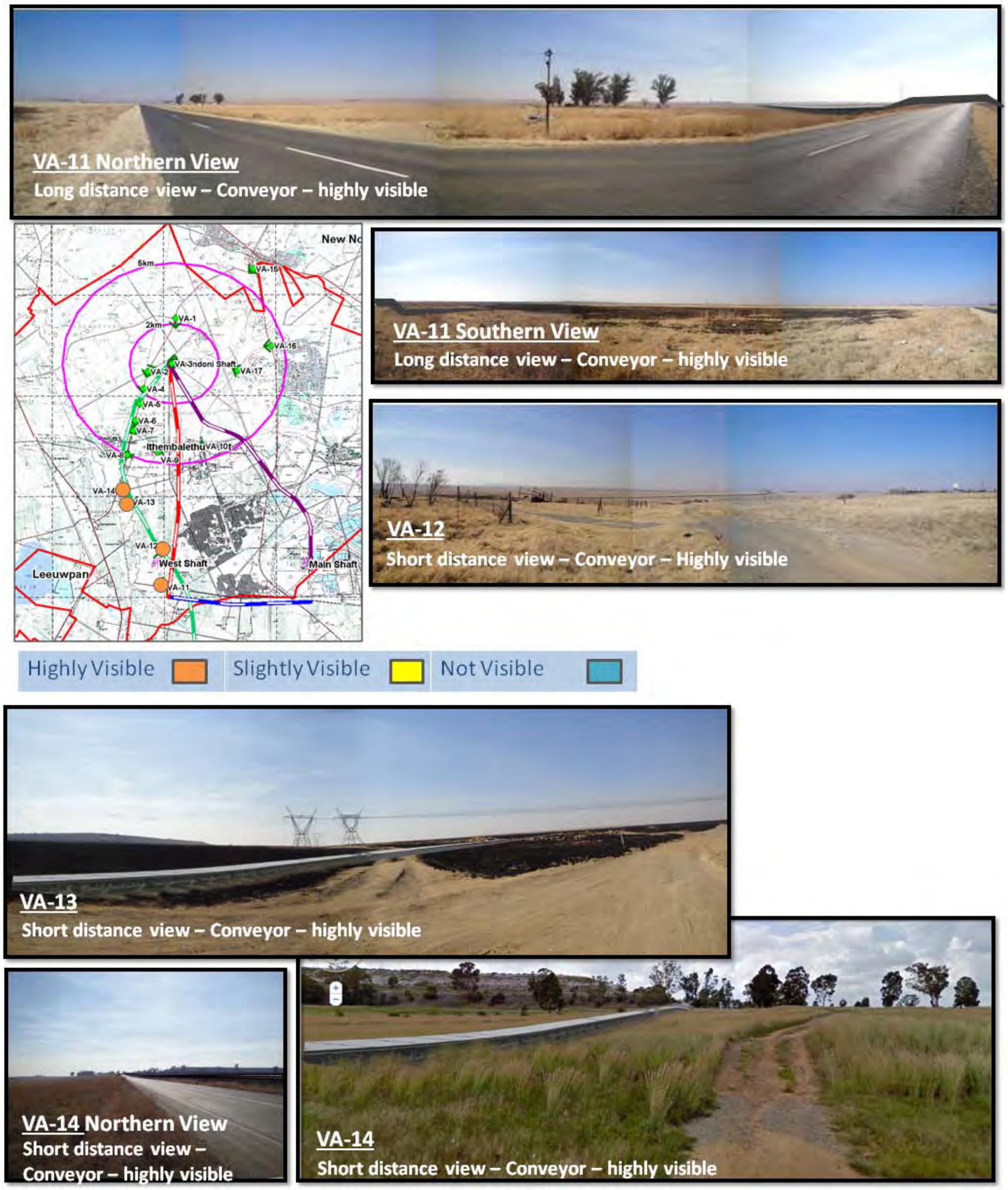


Figure 4.3.3(d): Shondoni Visuals VA-11 through VA-14

Shondoni Visual VA-11 is a long range view. The conveyor route is highly visible because of the topography and the fact that it crosses the road a short distance east of the viewing locality.

Shondoni Visual VA-12 is a short distance view of the conveyor route which, when constructed will be situated about 50 m east of the farm boundary on the left of the photo.

Shondoni Visual VA-13 is a short range view. The conveyor route is highly visible because of the topography. The viewing locality is however not on the main road, but a dirt road leading to the farm house at VA-12.

Shondoni Visual VA-14 is a short range view. The conveyor route is highly visible because of the topography and the fact that it crosses the road a short distance east of the viewing locality.

Figure 4.3.3(e): **Shondoni Visuals VA-9, VA-10, VA-15, VA-16, VA-17**

Shondoni Visual VA-9 is a long range view from the iThemba Lethu Shaft crossing and the Shondoni shaft is not visible.

Shondoni Visual VA-10 and VA-16 are long range views and the shaft is only slightly visible due to the distance as well as local screening.

Shondoni Visual VA-15 is a long range view from the crossing south of Kinross. The Shondoni shaft is not visible.

Shondoni Visual VA-17 is a long range view and the shaft is highly visible due to the topography.

4.3.4 Current Status Description

A current status description was performed to record the visual impact base line conditions for both long range views, as well as for medium to short range views. It is important to establish the current visual character of the area in order to determine whether the proposed new facilities blend into the visual environment and general visual character of the area. Locally it must also be established how the proposed construction of the Shondoni Shaft and Conveyor will alter the visual impact and if they will blend with existing environment.

4.3.5 Visual Impact Assessment

A visual impact assessment will be performed separately for the proposed Shondoni Shaft and associated Conveyor route, for their relevant life cycle phases. The visual impact will be considered separately, in terms of the following aspects:

- Visibility
- Visual Intrusion
- Visual Exposure
- Visual Absorption Capacity
- Alterations to Landscape and Visual Character: Morphology and Topography
- Alterations to Landscape and Visual Character: Vegetation and Land Cover
- Alterations to Landscape and Visual Character: Hydrology
- Alterations to Landscape and Visual Character: Visual Character
- Alterations to Landscape and Visual Character: Sense of Place

4.3.6 Scoping of Visual Management Measures

There is currently no formal compliance requirements embedded in South African Environmental Legislation that governs or prescribes the management of visual impacts for mining or industrial activities. Therefore the measures scoped and proposed in this report were selected to provide guidance on visual impact management from an aesthetic and practical, site housekeeping, management perspective. The measures scoped were selected to enhance existing and proposed environmental management measures related to legally required aspects such as air quality management, biodiversity management, water management and waste management.

5. PROJECT DESCRIPTION

The Middelbult (Block 8) Shondoni Project comprises the development of a new Shaft Complex in the Block 8 Reserves, the construction and commissioning of a Conveyer Belt system to transport the coal to Middelbult Main Shaft and then to Sasol Coal Supply (SCS, the central coal stockpiles) and the associated development of underground bord and pillar and high extraction mining on the No. C4L and No. C2 Coal Seams.

5.1 Proposed Project Infrastructure

The Shondoni Shaft Complex will be located within a fenced secondary security area. The Shaft Complex will be accessed along a newly constructed tar road with a T-junction from the provincial secondary road R547. The Shaft Complex itself will contain the following infrastructure:

- Offices
- Workshops
- Wash bays
- Stores
- Change houses
- Internal Roads and Parking Areas
- Electrical Substations
- Fuels Storage
- Soils/Overburden Stockpiles
- People and Material Shafts
- Ventilation Shafts
- Surface Bunker/ROM Emergency Stockpile
- Raw/Potable Water Supply and Storage
- Process Water Supply and Storage
- Storm Water Management System (bunds/berms/canals/outlets)
- Pollution Control Dams
- Sewage Treatment Plant
- Domestic Waste Disposal Facilities
- Industrial/Hazardous Waste Disposal Facilities
- Salvage Yard

A tarred access road of approximately 600 m will be constructed from the R 547 to the Shondoni Shaft Complex.

The underground operation will comprise of nine mechanised sections and two stone work sections, for which support facilities will be located on surface.

Internal roads and parking areas will be fully paved. Other open areas will be grassed with kikuyu lawns. The photograph depicted in Figure 5.1(a) and Figure 5.1(b)shows a typical infrastructure at a Shaft Complex.

The Shondoni shaft will be supplied with ESKOM power. A sub-station of sufficient capacity will be located on surface at the Shondoni Shaft. Fuel storage on surface at Shondoni will be restricted to one or two surface diesel tanks to be located on concrete a floor and within a bunded area.

Figure 5.1(a): Typical Shaft Complex Infrastructure

Figure 5.1(b): People and Material Shaft as well as Ventilation Shaft

Coal will be brought out of the mine to surface via the incline shaft on a conveyor belt. On surface at the Shaft Complex, the ROM coal will be stored in a surface bunker. This storage is an intermediate step in the coal conveyance as it merely represents a buffer and a transfer station in order to feed the overland coal conveyer which will transport the coal to the central coal stockpile area. The surface bunker is an enclosed concrete structure but also has an emergency coal throw out area adjacent to it.

The throw out area is an emergency stockpile area and is not allowed to exist as a matter of routine operation. A typical surface coal bunker and its associated surface throw out area is depicted in Figure 5.1(c).

Figure 5.1(c): Surface ROM Coal Bunker & Emergency Throw-out

The ROM coal from the Shondoni operations will be transported along a surface coal conveyer from the Shaft Complex to the central coal stockpile area. The new overland conveyor will be some 17 km in distance. The conveyor system will be covered and critical sections will be fitted with special low noise rollers to minimize noise. Access across and underneath the servitude will be provided to land owners. The access crossings are specifically designed according to the individual requirements of the relevant property owner.

The photograph depicted in Figure 5.1(d) depicts a typical overland coal conveyor with its associated infrastructure and servitude.

Figure 5.1(d): A Typical Overland Coal Conveyor

Sasol Mining performs water management on a mine by mine basis as far as practically possible. Each shaft therefore provides for its own water management infrastructure on surface, whilst underground mine water management is designed on a reserve and mine lease boundary scale.

Shondoni Shaft will use Rand Water for potable and general domestic purposes. The Rand Water take off pipe line supplying the mine, will most probably run within the surface coal conveyor servitude. An elevated header tank and a surface buffer storage facility, similar to the ones shown in Figure 5.1(e) will be constructed at Shondoni.

Figure 5.1(e): Potable Water Storage at Shaft Complex

Mine water accumulating into the underground workings is recycled and used for mining purposes underground. The water is extracted from underground via a borehole and pumped into service water dams located on surface at the shaft complex. This will be done to generate a sufficient pressure head before the water is reticulated back into the mine workings under gravitation.

The service water dams on surface are specifically constructed facilities as they contain affected (dirty) water and are authorized in terms of a NWA section 21(g) water use. A typical service water dam system is shown in Figure 5.1(f).

Figure 5.1(f): Service/Process Water Storage at Shaft Complex

Storm water management at the shaft complex will be done in accordance with the requirements as specified in regulation GN 704 of the NWA, which deals specifically with mine water management at mines. This will involve the separation of clean and dirty water at the shaft with a series of berms, cut-off canals and bunds around dirty areas. Clean water will be diverted around and off the site whilst dirty water will be captured and contained in a Storm Water Pollution Control Dam with an oil trap.

Similar to the service water dams, PCD's are also specifically constructed facilities as they contain affected (dirty) water and are also authorized in terms of a NWA section 21(g) water use. A typical PCD layout is shown in Figure 5.1(g).

Figure 5.1(g): Storm Water PCD at Shaft Complex

A modular Prentec type sewage plant will be provided at the Shondoni Shaft Complex. These plants are self-contained systems, the maturation water discharge from which are managed to acceptable standards for either discharge into the environment, or else for storage into the Storm Water PCD. A typical sewage plant layout is shown in Figure 5.1(h).

Figure 5.1(h): Typical Sewage Plant at Shaft Complex

No mining wastes such as discard or coal fines slurry will be generated at Shondoni. The coal will be cut from the coal seams underground and then conveyed as ROM coal along the conveyor belt to the central coal stockpile area. The overburden material excavated from the shaft during the shaft construction will be used in small amounts for berm walls and embankments at the shaft complex and will be covered with clay and topsoil before these structures are re-vegetated. The placement of these materials is dealt with in terms of a NWA section 21(g) water use authorisation.

All household (general or domestic) and small volumes industrial wastes are separated and disposed of in bins within dedicated concrete lined and bunded structures for removal off-site by outside licensed waste management contractors.

Figure 5.1(i): Domestic/Industrial Waste Disposal Facilities

5.2 Project Life Cycle Activities

5.2.1 Construction Phase Activities

Construction activities will be restricted to the Shaft Complex and its access route from the R 547, as well as along the coal conveyor servitude. The construction phase will run for approximately three years and is scheduled to commence in 2011 with completion in 2013. The mine needs to be in production by 2014.

Construction will commence with site clearance and will primarily comprise civil and building construction works of the access road, the shaft complex buildings, water pollution control measures, service water dams, as well as the vertical people and materials shaft, the incline coal conveyance shaft and the vertical ventilation shaft.

Activities will be restricted to within the different servitude areas for the access road, the shaft complex, and the conveyor route.

As indicated earlier blasting will occur during the vertical and incline shaft construction. The excavated materials from the shaft will be used to construct berms and embankments around and within the shaft complex.

All construction sites will be fenced to regulate access during the construction period.

Of particular importance during the construction phase, are the potential for stream crossings by the coal conveyor system and possibility of one stream diversion that may be required. Depending on the selected conveyor route, a number of stream crossings may be required. At the incline shaft for the proposed shaft locality, a stream diversion may be required depending on the final design. Stream crossings and river diversions are authorized as NWA section 21 (c) and (i) water uses or General Authorisations.

5.2.2 Operational Phase Activities

The mine will go into production in 2014 and will have an expected life of approximately 27 years. The mine will operate on a 24 hour per day basis.

During the operational phase most activities will occur underground. The two coal seams will be mined with continuous miners and therefore no routine mining related blasting will occur. However, when dolerite structures need to be penetrated to access the coal seams, limited underground blasting will occur from time to time.

The coal is cut at the mining faces, loaded automatically onto the shuttle cars from which it is loaded onto the conveyor system which takes the coal along the incline shaft to surface.

On surface the coal goes directly into the surface bunker from where it is transferred onto the overland conveyor which transports the ROM coal to Middelbult Main shaft and Sasol Coal Supply. The surface coal bunker also has an emergency surface throw our area in the event that the conveyor system cannot handle the volume of coal as a result of maintenance.

Surface activities at the shaft relate to general administration and management. Underground personnel access the mine through the vertical people and material shaft after preparing for shifts in the change houses, where they also wash and refresh at the end of shifts.

The shaft complex also handles all materials that need to go underground and has stores and workshops to cater for repairs that cannot be done underground.

The ventilation shaft is also operated at the shaft complex and comprises the operation of extraction fans to drive the up cast ventilation system.

Apart from the operational activities, general water management and waste management is also done on surface at the shaft complex. Potable water, service water and storm water management infrastructure are located at the shaft and operated on an ongoing basis. Waste generated on surface is disposed in bins located in dedicated areas and removed by waste management contractors.

Water make in the underground mining sections is largely managed underground. Only that portion which is required for service water purposes is pumped to surface and stored in specially constructed service water dams, and then gravitated back underground for use for mining and dust suppression.

5.2.3 Decommissioning and Closure Phase

During decommissioning and closure equipment will be removed and sold for re-use or disposed of as scrap. The buildings will be renovated for alternative use or be demolished. Access roads, if not used, will be scarified and re-vegetated. All plant will be sold to appropriate dealers and removed from the mine property. Electrical and water supplies in the plant area, if not used, will be terminated and made safe.

The shaft entrance will be sealed according to the requirements of the MPRDA. Overburden removed from the shaft originally will be returned to the hole and compacted. Usable soil will then be replaced and contoured to be free draining. Topsoil will be replaced over this material. Final soil remediation and re-vegetation of the site will be undertaken.

Figure 5.2.3(a): Typical Closed and Rehabilitated Vertical Shaft

During decommissioning any cracks that resulted from surface subsidence in the mining area will be filled and subsided areas made free draining.

Water levels in the workings will start to recover once mining ceases. However, the relatively low percentage of pillar extraction planned (25% of the mining area) and the isolation of these areas from the rest of the mining is likely to result in favourable conditions for decant (i.e. decant of a good water quality) over most of the area. Of the predicted decant, some 60% is predicted to be from the areas of pillar extraction, with the balance from the areas of bord-and-pillar mining.

The high extraction compartments are expected to fill nearly three times faster than the bord-and-pillar compartments, and these areas may require water to be actively extracted and managed within 30 years of mine closure. Should the compartments remain separate as intended, this will delay the onset of decant from the areas mined by bord-and-pillar methods.

Various options remain to manage the pillar extraction compartments, including placing this water into the base of bord-and-pillar compartments (if this can be done without affecting stratification of these compartments) and/or management as part of the Synfuels Complex water balance. Options of moving water between compartments will be evaluated and submitted to the authorities if and when applicable. A commitment will be given to actively manage water from the high extraction compartments if required, as well as to monitor, reuse and treat (if necessary, but considered unlikely) the water in the bord-and-pillar areas.

5.2.4 Post Closure Phase

It is envisaged that during the Post Closure Phase the surface infrastructure which has not been demolished will be used for alternative purposes. In the remainder of the mining area it is expected that the current pre-mining land uses will be able to continue.

The only significant post closure residual impact that could occur, relates to possible decant of contaminated water from the underground mine if proper management is not followed. Various options to manage this residual impact exist. The selected methodology and technology will be formalized during application for Closure.

6. CONTEXTUAL ANALYSES

It is important to provide a contextual description of the study area as it provides the main emphasis for the required visual character of the site and its activities.

6.1 Macro Context

The site of this project is located in the Mpumalanga Province of South Africa.

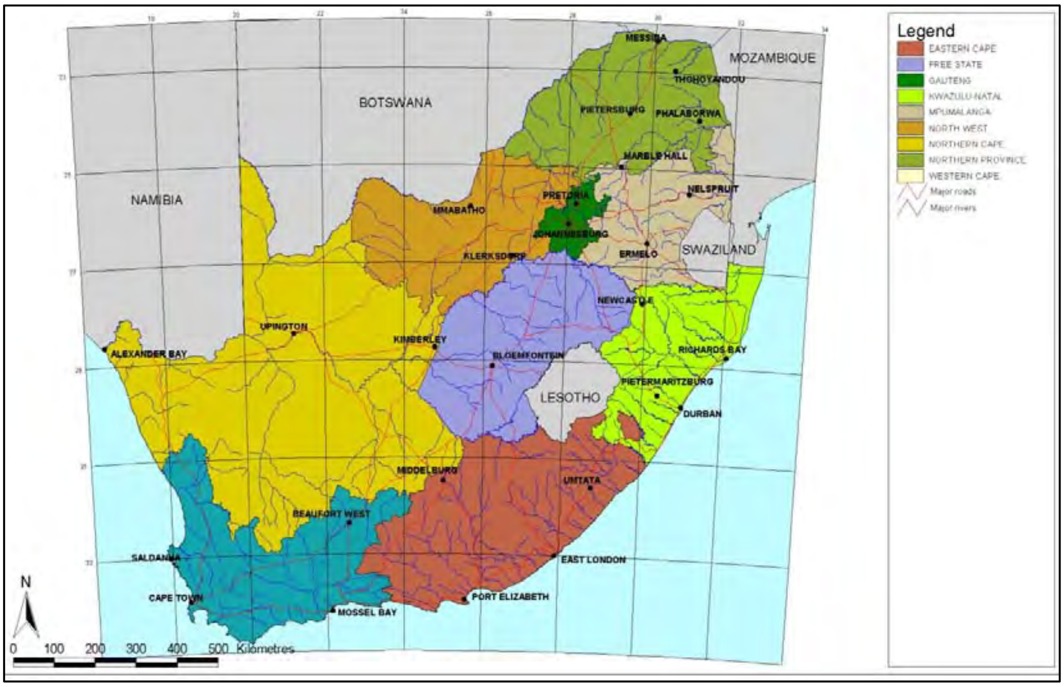


Figure 6.1(a): Setting of the Site in South Africa (macro context)

The Mpumalanga Province is bounded in the north by the Limpopo Province of SA, in the west by the Gauteng Province of SA, in the east by the Swaziland and Mozambique and in the south by the Free State and Kwa-Zulu Natal Provinces of SA.

6.2 Micro Context

A discussion on the micro context provides the motivation to keep the area visually acceptable.

Enpat (2002)

6.2.1 Mpumalanga Province Profile

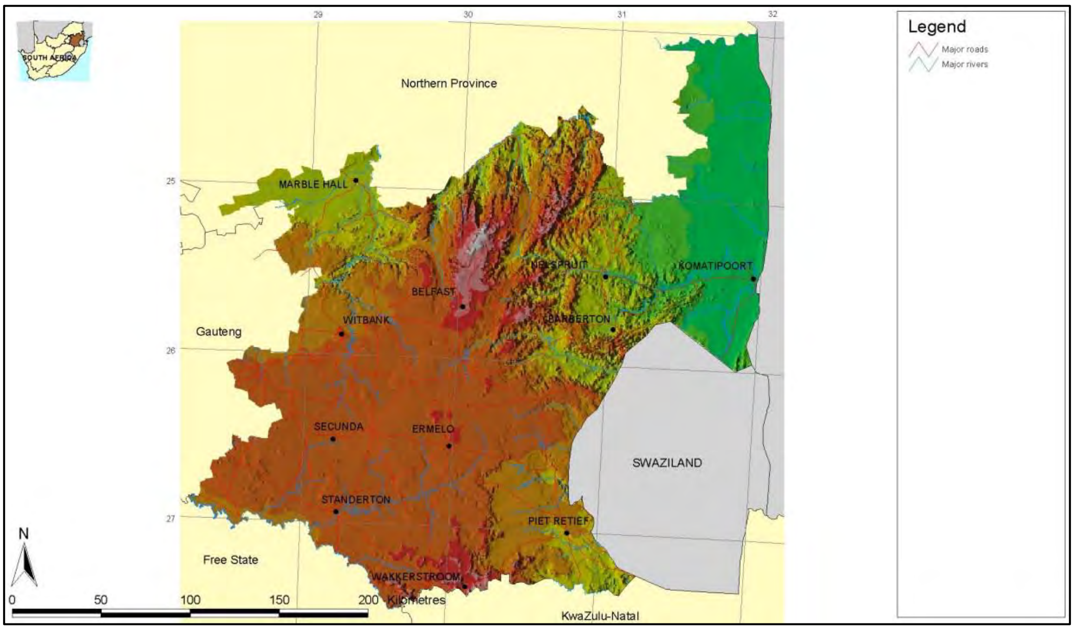


Figure 6.2.1 (a): Regional Setting of the Site

Mpumalanga means "Place Where the Sun Rises". Due to the province's spectacular scenic beauty and abundance of wildlife, it is one of South Africa's major tourist destinations.

With a surface area of only 79 490 km^2, the second-smallest province after Gauteng, it has the fourth-largest economy in South Africa.

Bordered by Mozambique and Swaziland in the east, and Gauteng in the west, it is situated mainly on the high plateau grasslands of the Middleveld, which roll eastwards for hundreds of kilometres. In the north-east, it rises towards mountain peaks and terminates in an immense escarpment. In some places, this escarpment plunges hundreds of metres down to the low-lying area known as the Lowveld.

Enpat (2002)

The area has a network of excellent roads and railway connections, making it highly accessible. Because of its popularity as a tourist destination, Mpumalanga is also served by a number of small airports, such as the Kruger Mpumalanga International Airport.

The best-performing sectors in the province include mining, manufacturing and services. Tourism and agro-processing are potential growth sectors in the province.

Mining is an important sector in Mpumalanga providing jobs and contributing to over one fifth of Mpumalanga's GGP (Gross Geographic Product). Extensive coal resources are situated in the western and south-western part of the Province and sustain several large coal-fired power stations situated on the Highveld between Witbank, Standerton, Piet Retief and Carolina, as well as and the petrochemical plants in the area. The Witbank coalfield lies between Bethal and Springs in Gauteng Province, while the southern Highveld coalfield lies between Secunda and Standerton and the eastern Highveld coalfield lies between Ermelo and Volksrust.

Mpumalanga falls mainly within the grassland biome. The escarpment and the Lowveld form a transitional zone between this grassland area and the savannah biome.

Long stretches of undulating grasslands change abruptly into thickly forested ravines and thundering waterfalls of the escarpment, only to change again into the subtropical wildlife splendour of the Lowveld.

6.2.2 Basic Information

LAND AREA:	79 490 km²
POPULATION:	3.508 million
CAPITAL CITY:	Nelspruit
LANGUAGES:	SiSwati, IsiZulu, English
CLIMATE:	Extremely varied climate across province.
AIRPORTS:	Nelspruit
ROADS:	Good to fair, suitable for all vehicles
RAIL AND BUS SERVICES:	Available throughout the Mpumalanga Province.
DISTRICTS:	The province consists of 3 districts: Ehlanzeni, Gert Sibande, Nkangala Districts (www.mpumalanga.gov.za)

Figure 6.2.2 (a): District Location of Site (Gert Sibande)

6.2.3 Describing the Mpumalanga Province

Boundaries

The Mpumalanga Province is bounded in the north by the Limpopo Province of SA, in the west by the Gauteng Province of SA, in the east by the Swaziland and Mozambique and in the south by the Freestate and Kwa-Zulu Natal Provinces of SA.

Major Natural Features

Mpumalanga falls mainly within the grassland biome. The escarpment and the Lowveld form a transitional zone between this grassland area and the savanna biome. Long sweeps of undulating grasslands change abruptly into thickly forested ravines and thundering waterfalls of the escarpment, only to change again into the subtropical wildlife splendour of the Lowveld.

Climate

The Lowveld is subtropical, due to its proximity to the warm Indian Ocean and latitude. The Highveld is comparatively much cooler, due to its altitude of 2300m to 1700m above sea level. The Drakensberg Escarpment receives the most precipitation, with all other areas being moderately well-watered by mostly summer thunderstorms. The Highveld often experiences severe frost, whilst the Lowveld is mostly frost-free. Winter rainfall is rare, except for some drizzle on the escarpment. The differences in climate are demonstrated below by the capital, Nelspruit, which is in the Lowveld, located just an hour from Belfast on the Highveld.

Belfast averages: January maximum: 23°C (min: 12°C), June maximum: 15°C (min: 1°C), annual precipitation: 878 mm

Population

- Total Population 3,643,435
- Rank: 6th in South Africa
- Density: 45.8/km2 (118.7/sq mi)
- Density rank: 3rd in South Africa [Community Survey 2007: Basic results". Statistics South Africa. p. 2.]

Literacy Rate

The Mpumalanga Department of Social Services, Population and Development reported that 29% of the population in the province aged 20 years and older received no schooling or formal education at all, constituting almost a third of the population in this age group (DSSPD, 2001). In addition, it is estimated that only 5% of the population in the province has post-school qualifications. Furthermore, it was reported that only 47% of Grade 12 learners in the province obtained their matriculation in 1996 and that Mpumalanga has a high percentage of ever-age learners (HSRC, 1998).

Major Cities and Towns

Nelspruit, Witbank, Standerton, Barberton, Ermelo, Secunda, Middelburg

Sites of Importance

Nelspruit is the capital, and the administrative and business hub of the Lowveld.

Witbank is the centre of the local coal-mining industry; Standerton, in the south, is known for its large dairy industry; and Piet Retief in the southeast is a production area for tropical fruit and sugar.

A large sugar industry is also found at Malelane in the east; Ermelo is the district in South Africa that produces the most wool; Barberton is one of the oldest gold-mining towns in South Africa; and Sabie is situated in the forestry heartland of the country.

The Maputo Development Corridor, which links the province with Gauteng and the Port of Maputo in Mozambique, heralds a new era of economic development and growth for the region. As the first international toll road in Africa, the corridor is set to attract investment and release the local economic potential of the landlocked parts of the country.

Economy

- Agriculture

  More than 68% of Mpumalanga is utilised by agriculture. Crops include maize, wheat, sorghum, barley, sunflower seed, soybeans, groundnuts, sugar cane, vegetables, coffee, tea, cotton, tobacco, citrus, subtropical and deciduous fruit.

  Natural grazing covers approximately 14% of Mpumalanga. The main products are beef, mutton, wool, poultry and dairy.

- Mining

  Extensive mining is done and the minerals found include: Gold, Platinum group metals, Silica, Chromite, Vanadiferous Magnetite, Argentiferous Zinc, Antimony, Cobalt, Copper, Iron, Manganese, Tin, Coal, Andalusite, Chrysotile Asbestos, Kieselguhr, Limestone, Magnesite, Talc and Shale.

  Mpumalanga accounts for 83% of South Africa's coal production. 90% of South Africa's coal consumption is used for electricity generation and the synthetic fuel industry. Coal power stations are in proximity to the coal deposits. A coal liquefaction plant in Secunda (Secunda CTL) is the one of the country's two petroleum-from-coal extraction plants, which is operated by the synthetic fuel company Sasol.

- Tourism

  Mpumalanga is also a popular tourism destination. Kruger National Park, established in 1898 for the protection of Lowveld wildlife, covering 20,000 square kilometres (7,800 square miles), is a popular destination. The other major tourist attractions include the Sudwala Caves and the Blyde River Canyon.

  Many activities including The big jump, mountain and quad biking, horse trails, river rafting and big game viewing are endemic to the region. This is Big 5 territory.

  In 2008 a Haute Cuisine route was formed, trickling from Mbombela down to Hazyview, the Lowveld Gourmet Route covers the four top fine dining restaurants the area has to offer. The restaurants include Summerfields Kitchen, Oliver's Restaurant, Orange and Salt.

Biological Diversity

Mpumalanga province boasts a high level of biological diversity, with three recognised centres of endemism in the province (Barberton, Sekhukhuneland and Wolkberg) and one proposed centre of endemism (Lydenburg). The level of protection of these centres is, however, very low and conservation efforts should be focused on these areas. Despite this though, many areas of the province are still in pristine condition.

6.2.4 The Gert Sibande District

Gert Sibande District Municipality lies in the Highveld grass-lands of Mpumalanga. It is bounded by Gauteng Province to the west, Swaziland and Ehlanzeni District Municipality to the east, Free State and KwaZulu-Natal in the south and Nkangala District Municipality in the north. The district is the largest municipality in the province, covering 40% of the area and has seven local municipalities under its jurisdiction. The head office is located in Secunda, which is 100 km away from Johannesburg (South Africa's economic hub). The district is home to 985 632 people who constitute 25% of the Mpumalanga Province's total population, with an average population density of 30.12 per km^2.

Gert Sibande District Municipality has a strong economy within the region which is predominantly mining. The coal belt starts from Govan Mbeki, running through Msukaligwa and Pixley Ka Seme. The district's forestry sector stretches from Mkhondo, Pixley Ka Seme and to Albert Luthuli. Farming includes cattle, sheep breeding and maize production. The district host one of the largest petro-chemical industries in the country (Sasol) and a number of Eskom coal powered stations. The district also boasts attractive leisure and conservation areas.

To date the district still has a huge backlog in terms of addressing the basic needs of its community. Much financial resources have been invested towards accelerating the provisions of free basic services and more people are enjoying the benefits of democracy and access to basic services. (http://www.mputopbusiness.co.za /site/gert-sibande-district-municipality/).

Figure 6.2.4 (a): The Gert Sibande District

7. CURRENT VISUAL AND LANDSCAPE CHARACTER

7.1 Regional Visual Character – Long Range Views

Regionally the visual character is three-fold:

<u>The first:</u> is that of the coalfields of Mpumalanga. The area around Secunda is largely occupied by mining facilities. Here the perceived degree of human intrusion is moderate to high, and the vegetation not uniquely grassland anymore. Therefore if the shaft infrastructure is viewed from close up, against the surrounding environment as backdrop, the visual impact will be relatively low, as the nature of these elements will not contrast greatly with their surrounding visual context.

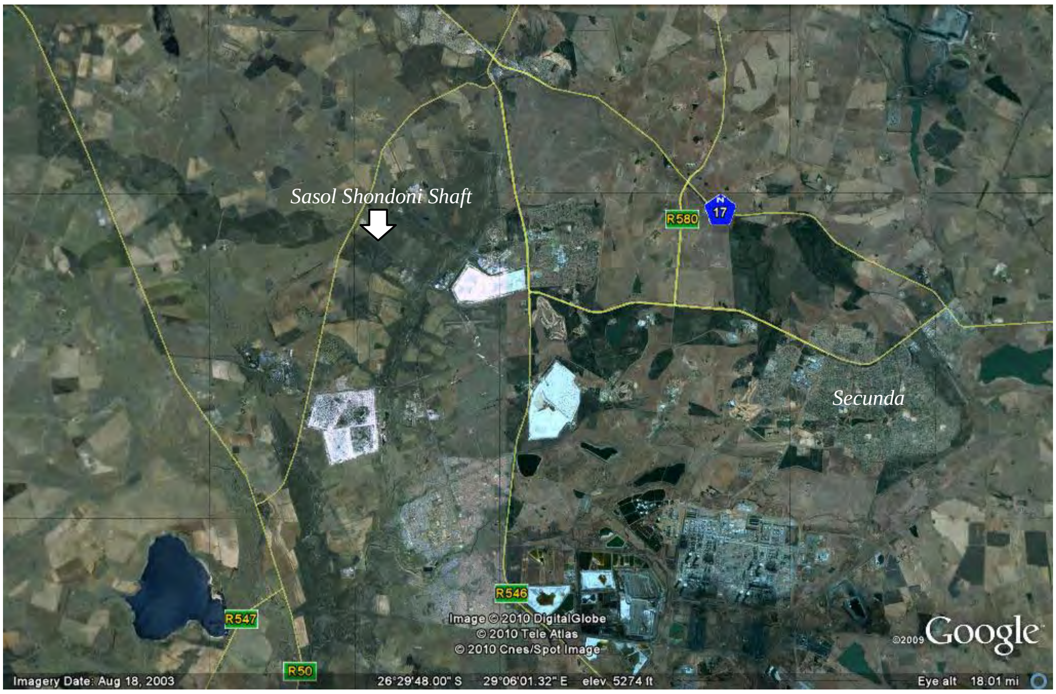


Figure 7.1 (a): Aerial Photograph indicating Site within the Secunda Area

If the proposed Shondoni site is analysed in this context, it cannot be described as the highest or biggest structure in the Secunda area and thus does not present a problem considering visual intrusion from long range views.

Figure 7.1 (b): Shondoni Shaft viewed from the West

The second: is that of the grassland in which the shaft is located. The perceived degree of human intrusion in this area is low with natural grasslands surrounding the proposed shaft area. The veld adjacent to this area is acceptable for natural camouflage of lower structures.
The visual impact of the Shondoni shaft and conveyor route in this area is moderate, as only a few high structures can also be found here.

The third: visual character area is that of human settlement. Because the proposed shaft will be situated within an open veld area, it will be seen by some of the western suburban residential parts of Evander. Even though the shaft is visible, it blends in with the other mining activities in the area.

The area is characterised by extensive human intrusion and alteration, and is visually very complex.

To the south of the proposed Shondoni shaft, lies a small residential area called Brendan Village, the shaft is not visible from the edge of the village. The conveyor route however will run past the village on the opposite side of the R547. For the most part the existing trees will successfully screen the conveyor route. Because it is a low lying structure, the impact will also be softened by the grasses growing naturally in the area.

Figure 7.1 (c): Trees Screening the Proposed Conveyor Belt next to Brendan Village

To the south, the conveyor route runs across an open veld area on the Grootspruit farm. Here the conveyor route will be highly visible. The population density in this area is very low, with only a few farmers and local workers using the dirt road running alongside the conveyor route.

The Sasol Shondoni Shaft and associated conveyer route visual impact on the town of Secunda and regional areas is that of a minimum, as it is not a unique feature in the area's landscape as many other similar activities can be identified. The visual impact of the shaft on the passersby in near vicinity of the site is negative, but little or no measures can be taken to improve this.

In terms of visual character, the proposed facility does not intrude radically with the surrounding regional visual character.

7.2 Local Visual Character – Short/Medium Range Views

When buildings, vegetation or landforms obscure a view, the range of the view is shortened, resulting in a short-range view. In this report, short-range views are those views that are closer than 300 meters to a feature.

In instances where physical objects do not dominate short-range views or obscure objects that are further off in the distance, the eye is automatically drawn to any prominent vertical feature, even if these are some distance away. In this proposed context, this phenomenon is illustrated by the proposed Shondoni Shaft and conveyor route in the landscape. Where views are not obstructed by nearby objects, the proposed shaft and conveyor route will draw the observer's attention

In this instance, from the western side of the site, views across to the site and its surroundings are generally not restricted and long-range views become dominant. Although vegetation growing close to or along the road, blocks long-range views in many instances, the shaft and conveyor route are still visible from several sections along the roads and from other significant vantage points. Furthermore the vegetation found along the road is constantly changing, and as such the visibility of the site and surroundings subtly changes as time passes.

From the eastern, southern and northern sides the dominance of short range views are definite because of the landscape and structures closer to the road which can be observed, restricting views to the shaft area.

The proposed conveyor route has five public road crossings as well as a number of private road crossings. The visual impact of the conveyor belt at these road crossings can be minimised by routing the conveyor belt underneath the road instead of over it. This is illustrated in Figure 7.2(a) below.

Figure 7.2(a): Examples of Conveyor Belts crossing over the Road versus under the Road

For the conveyor route the southern, northern and western sides are dominated by long range views, where as the eastern side is dominated by short range views. Regarding the long range view; although the conveyor belt can be seen, the visual impact is generally low.

Another factor that may influence short-range views is the backdrop against which an element is viewed. When viewed from close up, landscape elements are usually seen against the sky and are therefore more visible. When the same elements are viewed against a backdrop of similar colour, they tend to be "hidden" more.

7.3 Landscape Character

In this document, Landscape Character is a discussion of the nature and occurrence of the physical environment:

7.3.1 Morphology and Topography

The Shondoni Shaft area and associated conveyor route will be located in an open veld area that lies among other mining sites, near Secunda. The site is therefore, from a morphological and topographical point of view, partially modified from its pristine condition.

The topography of the shaft site itself is relatively flat and generally slopes at a small gradient towards the south and south-west. The site is surrounded by open grasslands. A chicken farm is situated approximately 500 m to the west of the proposed Shondoni site. Towards the south a buffer zone of some 3.2 km exists between the proposed Shondoni Shaft and Brendan Village residential area, whilst open grassland area occurs towards the north. A Kinross mines shaft is situated 1.7 km to the north-east to the site, while another shaft is situated 3.2 km to the east of the site.

The site and its surrounds therefore occur in an area where the local topography and morphology have been altered due to mining and residential activities. The area therefore by no means represents a green fields morphological and/or topographical environment.

7.3.2 Hydrology

The Shondoni Block 8, Block 8 Northern Reserves, Springbokdraai and Leeuwpan reserves are located on the southern side of the watershed (1580 - 1600 mamsl) between the Waterval River, which drains to the Vaal River and a number of tributaries (Blesbokspruit, Rietspruit and Vaalbankspruit) draining to the Olifants River. The proposed Shondoni Shaft and associated conveyor belt lies within the quaternary catchment C12D.

The Waterval River drains to the south across the western side of the reserves at an elevation of 1580 mamsl in the north, to 1560 mamsl in the south. The surface of the reserve area is gently undulating between the tributaries of the Waterval River that drain in a south-westerly direction from the watershed on which the N17 national road runs from Trichardt to Leandra.

To the south-west of the site, a non-perennial stream runs from north-west to south-east. The conveyor belt will cross this stream at approximately 600 m from the shaft area. Several stream crossings by the coal conveyor system and possibility of one stream diversion that may be required. Depending on the selected conveyor route, a number of stream crossings may be required.

At the incline shaft for the proposed shaft locality, a stream diversion may be required depending on the final design. Stream crossings and river diversions are authorized as NWA section 21 (c) and (i) water uses or General Authorisations. Despite these issues, it can be stated that the hydrological attributes of the site in general, make no significant contribution to the visual appeal of the region.

7.3.3 Surface Vegetative Cover

The study area is located within the grassland biome of South Africa. The grassland biome is one of the most threatened biomes in South Africa, due to agricultural and mining activities. According to Low and Rebelo (1996), the mining area falls within the Moist Clay Highveld Grassland (10 265 km² total area; ± 79% transformed; 0% conserved).

Visually this vegetation community is quite permeable, allowing for long-range views, especially where the viewer is in an elevated position and looks onto lower-lying areas. Small clumps of larger trees may however obscure long-range views locally.

7.3.4 Current On-Site and Adjacent Land Use

Land use within the Block 8 study area is predominantly agriculture, consisting of maize cropping and grazing. Underground gold mining activities also occur in the area and surface infrastructure consists of shaft complexes and gold slimes dams. Human settlements in the south and east of the study area are largely urbanised with scattered farmsteads and farm worker houses in the north-western area. Mixed commercial and residential land use activities are concentrated in the towns of Evander located in the east while the residential area of Brendan village occurs in the west.

The Shondoni Shaft Complex will be located within a fenced secondary security area. The Shaft Complex will be accessed along a newly constructed tar road with a T-junction from the provincial secondary road R547. The Shaft Complex itself will contain the following infrastructure:

- Offices
- Workshops
- Wash bays
- Stores
- Change houses
- Internal Roads and Parking Areas
- Electrical Substations
- Fuels Storage
- Soils/Overburden Stockpiles
- People and Material Shafts
- Ventilation Shafts
- Surface Bunker/ROM Emergency Stockpile
- Raw/Potable Water Supply and Storage
- Process Water Supply and Storage
- Storm Water Management System (bunds/berms/canals/outlets)
- Pollution Control Dams
- Sewage Treatment Plant

- Domestic Waste Disposal Facilities
- Industrial/Hazardous Waste Disposal Facilities
- Salvage Yard

The towns and residential areas of Secunda, eMbalenhle and Kinross are located adjacent to the south-eastern, southern and northern boundaries of the study area, respectively. The adjacent land use consists of agricultural activities in the north and west, mixed commercial and residential activities to the south and east, coal and gold mining activities occur in the region with concentrations to the south, and industrial activities (Sasol Synfuels) in the southeast.

Structure plans for the Govan Mbeki Municipality indicate future expansion of Secunda, Kinross, Evander and eMbalenhle towards each other along axes between the towns. This plan will soon be revised in terms of new legislation.

The current land use attributes undoubtedly represents the dominant component of the landscape character.

7.4 Existing Visual Character

The site lies in an active residential and mining area. Long range views of the site occur from lower vantage points located east and west of the site. From the north and south the undulating topographical definition restricts long range views to a few vantage points only, and then even if visible, the infrastructure is visually absorbed by the background and surrounding landscape.

The existing visual character of the site and greater region is therefore not undisturbed and is in fact characterised by manmade elements. The proposed facilities will not be uniquely visible and therefore will not visually dominate the area, and will only contrast visually with the area's character context to a small extent.

7.4.1 Landscape Visual Quality Assessment

In this document, Landscape Quality is a measurement of the union of ecological integrity and aesthetic appeal. Ecological integrity refers to the condition or overall health of the landscape measured in terms of the quality of the physical environment – morphology, topography, vegetation and hydrology.

Note that air quality and dust pollution is not investigated in this study. It should however be noted that dust from truck traffic and smoke pollution can be the most visible features of mining and industrial activities, when viewed from some distance away. Emissions from mines and other industrial activities are visible from great distances away, more so than the structures or activities themselves that causes it.

Aesthetic appeal refers not only to the visual quality of elements of an environment but also to the way in which combinations of elements in an environment appeal to our senses. Studies of perceptual psychology have shown human preferences for landscapes with a higher visual complexity, rather than homogeneous ones.

On the basis of contemporary research by Crawford (Crawford, 1994), landscape quality increases when:

- Topographic ruggedness and relative relief increase.
- Where water forms are present.
- Where natural landscapes increase and human-made landscapes decrease.
- Where land use compatibility increases and land use edge diversity decreases.

Using these criteria to analyse the landscape quality of the existing site and its immediate surroundings, the following conclusions were subjectively (but in a professional opinion) made. Where the natural/expected condition of the site and immediate surroundings is unaltered, a rating of 1 is given, and where the expected existing condition is not present or has been changed, a rating of 0 is given.

Table 7.4.1 (a) - Local Landscape Quality

Ecological integrity	
Morphology	0
Topography	0
Vegetation	0
Hydrology	0
Aesthetic appeal	
Topographical ruggedness	0
Presence of water	1
Natural versus human landscape	0
Land use compatibility	1

As can be seen from the Table above, the ecological integrity of the site and immediate surroundings has been largely altered. With the exception of the localised alteration of the horizon from some vantage points, no significant topographical alterations will occur at Sasol Shondoni – no excavations.

The vegetation on the Sasol Shondoni shaft area will be altered with the establishment of the site. The alteration of vegetation will be restricted to the site, its associated infrastructure (including its access road) and the conveyor belt and its immediate surroundings.

The aesthetic appeal of the local setting is moderate, the greatest negative impact being the extensive presence of manmade elements (specifically extensive mining and residential activities).

The land use compatibility of the proposed activity is high. The shaft area and conveyor belt will have only a low to moderate effect on the visual character of the local vicinity of the site. The proposed Shondoni shaft facilities will not greatly contrast with the regional character, as there are many similar structures present locally and regionally. Thus the degree of visual intrusion of these structures in their regional setting is low.

From the above it can be argued that the landscape quality is relatively low, but acceptable, considering that mining in this area is a major economic booster for the region and the country and the area character is already damaged and typically mining. Substantial human intervention has already occurred locally and the visual intrusion of a new intervention will be relatively low.

7.4.2 Visual Character (Sense of Place) Assessment

According to Lynch (Lynch, 1992) sense of place is "the extent to which a person can recognise or recall a place as being distinct from other places, as having a vivid or unique, or at least particular character of its own". Thus sense of place means that a site has a uniqueness or distinctiveness, which distinguishes it from other places. The primary informant of these qualities is the spatial form and character of the natural landscape together with the cultural transformation associated with historic use and habitation. In this analysis the cultural transformation can be seen as the site and regional character, which has been described above. A landscape can be said to have a strong sense of place, regardless of whether it is considered to be scenically beautiful or not. Where high landscape quality and strong sense of place coincides, the visual resource is considered to be high.

Using these criteria to analyse the sense of place of the Sasol Shondoni site, the following subjective conclusions are made:

- The region discussed in the mining district of Secunda has a very specific character, which is a mining, agricultural and residential/rural combination. The area itself has a relatively moderate - low visual quality, but fits into the character of place. This area is not visually unique, as it is a monotonous, typical mining/industrial area, but the natural landscape, the grasslands of Mpumalanga does give the region a unique feeling when viewed from other vantage points.
- The proposed Shondoni shaft development is similar in character to those of the current mining facilities and it can therefore not be considered to have a unique genus loci or sense of place.
- The presence of the proposed Shondoni facilities will not detract from the aesthetic appeal of the area, as the entire area consist of similar activities, which will to some extent lessen the visual impact of the proposed facilities. The nature of the visual impact will however be undesirable and visual mitigation should be considered.

8. VISUAL IMPACT ASSESSMENT

The visual impact assessment will be performed for the proposed Shondoni Shaft area and associated Conveyor Belt.

8.1 Life Cycle – Description Of Activities

A description of the Shondoni Project attributes, infrastructure and life cycle activities, was given in Chapter 5 of this report.. It follows logically that for these proposed activities and infrastructure, the life cycle phases would include all life cycle phases which are: the Construction Phase, Operational Phase, the De-commissioning and Closure Phase and the Post Closure Phase.

8.2 Assessment Of Impacts

8.2.1 Visibility

A photographic assessment was carried out to define areas that contain key possible observation sites from which the proposed Shondoni facilities will be visible. This analysis is used to visualise the visibility of the proposed facilities over both short and long-range views and subsequently understand the potential impacts on the environment because of them. Points from which photos were taken were chosen to explain the visibility of the site from all angles. Photos were taken from several positions at close, medium and long-range from the site and surrounding areas.

- The Shondoni facilities will be most visible in short range around the site, along the R547 to the west of the shaft and in long range from the east and higher south-east.
- The shaft facilities will not be visible from the roads on the south-western, southern and south-eastern directions. The conveyor route or part thereof however, will be highly visible in short and long range views in all directions.
- The visibility of the conveyor belt will increase at road-crossings, where the conveyor goes over the road. In the instance of road-crossings where the road goes over the conveyor, the visibility impact is much less.
- From the roads along the east of the site, the shaft is only slightly visible due to the presence of vegetation. At instances where the shaft can be seen, it is so far away that the visual perception is not a negative one and the visual impact can be classified as minimal.
- From the north the shaft facilities will only visible when approaching in short and medium range.

During decommissioning and closure, equipment will be removed and sold for re-use or disposed of as scrap. The buildings will be renovated for alternative use or be demolished. Access roads, if not used, will be scarified and re-vegetated. All plant will be sold to appropriate dealers and removed from the mine property. Electrical and water supplies in the plant area, if not used, will be terminated and made safe.

The shaft entrance will be sealed according to the requirements of the MPRDA. Overburden removed from the shaft originally will be returned to the hole and compacted. Usable soil will then be replaced and contoured to be free draining.

Topsoil will be replaced over this material. Final soil remediation and re-vegetation of the site will be undertaken.

The post-closure visibility of the site will therefore be almost insignificant after closure, as it is envisaged that surface infrastructure which has not been demolished will be used for alternative purposes. In the remainder of the mining area it is expected that the current pre-mining land uses will be able to continue.

Figure 8.2.1(a): Typical Closed and Rehabilitated Vertical Shaft

Impact Significance Rating (Visibility):

High to Medium to Low to Insignificant to No Impact

8.2.2 Visual Intrusion

Visual intrusion deals with contextualism, i.e. how well project components fit into the ecological and cultural aesthetic of the landscape as a whole. Generally an object will have a greater negative impact on scenes considered to have a high visual quality than on scenes of low quality because the most scenic areas have the "most to lose".

The visual impact of a landscape alteration also decreases as the complexity of the context within which it takes place, increases. If the existing visual context of the site is relatively simple and uniform any alterations or the addition of manmade elements tend to be very noticeable, whereas the same alterations in a visually complex and varied context do not attract as much attention. Especially as distance increases, the object becomes less of a focal point because there is more visual distraction, and the observer's attention is diverted by the complexity of the scene (Hull and Bishop, 1998).

The extent to which the proposed Shondoni facilities fit into, or contrast with, the landscape setting is assessed in Table 8.2.2 (a) using the listed criteria.

Table 8.2.2(a): Assessment of Visual Intrusion of the Shondoni Shaft and Conveyor Belt

Possible Visual Intrusion Effect of proposed Shondoni Facilities	Occurrence
Does the physical design concept/ development have a negative, positive or neutral effect on the quality of the landscape?	Neutral effect due to the nature of the area it is situated in – a mining region. The classification of the landscape is currently one of moderate quality.
Does the design/ development enhance or contrast with the patterns or elements that currently define the structure of the landscape?	Neither, due to the size of the shaft and infrastructure and the degree to which it will be visible, this site does not contribute or detract from the area character. It fits in with the overall character.
Does the design/ development of the project enhance and promote cultural continuity or does it disrupt it?	The character of the area is that of all mining and agriculture, thus the plant does not disrupt the cultural continuity, but the enhancement or promotion thereof cannot be definitely confirmed at this stage.

As stated previously, during decommissioning and closure, all surface infrastructure will be demolished and the land footprint will be reclaimed for pre-mining land use.

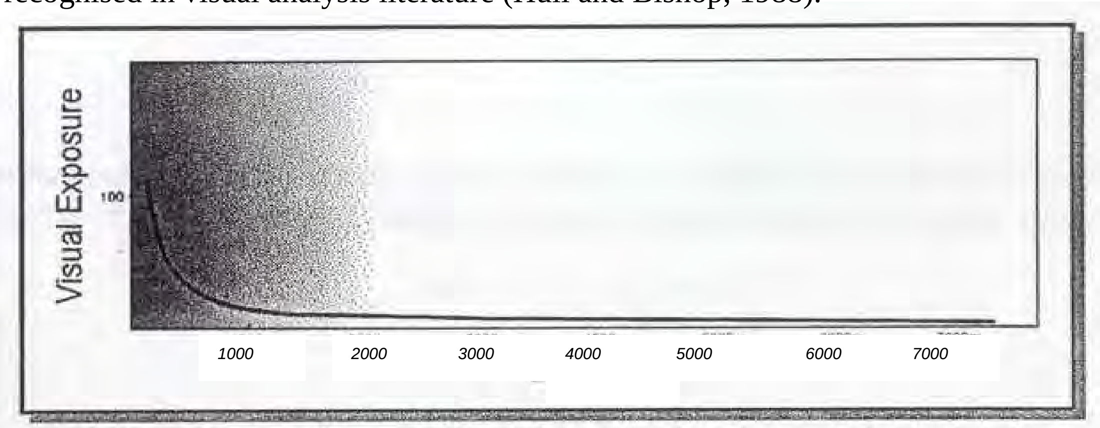
The post-closure visual intrusion of the site will therefore also be almost insignificant after closure as the only remaining Shondoni Shaft structures will be landscaped to fit into the surrounding environment.

<u>Impact Significance Rating (Visual Intrusion):</u>

Insignificant

8.2.3 Visual Exposure

Visual exposure is a criterion used to account for the limiting effect that increased distance has on visual impact. This means that the impact of an object diminishes at an exponential rate as the distance between the observer and the object increases. The inverse relationship of distance and visual impact is well recognised in visual analysis literature (Hull and Bishop, 1988).



Visual Exposure Curve derived from empirical psychological data

Figure 8.2.3 (a): Visual Exposure Graph (Source: Hull and Bishop, 1988)

From the photographic assessment it can be seen that the visual exposure of the proposed Shondoni facilities varies significantly depending on the location of the observer and that it is quite prominent in short range around the site and along the conveyor route. Here the distance between the structures and the observer is least, which results in increased visual exposure.

Although the visibility of the proposed shaft facilities is still quite high from further away on the eastern and south-eastern sides, the actual visual impact is reduced, as the structures are visually "camouflaged" when viewed from these locations, due to the distance and colour tones of the background. The post-closure situation will of course be even better. When considering the conveyor route, the visibility is high from further away on all sides, the actual visual impact however is low, as the structures are visually "camouflaged" due to the distance, colour tones of the background and nature of conveyor belt.

Impact Significance Rating (Visual Exposure):

High to Medium to Low to Insignificant to No Impact

8.2.4 Visual Absorption Capacity (VAC)

Visual absorption capacity can be defined as "an estimation of the capacity of the landscape to absorb development without creating a significant change in visual character or producing a reduction in scenic quality" (Oberholzer, 2005). The ability of a landscape to absorb development or additional human intervention is primarily determined by the vegetation cover, topographical landforms and existing human structures. A further major factor is the degree of visual contrast between the proposed new development and the existing elements in the landscape. If, for example, a visually prominent industrial development already exists in an area, the capacity of that section of landscape to visually "absorb" additional industrial structures is higher than that of a similar section of landscape that is still in its natural state.

In this instance the region in vicinity of the site has a relatively high VAC, due to its mining nature. Because of the relatively high VAC of the surrounding landscape the proposed facilities will not stand out in their visual context, neither will they after closure.

Impact Significance Rating (Visual Absorption Capacity):

VAC is high which indicates a high level of inherent visual mitigation capacity.

8.2.5 Alterations to Landscape and Visual Character (Morphology & Topography)

From all directions around the Shondoni project area, when it is visible, the structures of the proposed Shononi facilities will be viewed against grassland as backdrop and subsequently are moderately intrusive. The structures will slightly contrast with their backdrop in terms of colour and they will partially protrude above the horizon. Furthermore the tonal values of the colours of the proposed structures are such that they will not be particularly intrusive.

Once again, the post closure situation will restore most of the Shaft and Conveyor areas to their pre-mining condition.

Impact Significance Rating (Morphology & Topography):

Medium to Low Significance

8.2.6 Alterations to Landscape and Visual Character (Vegetation & Land Cover)

Where the proposed Sasol Shondoni facilities are located all vegetation within the footprint will be completely removed and the only vegetation to be found will be that which will be planted as part of mitigation measures. The vegetation adjacent to the site will still be present though, but not as naturally undisturbed land.

Closure and rehabilitation of the site will involve an extensive land shaping and re-vegetation exercise to achieve an acceptable post closure vegetative cover. Indigenous vegetation will be used extensively during final rehabilitation.

Impact Significance Rating (Vegetation & Land Cover):

High to Medium Significance

8.2.7 Alterations to Landscape and Visual Character (Hydrology)

The runoff pattern and character of the catchment area within which the proposed Shondoni Shaft facilities will be located, will be altered due to the shaft infrastructure and associated activities. More significant though is the stream crossings that will be required by the coal conveyor system. Depending on the selected conveyor route, a number of stream crossings may be required. At the incline shaft for the proposed shaft locality, a stream diversion may be required depending on the final design.

During the rehabilitation phase, the reclaimed land surface will be made free draining. The visual character from a hydrology perspective will be much improved after closure of the site and its facilities.

Impact Significance Rating (Hydrology):

High to Medium to Low

8.2.8 Alterations to Landscape and Visual Character (Visual Character)

The proposed facilities will contrast with the visual character of the immediate surroundings, and as such will constitute a visual impact on the visual character of the site context. It will however not contrast with the regional visual character as this area is characterised with mining activities.

Post closure the situation will further improve due to the proposed rehabilitation and closure measures.

<u>Impact Significance Rating (Visual Character):</u>

Low

8.2.9 Alterations to Landscape and Visual Character (Sense of Place)

The proposed facilities will not contrast at all with the larger local and regional setting as there are similar structures within a considerable distance.

The presence of the Sasol Shondoni Shaft, therefore fits into the visual character of the greater area and mining character of the region. The mining nature of the Sasol Shondoni facilities is in keeping with the surrounding land uses, and will not form a single intrusive landmark.

<u>Impact Significance Rating (Sense of Place):</u>

Low to Insignificant

9. VISUAL ASPECTS MANAGEMENT PLAN

There are no formal legal compliance guidelines for the management of visual impacts for mining or heavy industry. Commissioning of these measures therefore remains at the discretion of SASOL and are basically motivated in terms of good neighbourliness and sound facility housekeeping.

However having stated this, the benefit of effective visual impact management measures more than often are much wider than visual improvement only. In this regard it can be mentioned that screening berms for instance are also effective for water and noise management, whilst shaping, capping and re-vegetation of open areas, are effective controls for dust pollution and water management. Effective re-vegetation also enhances the faunal wellbeing of an area.

Therefore the management measures proposed in this chapter should be seen as visual optimization measures to enhance other required management interventions on the Sasol Shondoni site.

9.1 Specific Visual Impacts Identified

Based on the findings of this study a number of distinguishable visual impacts have been identified for the proposed Shondoni facilities and its associated conveyor development. The visual impacts identified are largely neutral, thus they neither reduce the visual quality of the landscape nor contrast significantly with the existing landscape character and aesthetic and the experience thereof. Even though some negative impacts were identified, they do not cause an unacceptable new character and will be overseen or altered by mitigation measures. The following observations can be made with regard to visual impacts at Sasol Shondoni:

- **Visibility:** On a medium to short range the shaft is highly visible, but for long range views it blends into the surrounding mining landscape. The conveyor route is highly visible in all directions for short to long range. However, due to its low height and nature, it will blend into the surroundings when viewing long range. At road crossings the visibility impact is however more significant where the conveyor crosses above the road. This impact can be mitigated by letting the conveyor go underneath the road at road-crossings. There are five public road crossings planned at this stage as well as a number of private road-crossings.

- **Alterations to site Morphology and Topography:** The shaft facilities represent a significant alteration to the topography and could from certain vantage points alter the visual horizon line. The conveyor route will not have any significant morphological or topographical impact, mainly due to its low height.

- **Alterations to Vegetation and Land Cover:** The erection of large manmade structures and associated earthworks result in the complete removal of vegetation and a change of the land cover, detrimentally altering the visual character of the landscape. This impact however will be mitigated during the rehabilitation of the site.

- **Alteration of Water Runoff and site Hydrology:** The natural hydrology will be impacted in the shaft area because of the shaft infrastructure and storm water management measures. Another concern relates to the possible diversion of a stream at the incline shaft.

An Impact Summary Table is attached as APPENDIX II to this report.

9.2 Possible Mitigation Measures

As stated in the introductory paragraph, the management measures proposed in this chapter should be seen as visual optimization measures to enhance other required management interventions on the Sasol Shondoni site. It is advised that appropriate mitigation measures be implemented and managed and maintained during the Construction, Operational, Decommissioning and Post-Closure phases, with an emphasis being placed on mitigating short to medium-range views.

The main visual management measures proposed can be divided into two categories and are applicable to all life cycle phases of the existing as well as any Shondoni activities.

Vegetation

As can be seen along the R547 bordering Brendan Village, trees planted next to the road aids in screening the conveyor route and thereby mitigating the visual impact at close and medium range. Screening trees will soften the visual contrast of the Shaft area with its surroundings and will lower visibility of activities around the Shaft area.

Vegetation clearance should be kept to a minimum during the construction phase to limit the contrast to the surrounding environment thereby reducing the visual impact as well as reducing the alteration to the visual character of the site.

It is proposed that whenever re-vegetation is planned for environmental management purposes for whichever impact it has to counter, that due consideration be given to the visual impact as well. In this regard the utilization of vegetation endemic to the area could greatly enhance the efficiency of the measures as well as the visual appeal thereof.

Housekeeping

For close-up views, good housekeeping is perhaps one of the most effective visual management measures. In this regard measures must be commissioned and optimised at Sasol Shondoni Shaft for the grounds to appear neat and controlled. Special attention should be afforded to for instance the Salvage Yard, as well as areas where domestic refuse is stored prior to removal.

Road Crossings

There are at least five public road-crossings in the planned conveyor belt route. The visibility impact can be minimised by letting the conveyor belt pass underneath the road instead of above it.

10. CONCLUSIONS

Based on the findings of this study a number of distinguishable visual impacts have been identified for the proposed Sasol Shondoni Shaft facilities and associated conveyor route. The visual impacts identified are largely neutral, thus they neither reduce the visual quality of the landscape nor contrast significantly with the existing landscape character and aesthetic and the experience thereof. Even though some negative impacts were identified, they do not cause an unacceptable new character and will be overseen or altered by mitigation measures. The following conclusions can be reached with regard to visual impacts at Sasol Shondoni:

- The regional setting in which the Sasol Shondoni facilities will be located, provides a high level of **Visual Absorption Capacity** for mining activity. The site will be located in a mining area with several other shafts surrounding it.

- **Visibility:** The visibility of the Sasol Shondoni facilities will vary considerably. Long range views for the shaft area exist from elevated vantage points in the east and south-east. These long range views are softened due to the high VAC of the area. The visibility of the conveyor belt is very high on short to medium range, but once more blends into the surrounding activities. At road crossings the visibility impact is however more significant where the conveyor crosses above the road. This impact can be mitigated by letting the conveyor go underneath the road at road-crossings.

- **Visual Intrusion:** Visual intrusion deals with how well the project components fit into the ecological and cultural aesthetic of the landscape as a whole. Whereas the Sasol Shondoni infrastructure represent mining components, which by their very nature and size represent significant visual components, their degree of visual intrusion in the specific setting in which they are located, are acceptable.

- **Visual Exposure:** The main factors that influence visual exposure at Sasol Shondoni are elevation and distance. Once again, visual exposure is considered acceptable due to the undulating surrounding landscape which benefits short range views, and the distance of the Shaft area away from public vantage points such as roads. The visual exposure of the conveyor belt is more significant, as it follows next to the R547, passing Brendan Village and crossing the road several times.

- **Alterations to site Morphology and Topography:** The only significant alterations to topography relate to the vertical shaft and ventilation shafts. These shafts will represent a significant alteration to the topography and could from certain vantage points alter the visual horizon line. The proposed conveyor belt will not have any significant morphological or topographical impact, mainly due to its low height.

- **Alterations to Vegetation and Land Cover:** The erection of large manmade structures and associated earthworks result in the complete removal of vegetation and a change of the land cover, detrimentally altering the visual character of the landscape. In this regard the impact will manifest when the Shondoni Shaft facilities will be constructed.

- **Alteration of Water Runoff and site Hydrology:** The runoff pattern and character of the catchment area within which the proposed Shondoni Shaft facilities will be located will be altered due to the shaft infrastructure and associated activities. More significant though is the stream diversion that may be required by the coal conveyor system. Depending on the selected conveyor route, a number of stream crossings may be required. At the incline shaft for the proposed shaft locality, a stream diversion may be required depending on the final design.

- **Alteration to Visual Character:** The proposed Shondoni facilities will contrast with the visual character of the immediate surroundings, and as such will constitute a visual impact on the visual character of the site context. It will however not contrast will the regional visual character as this area is characterised with mining activities. Post closure the situation will further improve due to the proposed rehabilitation and closure measures.

- **Alteration to Sense of Place or Genus Loci:** The sites of the proposed Shondoni facilities are not unique in terms of their perceived character or the experiences that they evoke, neither does the introduction of the mining structures and activities negatively impact on the sensory and emotional experiencing of the affected sites and surrounding landscape, as they are of the same character. The manmade structures and associated activities will not visually disrupt the existing visual conditions any more as currently done by other mining facilities in the area. There is no disruption of existing cultural and land use continuity. The mining elements and structures are of the same character as that which is currently in the region.

- Management measures proposed should be seen as visual optimization measures to enhance other required management interventions on the Sasol Shondoni site.

- Appropriate mitigation measures should be implemented and managed and maintained during the Construction, Operational, Decommissioning and Post-Closure phases, with an emphasis being placed on mitigating short to medium-range views.

- The main visual management measures proposed can be divided into three categories which are shaping of use of vegetation, general housekeeping and road-crossings.

11. REFERENCES

Crawford, D. Using remotely sensed data in landscape visual quality assessment, Landscape and Urban Planning, No. 30, 1994. p 71-81.

Higuchi, T. The Visual and Spatial Structure of Landscapes. MIT Press, Cambridge, Mass., 1998. p. 3-4.

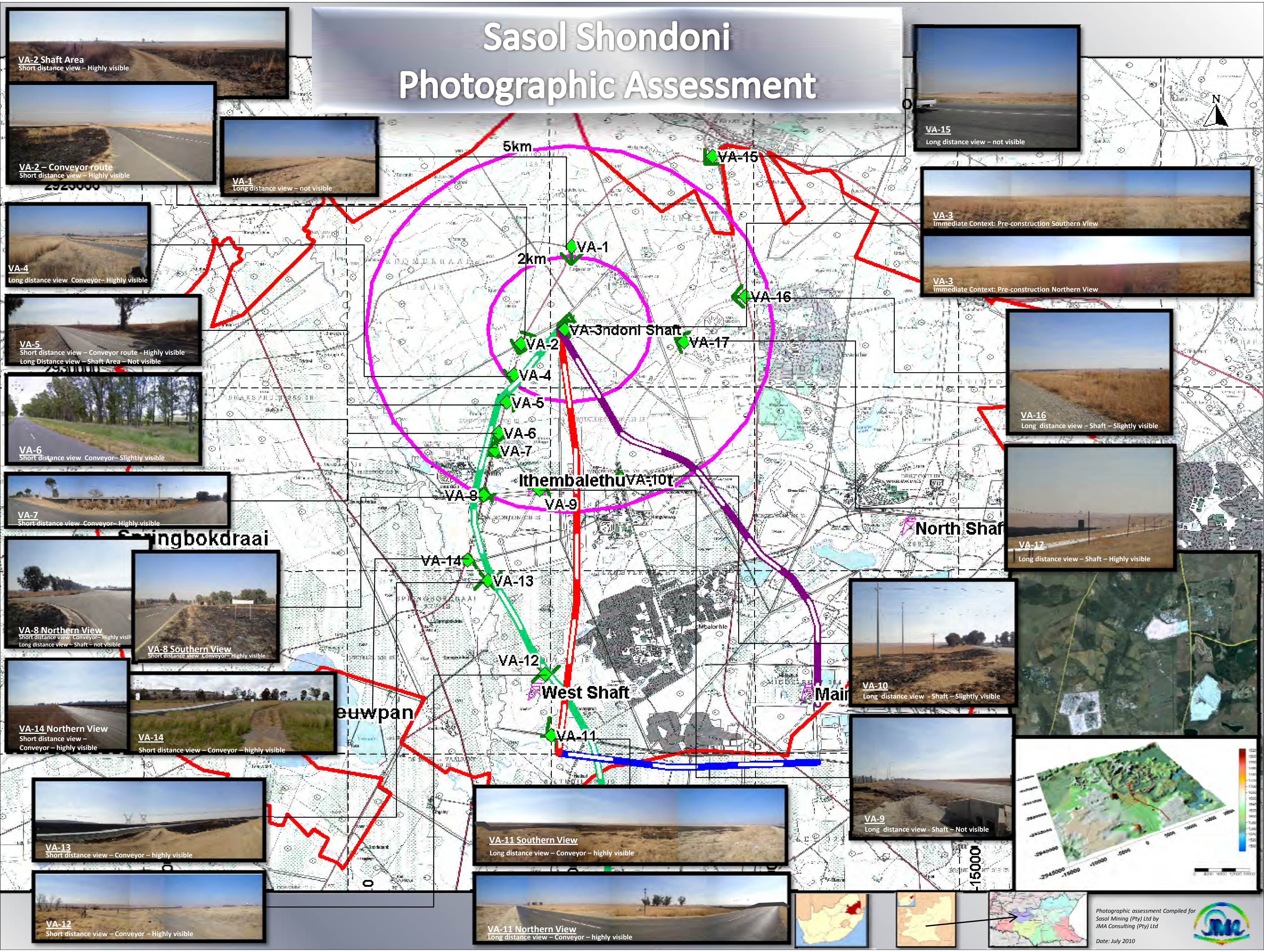
Hull, R.B., and Bishop, I.E. Scenic Impacts of Electricity Transmission towers: The influence of landscape type and observer distance. Journal of Environmental Management, 1988. Vol 27. p. 99-108.

Lynch, K. Good City Form. The MIT Press, 1992. p 131.

Oberholzer, B. 2005. Guideline for Involving Visual and Aesthetic Specialists in EIA Processes. Edition 1 (Draft for Comment). [Online] Available: http://www.capegateway.gov.za/Text/2005/4/deadp_visual_guideline_draft_15april05.pdf. (Accessed 02 September 2005).

APPENDIX I

Poster of Photographic Assessment



Sasol Shondoni
Photographic Assessment
VA-2 Shaft Area
Short distance view – Highly visible
VA-2 – Conveyor route
Short distance view – Highly visible
VA-1
Long distance view – not visible
VA-4
Long distance view Conveyor– Highly visible
VA-5
Short distance view – Conveyor route - Highly visible
Long Distance view – Shaft Area – Not visible
VA-6
Short distance view Conveyor– Slightly visible
VA-7
Short distance view Conveyor– Highly visible
VA-8 Northern View
VA-8 Southern View
Short distance view Conveyor– Highly visible
VA-14 Northern View
Short distance view –
Conveyor – highly visible
VA-14
Short distance view – Conveyor – highly visible
VA-13
Short distance view – Conveyor – highly visible
VA-12
Short distance view – Conveyor – Highly visible
VA-11 Southern View
Long distance view – Conveyor – highly visible
VA-11 Northern View
Long distance view – Conveyor – highly visible
VA-15
Long distance view – not visible
VA-3
Immediate Context: Pre-construction Southern View
VA-3
Immediate Context: Pre-construction Northern View
VA-16
Long distance view – Shaft – Slightly visible
VA-17
Long distance view – Shaft – Highly visible
VA-10
Long distance view - Shaft – Slightly visible
VA-9
Long distance view - Shaft – Not visible
5km
2km
VA-1
VA-2
VA-3ndoni Shaft
VA-4
VA-5
VA-6
VA-7
VA-8
VA-9
VA-10
VA-11
VA-12
VA-13
VA-14
VA-15
VA-16
VA-17
Ithembalethu
North Shaf
West Shaft
Mai
Springbokdraai
euwpan
N
Photographic assessment Compiled for
Sasol Mining (Pty) Ltd by
JMA Consulting (Pty) Ltd
Date: July 2010

APPENDIX II

Impact Summary Table

Activity Description	Impact Description	Criteria for Determining Severity				SEVERITY C-NUMBER	Degree Of Likelihood	Risk Level Before Mitigation	Mitigatory difficulty	Mitigation/ Management Objective	Proposed Mitigation Measure	Risk Level After Mitigation
		Extent	Duration	Status	IAP							
Shondoni Shaft Area - Construction Phase												
Clearing of Vegetation	Highly visible from R547; has impact on short to medium range views on road users	1	0	1	1	C1	Certain	6	High	Reduce visual impact of clearing of vegetation	Clearing of smallest possible area	6
	Alterations to Landscape and Visual Character (Vegetation & Landcover)	1	0	1	1	C1	Certain	6	High	Reduce visual impact of clearing of vegetation	Clearing of smallest possible area	6
	Alterations to Landscape and Visual Character (Hydrology)	1	0	1	1	C1	Likely	6	High	Reduce visual impact of clearing of vegetation	Clearing of smallest possible area	6
Construction Activities	Highly visible from R547; has impact on short to medium range views on road users	1	1	1	2	C1	Certain	6	High	Reduce short range visibility of construction activities	Planting of trees to use for screening purposes	6
	Visibility impact for long range views from east	1	1	0	2	C1	Certain	6	High	None Available	None Available	6
	Alterations to Landscape and Visual Character (Morphology & Topography)	1	1	0	2	C1	Certain	6	High	Reduce contrast to surrounding environment	Use natural tones that blend in with environment when constructing shaft facilities	6
Conveyor Belt Route - Construction Phase												
Clearing of Vegetation	Highly visible from R547; has impact on short to medium range views on road users and Brendan Village residents	1	0	1	2	C1	Certain	6	High	Reduce visual impact of clearing of vegetation	Clearing of smallest possible area	6
	Alterations to Landscape and	1	0	1	1	C1	Certain	6	High	Reduce visual	Clearing of smallest	6

Activity Description	Impact Description	Criteria for Determining Severity				SEVERITY C-NUMBER	Degree Of Likelihood	Risk Level Before Mitigation	Mitigatory difficulty	Mitigation/ Management Objective	Proposed Mitigation Measure	Risk Level After Mitigation
		Extent	Duration	Status	IAP							
	Visual Character (Vegetation & Landcover)									impact of clearing of vegetation	possible area	
	Alterations to Landscape and Visual Character (Hydrology)	1	0	1	1	C1	Likely	6	High	Reduce visual impact of clearing of vegetation	Clearing of smallest possible area	6
Construction Activities	Highly visible from R547 and Brendan Village; has impact on short to medium range views on road users and residents	1	0	0	2	C1	Certain	6	High	Reduce short range visibility of construction activities	Planting of trees to use for screening purposes	6
	Visibility Impact on road users at road-crossings	1	0	1	1	C1	Certain	6	Low	Reduce short range visibility of conveyor route	Take conveyor belt underneath road to make it less visible	6
	Visibility impact for long range views	1	0	0	2	C1	Certain	6	High	None Available	None Available	6
	Alterations to Landscape and Visual Character (Morphology & Topography)	1	0	0	2	C1	Certain	6	High	None Available	None Available	6
	Visual Exposure impact for road users of R547 as well as Brendan Village residents	1	0	1	2	C1	Certain	6	High	None Available	None Available	6

Activity Description	Impact Description	Criteria for Determining Severity				SEVERITY C-NUMBER	Degree Of Likelihood	Risk Level Before Mitigation	Mitigatory difficulty	Mitigation/ Management Objective	Proposed Mitigation Measure	Risk Level After Mitigation
		Extent	Duration	Status	IAP							
Shondoni Shaft Area - Operational Phase												
Shondoni Shaft Operation	Highly visible from R547; has impact on short to medium range views on road users	1	1	1	1	C1	Certain	6	Med.	Reduce short range visibility of shaft area	Planting of trees to use for screening purposes	6
	Visibility impact for long range views from east	1	1	0	2	C1	Certain	6	High	None Available	None Available	6
	Alterations to Landscape and Visual Character (Morphology & Topography)	1	1	0	2	C1	Certain	6	High	Reduce contrast to surrounding environment	Use natural tones that blend in with environment surrounding shaft facilities	6
Conveyor Belt Route - Operational Phase												
Operation of Conveyor Belt	Highly visible from R547 and Brendan Village; has impact on short to medium range views on road users and residents	1	1	1	2	C2	Certain	5	Med.	Reduce short range visibility of conveyor belt	Planting of trees to use for screening purposes	6
	Visibility impact for long range views	1	0	0	2	C1	Certain	6	High	None Available	None Available	6
	Visibility and Visual Exposure Impact on road users at road-crossings	1	1	1	1	C1	Certain	6	Low	Reduce short range visibility of conveyor route	Take conveyor belt underneath road to make it less visible	6
	Visual Exposure impact for road users of R547 as well as Brendan Village residents	1	1	1	2	C2	Certain	5	High	Reduce short range visual Exposure of conveyor belt	Planting of trees to use for screening purposes	6

Activity Description	Impact Description	Criteria for Determining Severity				SEVERITY C-NUMBER	Degree Of Likelihood	Risk Level Before Mitigation	Mitigatory difficulty	Mitigation/ Management Objective	Proposed Mitigation Measure	Risk Level After Mitigation
		Extent	Duration	Status	IAP							
Shondoni Shaft Area – Decommissioning and Closure Phase												
Demolition Activities and removal of infrastructure	Highly visible from R547; has impact on short to medium range views on road users	0	1	1	2	C1	Certain	6	Med.	Reduce short range visibility of decommissioning activities	Planting of trees during the construction phase will serve to screen activities	6
	Visibility impact for long range views from east	0	1	0	2	C1	Likely	6	High	None Available	None Available	6
	Alterations to Landscape and Visual Character (Morphology & Topography)	1	1	-1	2	C1	Certain	6	High	Reduce contrast to surrounding environment	None Available	6
Re-establishing of Vegetation	Highly visible from R547; has impact on short to medium range views on road users	1	0	-1	1	C1	Certain	6	-	Positive Impact	None Required	6
	Alterations to Landscape and Visual Character (Vegetation & Land cover)	1	0	-1	1	C1	Certain	6	-	Positive Impact	None Required	6
	Alterations to Landscape and Visual Character (Hydrology)	1	0	-1	1	C1	Likely	6	-	Positive Impact	None Required	6
Conveyor Belt Route - Decommissioning and Closure Phase												
Removal of Conveyor Belt	Highly visible from R547 and Brendan Village; has impact on short to medium range views on road users and residents	1	0	0	2	C1	Certain	6	Med.	Reduce short range visibility of decommissioning activities	Planting of trees during the construction phase will serve to screen activities	6
	Visibility impact for long range views	1	0	0	2	C1	Certain	6	High	None Available	None Available	6
	Alterations to Landscape and Visual Character (Morphology &	1	0	0	2	C1	Certain	6	High	None Available	None Available	6

Activity Description	Impact Description	Criteria for Determining Severity				SEVERITY C-NUMBER	Degree Of Likelihood	Risk Level Before Mitigation	Mitigatory difficulty	Mitigation/ Management Objective	Proposed Mitigation Measure	Risk Level After Mitigation
		Extent	Duration	Status	IAP							
	Topography)											
	Visual Exposure impact for road users of R547 as well as Brendan Village residents	1	0	1	2	C1	Certain	6	Med.	None Available	None Available	6
Re-establishing of Vegetation	Visible from R547; has impact on short to medium range views on road users and Brendan Village residents	1	0	-1	2	C1	Certain	6	-	Positive Impact	None Required	6
	Alterations to Landscape and Visual Character (Vegetation & Landcover)	1	0	-1	1	C1	Certain	6	-	Positive Impact	None Required	6
	Alterations to Landscape and Visual Character (Hydrology)	1	0	-1	1	C1	Likely	6	-	Positive Impact	None Required	6

Activity Description	Impact Description	Criteria for Determining Severity				SEVERITY C-NUMBER	Degree Of Likelihood	Risk Level Before Mitigation	Mitigatory difficulty	Mitigation/ Management Objective	Proposed Mitigation Measure	Risk Level After Mitigation
		Extent	Duration	Status	IAP							
Shondoni Shaft Area – Post Closure Phase												
Rehabilitated Shondoni Shaft area	Visible from R547; has impact on short to medium range views on road users	1	2	-1	1	C1	Certain	6	-	Positive Impact	None Required	6
	Visibility impact for long range views from east	1	1	-1	2	C1	Certain	6	-	Positive Impact	None Required	6
	Alterations to Landscape and Visual Character (Morphology & Topography) – Landscape back to previous character	1	1	-1	2	C1	Certain	6	-	Positive Impact	None Required	6
Conveyor Belt Route - Post Closure Phase												
Rehabilitated Conveyor Belt route	Visible from R547 and Brendan Village; has impact on short to medium range views on road users and residents	1	1	-1	2	C2	Certain	6	-	Positive Impact	None Required	6
	Visibility impact for long range views	1	0	0	2	C1	Certain	6	-	None Available	None Available	6
	Visual Exposure impact for road users of R547 as well as Brendan Village residents	1	1	-1	2	C2	Certain	6	-	Positive Impact	None Required	6

APPENDIX III

CV’s of Contributing Personnel

Jasper L Müller (Pr.Sci.Nat.)

Date of Birth: 16 November 1957

Nationality: S A Citizen

Position in firm: Managing Director

Qualification:

B. Sc.: Geology and Geohydrology, UOFS, 1979
B. Sc. (Hons): Geohydrology, UOFS, 1980
M. Sc. (Cum Laude): Geohydrology, UOFS, 1984

Memberships:

Geological Society of SA : Ground Water Division
South African Council for Natural Scientific Professions
National Groundwater Association.

Jasper Lodewyk Müller is a professionally qualified earth and environmental scientist and is duly registered since 1986 as a Professional Natural Scientist with the South African Council for Natural Scientific Professions (SACNASP) in terms of Section 20(3)(a) of the Natural Scientific Professions Act.

His registration with SACNASP (Reg.No. 400073/86) authorizes him to perform consultative work in the relevant fields of earth science and environmental science for which he has demonstrated the necessary qualifications, skills and work experience.

Jasper obtained his B.Sc. degree from the University of the Free Sate in 1979. He majored in Geology and Geohydrology, with supporting subjects including *inter alia* mathematics, physics, chemistry, geophysics, geo-chemistry, applied mathematics, statistics and mathematical statistics. He obtained the degree with a distinction in Geology.

He obtained his B.Sc. Honns. Degree in Geohydrology from the University of the Free State in 1980.

He started his working career in 1981 with the then Department of Water Affairs in Pretoria where he was appointed as a Hydrologist with the ground water division. His work entailed ground water and surface water hydrology and aquifer and catchment management of the dolomite aquifers in the north-west province in the vicinity of Lichtenburg and Mafikeng. The management pertained both to water availability and water quality aspects and included regular assessment of dolomite aquifer fountain flows, dolomite aquifer pumping test assessments, ground water / surface water interactions, dolomitic ground water recharge assessments and dolomitic ground water quality assessments.

Towards the end of 1981 Jasper received a post graduate study bursary from the Institute for Ground Water Studies at the University of the Free State, which enabled him to perform full time research towards his M.Sc. degree in Geohydrology, which he obtained *cum laude* in 1984 from the University of the Free State.

His research and thesis dealt with aquifer management of a west coast fluvial/marine sand aquifer including the interaction between the aquifer and the sea, both in terms of ground water flow and mass (pollutant) transport. His thesis focused on the application of numerical mathematical ground water flow and mass transport computer models developed by world renowned researchers at the University of Princeton in the USA.

In 1984 he was appointed as a full time researcher/lecturer at the Institute for Ground Water Studies at the University of the Free State. His area of expertise centered around aquifer mechanics and numerical ground water modeling, which deals with the occurrence, flow and quality of ground water in the subsurface, together with interaction of ground water with surface water features such as streams and lakes.

Jasper left the university in 1986 to become a ground water consultant. His first position was with a consulting firm Terra Data (Pty) Ltd, located at the Hartebeespoort Dam. He was involved with projects related to ground water supply and ground water pollution and acted as a specialist consultant for the then Department of Water Affairs on matters related to ground water quality impacts from mines.

In 1987 he joined the firm Environmental Science Services (ESS), also located at the Hartebeespoort Dam, where he was appointed as the Head of their Water Department. It was here that he started to work as a team member on integrated environmental projects, with the main responsibility for surface water and ground water quality impact assessments. He also started a water quality monitoring division at ESS, and was at the time instrumental in the commissioning of water quality monitoring systems at several ESKOM Power Stations.

In October 1988 Jasper left ESS and moved to Delmas, where he is still stationed today, and founded his own practice under the name of Jasper Müller Associates. The practice moved away from ground water supply projects and he started to specialize in Environmental Ground Water Hydrology, focusing on impact and risk assessments, water quality monitoring programs and general water quality management aspects.

His involvement in Integrated Environmental Management, first as a ground water specialist on investigative teams with other scientists and engineers, and then later on as overall project manager of integrated environmental projects, started towards the end of 1989 after promulgation of the Environment Conservation Act, Act 73 of 1989.

Soon after this, in 1992, followed the requirement for EMPR compilation for mines in terms of the Minerals Act. Since the promulgation of the National Environmental Management Act, in 1998, the new National Water Act in 1998 and the Minerals and Petroleum Resources Development Act in 2002 to name a few, Jasper became increasingly involved in overall project management of Integrated Environmental Projects for mining and industry. This gave him significant exposure to a wide range of environmental disciplines including *inter alia* soils, animal life, plant life, aquatic ecosystems, ground water, surface water, air quality, etc which afforded him the privilege to work shoulder to shoulder with several renowned scientists and engineers in the fields of environmental assessment and management.

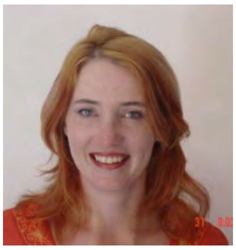
It was this extensive involvement in integrated environmental projects, which qualified him for his second formal registration with SACNASP in the field of practice of Environmental Science.

The firm Jasper Müller Associates CC, was converted to JMA Consulting (Pty) Ltd in 2005. Jasper currently holds the position of Managing Director of this firm. The firm's main activities relate to the provision of professional services to mining and industry to facilitate Sustainable Environmental Management through integrated Science and Engineering.

Since the founding of Jasper Müller Associates in 1988, Jasper was personally involved in more than 250 projects related to either surface and ground water quality aspects and/or integrated environmental management.

E-mail: **jasper@jmaconsult.co.za**

Genevieve M Cloete (Pr.Sci.Nat.)



Date of birth: 13 December 1976

Nationality: S A Citizen

Position in firm: Scientist (ST 4)
Environmental Monitoring and Auditing

Qualifications:

B.Sc. Zoology, UP 1997
B.Sc. (Hons) Environmental Analysis and Management, UP

Period employed:

1995 Plant Reproduction/Mycological research assistant, University of Pretoria, Department Botany.
1998 Typist/Graphical assistant, Modern Talking, Delmas
1999 General scientific assistant with JMA.

Genevieve Cloete completed her studies in the field of Environmental analyses & management at the University of Pretoria. During her time of study, she worked at the University of Pretoria as researcher in the field of Plant reproduction/Micological research.

After completing her studies she worked at Modern Talking - a computer & stationary shop - as a Typist/Graphical designer.

In 1999 she was appointed as a general scientific assistant with JMA. Her responsibilities included database management, assisting in GIS tasks and general office functions, including graphic designing.

At present she is responsible for impact studies in the field of natural vegetation and animal life. Apart from this, she is also involved in GIS/mapping tasks, as well as the compilation and management of ground water monitoring programs.

E-mail: **genevieve@jmaconsult.co.za**

APPENDIX 5.15(A)

SPECIALIST REPORT
HERITAGE ASPECTS

Prepared for:

JMA CONSULTING (PTY) LTD

SASOL MINING SECUNDA

A PHASE I HERITAGE IMPACT ASSESSMENT (HIA) STUDY FOR SASOL MINING'S PROPOSED SHONDONI PROJECT AND FOR BLOCK 8 ON THE EASTERN HIGHVELD IN THE MPUMALANGA PROVINCE OF SOUTH AFRICA

Prepared by:

Dr Julius CC Pistorius

Archaeologist & Heritage Consultant

Member ASAPA

352 Rosemary Street LYNNWOOD 0081

PO Box 1255 Bela Bela 0480

Tel and fax 0147362115

Cell 0825545449

August 2010

EXECUTIVE SUMMARY

The Phase I Heritage Impact Assessment (HIA) study for Sasol Mining's proposed Shondoni Project and for Block 8 on the Eastern Highveld in the Mpumalanga Province of South Africa was done according to Section 38 of the National Heritage Resources Act (No 25 of 1999). The areas to be affected by the Shondoni Project as well as the three pieces of land which constitute Sasol's Block 8 are here referred to as the Sasol Project Area. The Shondoni Project and the three pieces of land constituting Block 8 are collectively referred to as the Sasol Project in this report.

The aims with the Phase I HIA study were the following:

- To establish whether any of the types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999) (see Box 1) do occur within the perimeters of the Sasol Project Area.
- To determine the significance of these heritage resources and whether any of these types and ranges of heritage resources will be affected by the Sasol Project, and if so, to determine mitigation measures for those heritage resources that will be affected by the Sasol Project.

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

- Farmstead complexes associated with historical houses, outbuildings and cattle enclosures.
- Informal and formal graveyards.
- A commemorative beacon.

Remains from the recent past also occur in the Sasol Project Area but have no historical significance and therefore were not geo-referenced or mapped and are not discussed in this report.

These heritage resources were geo-referenced and mapped (Figure 2, Tables 1-2).

The significance of the heritage resources is indicated and mitigation measures are outlined for those heritage resources which may be affected by the Sasol Project.

The significance of the heritage resources

It is possible that a farmstead complex (FC04), graveyards (GY15, GY16, GY17 and GY18) as well as a cattle enclosure (CE02) may be affected (impacted) by the Sasol Project. The significance of the various types and ranges of heritage resources in the Sasol Project Area therefore is indicated whilst mitigation measures are outlined for those heritage resources which may be affected by the Sasol Project.

The significance of the heritage resources in the Sasol Project Area is indicated by means of stipulations derived from the National Heritage Resources Act (No 25 of 1999).

The farmstead complex and cattle enclosure

The historical farmstead complexes as well as the cattle enclosure are older than sixty years and therefore are protected by Section 34 of the National Heritage Resources Act (No 25 of 1999). The significance of the historical farmsteads complexes as well as the cattle enclosures therefore has been indicated as high (Table 1).

The level of significance of these heritage resources is determined by means of criteria such as their historical, cultural (social), aesthetic, technological and scientific value in relation to their uniqueness, state of preservation and research potential. Heritage resources which have low significance are viewed as fully recorded during this survey. Any impact on these heritage resources therefore are considered to be low. Heritage resources with medium to high significance will require further mitigation and/or management measures.

Graveyards and graves

All graveyards and graves can be considered to be of high significance and are protected by various laws (Table 2). Legislation with regard to graves includes Section 36 of the National Heritage Resources Act (No 25 of 1999) whenever graves are older than sixty years.

The act also distinguishes various categories of graves and burial grounds. Other legislation with regard to graves includes those which apply when graves are exhumed and relocated, namely the Ordinance on Exhumations (No 12 of 1980) and the Human Tissues Act (No 65 of 1983 as amended).

A commemorative beacon

The commemorative beacon in the No. 8 Harmony gold shaft in the Middelbult Mining Area will not to be affected by future coal mining activities and are therefore not further discussed.

Mitigating the heritage resources

The following mitigation measures have to be followed whenever FC04, CE02 and GY15 to GY18 are to be affected by the Sasol Project.

The farmstead complex and cattle enclosure

The farmstead complex and cattle enclosure may not be affected (demolish, renovate, alter) by the Sasol Project *prior* to their investigation by a historical architect in good standing with the South African Heritage Resources Agency (SAHRA). The historical architect has to acquire a permit from SAHRA before any of these structures may be affected (demolish, alter, renovate) as a result of the Sasol Project.

Graveyards and graves

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

<u>General</u>

It is highly likely that this Phase I HIA study may have missed heritage resources in the Sasol Project Area considering the size of the area and the fact that heritage sites may occur in thick clumps of vegetation while others may lie below the surface of the earth and may only be exposed once development commences.

If any heritage resources of significance is exposed during the Shondoni Project or during any future exploration, mining or other development activities, the South African Heritage Resources Authority (SAHRA) should be notified immediately, all development activities must be stopped and an archaeologist accredited with the Association for Southern African Professional Archaeologist (ASAPA) should be notify in order to determine appropriate mitigation measures for the discovered finds.

1 INTRODUCTION

This document contains the report on a Phase I Heritage Impact Assessment (HIA) study which was done for Sasol Mining's proposed Shondoni Project and for Sasol's Block 8 on the Eastern Highveld in the Mpumalanga Province of South Africa**.**

Focused archaeological research has been conducted in the Mpumalanga Province for more than four decades. This research consists of surveys and of excavations of Stone Age and Iron Age sites as well as the recording of rock art and historical sites. The Mpumalanga Province has a rich heritage comprised of remains dating from the pre-historical and from the historical (or colonial) periods of South Africa. Pre-historical and historical remains in the Mpumalanga Province of South Africa therefore form a record of the heritage of most groups living in South Africa today.

Previous heritage surveys conducted for Sasol Mining indicated that the most common types and ranges of heritage resources on the Eastern Highveld in the Mpumalanga Province include historical farmstead complexes associated with formal and informal graveyards. Stone walled settlements dating from the Late Iron Age and Historical Period also occur but are limited to areas where low, dolerite kopjes and randjes exist. These topographical features are generally scarce in the mining areas where Sasol is operational.

However, various types and ranges of heritage resources that qualify as part of South Africa's 'national estate' as outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999) do occur across the Mpumalanga Province (see Box 1, next page).

Box 1: Types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999).

The National Heritage Resources Act (Act No 25 of 1999, Section 3) outlines the following types and ranges of heritage resources that qualify as part of the national estate, namely:

(a) places, buildings structures and equipment of cultural significance;

(b) places to which oral traditions are attached or which are associated with living heritage;

(c) historical settlements and townscapes;

(d) landscapes and natural features of cultural significance;

(e) geological sites of scientific or cultural importance;

(f) archaeological and paleontological sites;

(g) graves and burial grounds including-

(i) ancestral graves;

(ii) royal graves and graves of traditional leaders

(iii) graves of victims of conflict

(iv) graves of individuals designated by the Minister by notice in the Gazette;

(v) historical graves and cemeteries; and

(vi) other human remains which are not covered by in terms of the Human Tissue Act, 1983 (Act No 65 of 1983)

(h) sites of significance relating to the history of slavery in South Africa;

(i) moveable objects, including -

(i) objects recovered from the soil or waters of South Africa, including archaeological and paleontological objects and material, meteorites and rare geological specimens;

(ii) objects to which oral traditions are attached or which are associated with living heritage;

(iii) ethnographic art and objects;

(iv) military objects;

(v) objects of decorative or fine art;

(vi) objects of scientific or technological interest; and

(vii) books, records, documents, photographs, positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No 43 of 1996).

The National Heritage Resources Act (Act No 25 of 1999, Art 3) also distinguishes nine criteria for places and objects to qualify as 'part of the national estate if they have cultural significance or other special value …'. These criteria are the following:

(a) its importance in the community, or pattern of South Africa's history;

(b) its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;

(c) its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;

(d) its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects

(e) ;its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;

(f) its importance in demonstrating a high degree of creative or technical achievement at a particular period;

(g) its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;

(h) its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa;

(i) sites of significance relating to the history of slavery in South Africa

2 TERMS OF REFERENCE

Sasol Mining intends to develop the Shondoni Project whilst Sasol Mining's Block 8 was not yet subjected to a Phase I Heritage Impact Assessment (HIA) study. Consequently, JMA who is responsible for compiling an Environmental Impact Assessment (EIA) study for the Shondoni Project commissioned the author to undertake a Phase I HIA study for the Shondoni Project as well as for Sasol's Block 8.

The various developmental components for the Shondoni Project as well as the three pieces of land which constitute Sasol's Block 8 are collectively here referred to as the Sasol Project Area. The Shondoni Project and the three pieces of land constituting Block 8 are here collectively referred to as the Sasol Project. This study outlines the Phase I HIA study which was done for the Sasol Project.

The aims with the Phase I HIA were the following:

- To establish whether any of the types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999) (see Box 1) do occur within the perimeters of the Sasol Project Area.
- To determine the significance of these heritage resources and whether any of these types and ranges of heritage resources will be affected by the Sasol Project, and if so, to determine mitigation measures for those heritage resources that will be affected by the Sasol Project.

3 THE SASOL PROJECT AREA

3.1 Location

Sasol Mining's mine lease area incorporates a vast track of land on the Eastern Highveld in the Mpumalanga Province of South Africa. The mine lease area is demarcated in various mining areas such as the Middelbult, Brandspruit, Twistdraai and Bosjesspruit Mining Areas which are located to the south of Leandra and Kinross and which stretches towards Balfour and Belfast in the south; the Block A (North) and Block B (South) Mining Areas which are located further to the west incorporating the village of VAL and which stretches towards Greylingstad further to the south as well as Sasol's Block 8 Mining Area which incorporates the Springbokdraai Reserves, Leeuwpan Reserves and the Northern Reserves.

This report focuses on the Shondoni Project which is located in the Middelbult Mining Area and on Sasol's Block 8 which incorporates the Springbokdraai Reserves, Leeuwpan Reserves and the Northern Reserves (Figure 2) (2628BD Leandra; 1: 50 000 topographical map & 2628 East Rand; 1:250 000 map).

The Sasol Project Area stretches across an undulating piece of veldt which incorporates agricultural fields as well as stretches with pristine grass veldt. The area has been transformed in the north where the towns of Leandra and Kinross are located as a result of town and mine development. Towards the south, untransformed grass veldt and relatively pristine heritage resources such as colonial farmsteads and graveyards are common. Few trees occur in the Sasol Project Area. Those that do occur are exotics such as Blue Gum lots, poplar-groves on the banks of streams and Oak trees which are usually located near historical farm homesteads. Most of these trees are anthropogenic as they have been introduced by human activities in the area in the past.

The Sasol Project Area is known for the production of agricultural crops such as maize wheat, sorghum, dairy, potatoes and other vegetables. Cattle and sheep ranching also make a significant contribution to the local economy. Coal, gold and silica mines also occur in the area.

Figure 1- The Sasol Project Area on the Eastern Highveld of the Mpumalanga Province is an undulating piece of land which is characterised by outstretched grass veldt interspersed with agricultural fields.

This tract of land is dotted with farmstead complexes which are usually associated with Blue Gum avenues or with smaller plantations of these trees (above).

3.2 The Sasol Project

The Sasol Project which is here referred to include the following (developmental) components, namely:

- Sasol's proposed Shondoni Project which involves the development of a new shaft, associated infrastructure around the shaft area and an overland conveyor belt running southwards from the shaft to one of Sasol's existing conveyor belts further to the south. This development component is primarily located in the Middelbult Mining Area.

- Sasol's Block 8 which includes the Springbokdraai Reserves, Leeuwpan Reserves and the Northern Reserves. These three mining areas involves parts of the following farms, namely Rietkuil 531IR, Leeuwpan 532IR and Zondagsfontein 124IS.

The areas to be affected by the Shondoni Project as well as the three pieces of land which constitute Sasol's Block 8 are here referred to as the Sasol Project Area. The Shondoni Project and the three pieces of land constituting Block 8 are collectively referred to as the Sasol Project in this report.

3.3 Within a cultural landscape

The Sasol Project Area is located in the midst of a cultural landscape that is marked by heritage remains dating from the pre-historical into the historical (colonial) period. Stone Age sites, Iron Age sites and colonial remains therefore do occur in the Eastern Highveld (see Part 9 'Select Bibliography').

The archaeological and historical significance of this cultural landscape therefore must be described and explained in more detail before the results of the Phase I HIA study is discussed (see below, Part 5).

4 METHODOLOGY

This Phase I HIA study was conducted by means of the following:

- Surveying the proposed Sasol Project Area with a vehicle and selected spots on foot.
- Briefly surveying literature relating to the pre-historical and historical context of the Sasol Project Area.
- Consulting maps of the proposed Sasol Project Area.
- Consulting archaeological (heritage) data bases.
- Consulting spokespersons regarding the possible presence of graves and graveyards in the project area.
- Synthesising all information obtained from the data bases, fieldwork, maps and literature survey.

4.1 Fieldwork

The proposed Sasol Project Area was surveyed with a vehicle where accessible roads existed while selected, sensitive spots in the project area were surveyed on foot.

4.2 Databases, literature survey and maps

Databases kept and maintained at institutions such as the Provincial Heritage Resources Agency (PHRA) and the Archaeological Data Recording Centre at the National Flagship Institute (Museum Africa) in Pretoria were consulted to determine whether any heritage resources of significance has been identified during earlier heritage surveys in or near the Sasol Project Area.

The author is not unacquainted with the Sasol Project Area at large as he had done several heritage impact assessment studies near the proposed project area (see Part 9, ‘Select Bibliography’).

Literature relating to the pre-historical and the historical unfolding of the Eastern Highveld where the Sasol Project Area is located was reviewed (see Part 5, ‘Contextualising the Sasol Project Area’).

It is important to contextualise the pre-historical and historical background of the Sasol Project Area in order to comprehend the identity and meaning of heritage sites in and near the project area.

In addition, the Sasol Project Area was studied by means of 1:50 000 topographical maps and the 1:250 000 map on which it appears.

4.3 Consulting spokespersons

Spokespersons living in the Sasol Project Area were consulted regarding the possible presence of solitary graves and graveyards. Many graveyards on the Eastern Highveld have been abandoned or occur in desolated areas or in maize fields where they remains undetected if not pointed out by persons, such as farmers and workers, who are well acquainted with the Sasol Project Area (see Part 8, ‘Spokespersons consulted’).

4.4 Assumptions and limitations

It is highly likely that this baseline heritage survey may have missed heritage resources in the Sasol Project Area considering the size of the area and the fact that heritage sites may occur in thick clumps of vegetation while others may lie below the surface of the earth and may only be exposed once development commences.

If any heritage resources of significance is exposed during the Shondoni Project or during any future exploration, mining or other development activities, the South African Heritage Resources Authority (SAHRA) should be notified immediately, all development activities must be stopped and an archaeologist accredited with the Association for Southern African Professional Archaeologist (ASAPA) should be notify in order to determine appropriate mitigation measures for the discovered finds.

This may include obtaining the necessary authorisation (permits) from SAHRA to conduct the mitigation measures.

4.5 Some remarks on terminology

Terms that may be used in this report are briefly outlined in Box 2.

Box 2. Terminologies that may be used in this report

The Heritage Impact Assessment (HIA) referred to in the title of this report includes a survey of heritage resources as outlined in the National Heritage Resources Act, 1999 (Act No 25 of 1999) (See Box 1).

Heritage resources (cultural resources) include all human-made phenomena and intangible products that are the result of the human mind. Natural, technological or industrial features may also be part of heritage resources, as places that have made an outstanding contribution to the cultures, traditions and lifestyles of the people or groups of people of South Africa.

The term 'pre-historical' refers to the time before any historical documents were written or any written language developed in a particular area or region of the world. The historical period and historical remains refer, for the Sasol Project Area, to the first appearance or use of 'modern' Western writing brought to the Eastern Highveld by the first Colonists who settled in this area during the 1830's.

The term 'relatively recent past' refers to the 20th century. Remains from this period are not necessarily older than sixty years and therefore may not qualify as archaeological or historical remains. Some of these remains, however, may be close to sixty years of age and may, in the near future, qualify as heritage resources.

It is not always possible, based on observations alone, to distinguish clearly between archaeological remains and historical remains, or between historical remains and remains from the relatively recent past. Although certain criteria may help to make this distinction possible, these criteria are not always present, or, when they are present, they are not always clear enough to interpret with great accuracy. Criteria such as square floor plans (a historical feature) may serve as a guideline. However, circular and square floors may occur together on the same site.

The term 'sensitive remains' is sometimes used to distinguish graves and cemeteries as well as ideologically significant features such as holy mountains, initiation sites or other sacred places. Graves in particular are not necessarily heritage resources if they date from the recent past and do not have head stones that are older than sixty years. The distinction between 'formal' and 'informal' graves in most instances also refers to graveyards that were used by colonists and by indigenous people. This distinction may be important as different cultural groups may uphold different traditions and values with regard to their ancestors. These values have to be recognised and honoured whenever graveyards are exhumed and relocated.

The term 'Stone Age' refers to the prehistoric past, although Late Stone Age peoples lived in South Africa well into the historical period. The Stone Age is divided into an Earlier Stone Age (3 million years to 150 000 thousand years ago) the Middle Stone Age (150 000 years to 40 000 years ago) and the Late Stone Age (40 000 years to 200 years ago).

The term 'Iron Age' refers to the last two millennia and 'Early Iron Age' to the first thousand years AD. 'Late Iron Age' refers to the period between the 16th century and the 19th century and can therefore include the historical period.

Mining heritage sites refer to old, abandoned mining activities, underground or on the surface, which may date from the pre-historical, historical or the relatively recent past.

The term 'study area', or 'Sasol Project Area' refers to the area where the developer wants to focus its development activities (refer to plan).

Phase I studies refer to surveys using various sources of data in order to establish the presence of all possible types of heritage resources in any given area.

Phase II studies include in-depth cultural heritage studies such as archaeological mapping, excavating and sometimes laboratory work. Phase II work may include the documenting of rock art, engraving or historical sites and dwellings; the sampling of archaeological sites or shipwrecks; extended excavations of archaeological sites; the exhumation of bodies and the relocation of graveyards, etc. Phase II work may require the input of specialists and requires the co-operation and approval of SAHRA.

5 CONTEXTUALISING THE SASOL PROJECT AREA

The following brief overview of pre-historical, historical, cultural and economic evidence will help to contextualise the Sasol Project Area.

5.1 Stone Age and rock art sites

Stone Age sites are marked by stone artefacts that are found scattered on the surface of the earth or as parts of deposits in caves and rock shelters. The Stone Age is divided into the Early Stone Age (ESA) (covers the period from 2.5 million years ago to 250 000 years ago), the Middle Stone Age (MSA) (refers to the period from 250 000 years ago to 22 000 years ago) and the Late Stone Age (LSA) (the period from 22 000 years ago to 200 years ago).

Dongas and eroded areas at Maleoskop near Groblersdal is one of only a few places in Mpumalanga where ESA Olduwan and Acheulian artefacts have been recorded.

Evidence for the MSA has been excavated at the Bushman Rock Shelter near Ohrigstad. This cave was repeatedly visited over a prolonged period. The oldest layers date back to 40 000 years BP and the youngest to 27 000BP.

LSA occupation of the Mpumalanga Province also has been researched at Bushman Rock Shelter where it dates back 12 000BP to 9 000BP and at Höningnestkrans near Badfontein where a LSA site dates back to 4 870BP to 200BP.

The LSA is also associated with rock paintings and engravings which were done by San hunter-gatherers, Khoi Khoi herders and EIA farmers. Approximately 400 rock art sites are distributed throughout Mpumalanga, note-ably in the northern and eastern regions at places such as Emalahleni (Witbank) (4), Lydenburg (2), White River and the southern Kruger National Park (76), Nelspruit and the Nsikazi District (250). The Ermelo area holds eight rock paintings.

The rock art of the Mpumalanga Province can be divided into San rock art which is the most wide spread, herder or Khoe Khoe paintings (thin scattering from the Limpopo Valley) through the Lydenburg district into the Nelspruit area) and localised late white farmer paintings. Farmer paintings can be divided into Sotho-Tswana finger paintings and Nguni engravings (Only 20 engravings occur at Boomplaats, north-west of Lydenburg). Farmer paintings are more localised than San or herder paintings and were mainly used by the painters for instructional purposes.

During the LSA and Historical Period, San people called the Batwa lived in sandstones caves and rock shelters near Lake Chrissie in the Ermelo area. The Batwa are descendants of the San, the majority of which intermarried with Bantu-Negroid people such as the Nhlapo from Swazi-descend and Sotho-Tswana clans such as the Pai and Pulana. Significant intermarriages and cultural exchanges occurred between these groups. The Batwa were hunter-gatherers who lived from food which they collected from the veldt as well as from the pans and swamps in the area. During times of unrest, such as the *difaqane* in the early nineteenth century, the San would converge on Lake Chrissie for food and sanctuary. The caves, lakes, water pans and swamps provided relatively security and camouflage. Here, some of the San lived on the surfaces of the water bodies by establishing platforms with reeds. With the arrival of the first colonists in the nineteenth century many of the local Batwa family groups were employed as farm labourers. Descendants of the Batwa people still live in the larger Project Area.

5.2 Iron Age remains

The Iron Age is associated with the first agro-pastoralists or farming communities who lived in semi-permanent villages and who practised metal working during the last two millennia. The Iron Age is usually divided into the Early Iron Age (EIA) (covers the 1st millennium AD) and the Later Iron Age (LIA) (covers the first 880 years of the 2nd millennium AD).

Evidence for the first farming communities in the Mpumalanga Province is derived from a few EIA potsherds which occur in association with the LSA occupation of the Höningnest Shelter near Badfontein. The co-existence of EIA potsherds and LSA stone tools suggest some form of ‘symbiotic relationship’ between the Stone Age hunter-gatherers who lived in the cave and EIA farmers in the area (also note Batwa and Swazi/Sotho Tswana relationship).

The Welgelegen Shelter on the banks of the Vaal River near Ermelo also reflects some relationship between EIA farmers who lived in this shelter and hunter-gatherers who manufactured stone tools and who occupied a less favourable overhang nearby during AD1200.

EIA sites were also investigated at Sterkspruit near Lydenburg (AD720) and in Nelspruit where the provincial governmental offices were constructed. The most infamous EIA site in South Africa is the Lydenburg head site which provided two occupation dates, namely during AD600 and from AD900 to AD1100. At this site the Lydenburg terracotta heads were brought to light. Doornkop, located south of Lydenburg, dates from AD740 and AD810.

The Late Iron Age is well represented in Mpumalanga and stretches from AD1500 well into the nineteenth century and the Historical Period. Several spheres of influence, mostly associated with stone walled sites, can be distinguished in the region. Some of the historically well known spheres of influence include the following:

- Early arrivals in the Mpumalanga Province such as Bakone clans who lived between Lydenburg and Machadodorp and Eastern Sotho clans such as the Pai, Pulana and Kutswe who established themselves in the eastern parts of the province.
- Swazi expansion into the Highveld and Lowveld of the Mpumalanga Province occurred during the reign of Sobhuza (AD1815 to 1836/39) and Mswati (AD1845 to 1868) while Shangaan clans entered the province across the Lembombo Mountains in the east during the second half of the nineteenth century.
- The Bakgatla (Pedi) chiefdom in the Steelpoort Valley rose to prominence under Thulare during the early 1800’s and was later ruled by Sekwati and

Sekhukune from the village of Tsjate in the Leolo Mountains. The Pedi maintained an extended sphere of influence across the Limpopo and Mpumalanga Provinces during the nineteenth century.

- The Ndzundza-Ndebele established settlements at the foot of the Bothasberge (Kwa Maza and Esikhunjini) in the 1700’s and lived at Erholweni from AD1839 to AD1883 where the Ndzundza-Ndebele’s sphere of influence became known as KoNomthjarhelo which stretched across the Steenkampsberge.
- The Bakopa lived at Maleoskop (1840 to 1864) where they were massacred by the Swazi while the Bantwane live in the greater Groblersdal and Marble Hall areas.
- Corbelled stone huts which are associated with ancestors of the Sotho on Tafelkop near Davel which date from the AD1700’s into the nineteenth century.
- Stone walled settlements spread out along the eastern edge of the Groot Dwarsriver Valley served as the early abode for smaller clans such as the Choma and Phetla communities which date from the nineteenth century.

5.3 The Historical Period

Historical towns closest to the Sasol Project Area include Leandra, Kinross, Evander and Secunda.

The town of Leandra’s name is derived from two townships, Leslie and Eendrag, which are incorporated in this mining village.

Kinross, about 20 km east of Leandra, is the railhead for the township of Leandra and four gold mines in the region, namely Winkelhaak, Leslie, Bracken and Kinross who all opened in the 1950's.

The village was proclaimed in the 1915 and named for Kinross in Scotland by the engineers who constructed the railway line between Springs and Breyton. Kinross is near the watershed that separates the rivers flowing towards the Indian Ocean in the east and the rivers flowing towards the Atlantic Ocean in the west.

Secunda developed around Sasol 1 and Sasol 2 in the 1970's. Sasol was born during the oil crisis of 1973 when OPEC virtually quadrupled the price of crude oil overnight. Construction started in 1976 and the first oil was delivered on 1 March 1980. Following the overthrow of the Shah of Iran in 1979, South Africa's major source of crude oil at the time, the government announced the construction of a second plant at Secunda to double output. Sasol 3 delivered its first oil from coal in May 1982. The total costs of the two plants came to R 5,8 billion, mostly financed by levies on motorists.

Sasol 2 and 3 use about 35 million tons of coal a year to produce mostly liquid fuels. The coal is produced by four mines collectively known as Secunda Colliers which is the world's largest underground mining complex and by a new open-cast mine at Syferfontein.

Evander, south of Kinross, was established in 1955 by the Union Corporation as a residential township for the employees of the Winkelhaak. Leslie and Bracken mines. The name Evander is a composite of Evelyn and Anderson, the names of the widow of the managing director of the company when prospecting began in the area.

Several large coal mines which feed the Sasol plants at Secunda and Eskom’s giant power stations on the Eastern Highveld are located near the project area. The Sasol Project Area is one of the most productive agricultural areas in the country. The principal crops which are produced in the region include maize, wheat, sorghum, dairy, potatoes and other vegetables.

5.4 A coal mining heritage

Coal mining on the Eastern Highveld is now older than one century and has become the most important coal mining region in South Africa**.** Whilst millions of tons of high-grade coal are annually exported overseas more than 80% of the country’s electricity is generated on low-grade coal in Eskom’s power stations such as Duvha, Matla and Arnot situated near coalmines on the Eastern Highveld.

The earliest use of coal (charcoal) in South Africa was during the Iron Age (300-1880AD) when metal workers used charcoal, iron and copper ores and fluxes (quartzite stone and bone) to smelt iron and copper in clay furnaces.

Colonists are said to have discovered coal in the French Hoek Valley near Stellenbosch in the Cape Province in 1699. The first reported discovery of coal in the interior of South Africa was in the mid-1830 when coal was mined in Kwa Zulu/Natal.

The first exploitation for coal was probably in Kwa Zulu/Natal as documentary evidence refers to a wagon load of coal brought to Pietermaritzburg to be sold in 1842. In 1860 the coal trade started in Dundee when a certain Pieter Smith charged ten shillings for a load of coal dug by the buyer from a coal outcrop in a stream. In 1864 a coal mine was opened in Molteno. The explorer, Thomas Baines mentioned that farmers worked coal deposits in the neighbourhood of Bethal (Transvaal) in 1868. Until the discovery of diamonds in 1867 and gold on the Witwatersrand in 1886, coal mining only satisfied a very small domestic demand.

With the discovery of gold in the Southern Transvaal and the development of the gold mining industry around Johannesburg came the exploitation of the Boksburg-Spring coal fields, which is now largely worked out. By 1899, at least four collieries were operating in the Middelburg-Witbank district, also supplying the gold mining industry. At this time coal mining also has started in Vereeniging. The Natal Collieries importance was boosted by the need to find an alternative for imported Welsh anthracite used by the Natal Government Railways.

By 1920 the output of all operating colliers in South Africa attained an annual figure of 9,5million tonnes. Total in-situ reserves were estimated to be 23 billion tonnes in Witbank-Springs, Natal and Vereeniging. The total in situ reserves today are calculated to be 121 billion tonnes. The largest consumers of coal are Sasol, Iscor and Eskom.

5.5 A vernacular stone architectural heritage

A unique stone architectural heritage was established in the Eastern Highveld from the second half of the 19th century well into the early 20th century. During this time period stone was used to build farmsteads and dwellings, both in urban and in rural areas. Although a contemporary stone architecture also existed in the Karoo and in the Eastern Free State Province of South Africa a wider variety of stone types were used in the Eastern Highveld. These included sandstone, ferricrete ('ouklip'), dolerite ('blouklip'), granite, shale and slate.

The origins of a vernacular stone architecture in the Eastern Highveld may be ascribed to various reasons of which the ecological characteristics of the region may be the most important. Whilst this region is generally devoid of any natural trees which could be used as timber in the construction of farmsteads, outbuildings, cattle enclosures and other structures, the scarcity of fire wood also prevented the manufacture of baked clay bricks. Consequently stone served as the most important building material in the Eastern Highveld.

LIA Sotho, Pedi, Ndebele and Swazi communities contributed to the Eastern Highveld's stone walled architecture. The tradition set by these groups influenced settlers from Natal and the Cape Colony to utilize the same resources to construct dwellings and shelters. Farmers from Scottish, Irish, Dutch, German and Scandinavian descend settled and farmed in the Eastern Highveld. They brought the knowledge of stone masonry from Europe. This compensated for the lack of fire wood on the eastern Highveld which was necessary to bake clay bricks.

6 THE PHASE I HERITAGE IMPACT ASSESSMENT

6.1 Types and ranges of heritage resources

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

- Farmstead complexes associated with historical houses, outbuildings and cattle enclosures.
- Informal and formal graveyards.
- A commemorative beacon.

Remains from the recent past also occur in the Sasol Project Area but have no historical significance and therefore were not geo-referenced or mapped and are not discussed in this report.

These heritage resources were geo-referenced and mapped (Figure 2, Tables 1-2).

The significance of the heritage resources is indicated and mitigation measures are outlined for those heritage resources which may be affected by the Sasol Project.

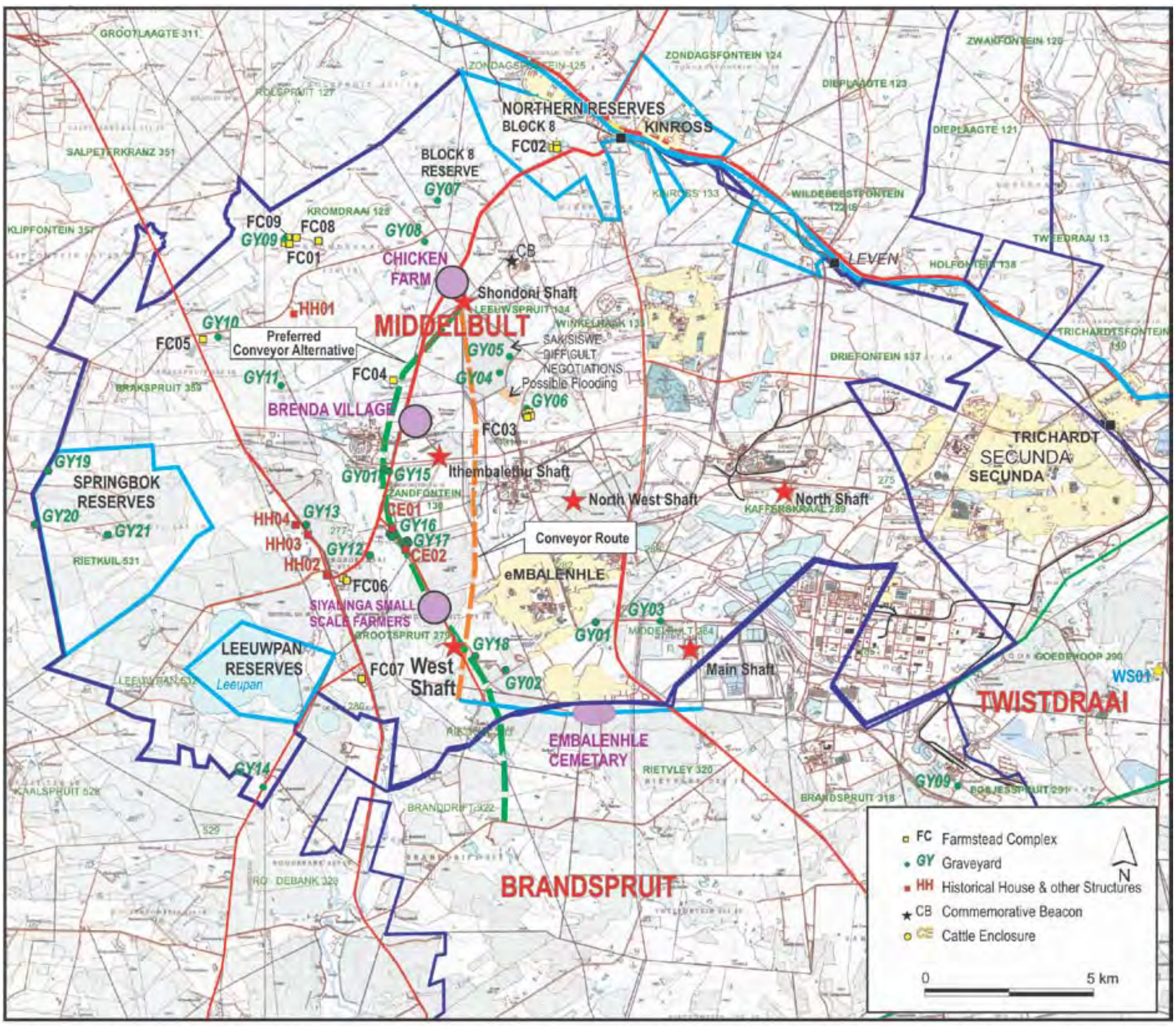


Figure 2- The Sasol Project Area involves the various developmental components for the Sasol Project as well as three portions of land (with coal reserves) which constitute Block 8.

Note the presence of farmstead complexes, historical structures such as cattle enclosures and graveyards in and near the Sasol Project Area (above).

6.2 Historical structures

Historical structures are divided into farmstead complexes and historical houses.

6.2.1 Farmstead complexes

The following farmstead complexes were observed in the Middelbult Mining Area.

6.2.1.1 Farmstead Complex 01

FC01 on Kromdraai 128IS is associated with some of the oldest graves that were observed in the area. The complex comprises of the following individual buildings:

- A wagon shed which was constructed with sandstone bricks and dolerite stone.
- A rondavel which was constructed with dolerite.
- An extended residence which was built with sandstone and dolerite stone.
- A cattle enclosure with exceptionally high walls which was probably used as an enclosure for cattle but which may also has served as a wagon shed.

Figure 3- A historical wagon shed on Kromdraai 128IS which is part of FC01 (above).

Figure 4- The main residence in FC01 on Kromdraai 128IS consists of a residence which was built with sandstone bricks and dolerite stone (above).

6.2.1.2 Farmstead Complex 02

This farmstead complex on Winkelhaak 139IS is occupied by Mr. Frikkie Oosthuizen and his wife and comprises of the following individual structures:

- An excellently well preserved main residence in an Edwardian style which was constructed with sandstone and with 'stoeps' (verandas) on at least two sides. It is fitted with a pitched iron corrugated roof.
- A wagon shed which was constructed with sandstone and which is fitted with a pitched corrugated iron roof.
- A possible 'bywonershouse' which was constructed with sandstone and which is fitted with a pitched corrugated iron roof.

Figures 5 & 6- The main residence on Winkelhaak 139IS with Edwardian features and the 'bywonershuis' (above and below). Both structures were constructed with sandstone in FC02.

6.2.1.3 Farmstead Complex 03

This farmstead complex on Witkleifontein 181IS is associated with the Pieterse family whose remains occur in a graveyard (GY06) some distance from the farmstead complex. This complex holds the following individual structures:

- A wagon shed which was constructed with sandstone bricks and dolerite stone.
- A small square structure which was constructed with dolerite stone, possibly a 'bywonershuis' or cool room ('koelkamer').
- A main residence which was constructed with sandstone bricks and with dolerite stones.
- An elongated cattle enclosure which was built with rocks.

Figure 7- A possible 'bywonershuis' or a cool room ('koelkamer') on Witkleifontein 181IS which was constructed with dolerite stone in FC03 (above).

Figure 8- A cattle enclosure on Witkleifontein 181IS which is part of FC03 which was constructed with stones (above).

6.2.1.4 Farmstead complex 04

This farmstead complex on Zandfontein 190IS is currently occupied by the Brits family and involves a number of individual buildings, namely:

- A residence constructed with sandstone.
- A wagon shed constructed with sandstone.

This farmstead complex was not accessible at the time when the fieldwork was done.

6.2.1.5 Farmstead complex 05

This farmstead complex on Brakspruit 359IH belongs to the Bekker family and consists of the following individual buildings, namely:

- Three wagon sheds next to each other which were constructed with clay bricks and whose walls are plastered. The sheds are fitted with pitched corrugated iron roofs.
- A main residence which was constructed with clay bricks and whose walls are plastered. The house is fitted with a pitched corrugated iron roof. This residence dated from the 1930/40's.

6.2.1.6 Farmstead complex 06

This farmstead complex on Springbokdraai 277IS is located near the T-junction between the Kinross road with the Leandra-Balfour road on Springbkdraai 277IS and incorporates the following two structures:

- A wagon shed constructed with corrugated zinc
- A dilapidated sandstone house.

These two structures are standing on a slight rise overlooking part of the Eastern Highveld.

6.2.1.7 Farmstead complex 07

This farmstead complex is located on Vaalbank on Roodebank 325IS to the south-east of Leeuwpan and consists of the following buildings and structures, namely:

- A house constructed with sandstone and fitted with a pitched corrugated iron roof.
- Large shed constructed with sandstone fitted with a pitched corrugated iron roof and a stand for a water tank.
- Diary constructed with sandstone and fitted with a pitched corrugated iron roof.

6.2.2 Historical houses and other structures

A number of individual structures, mostly houses with historical significance occur in the Sasol Project Area. Some may have been part of farmstead complexes but may represent the only structures that are left of these historical complexes.

6.2.2.1 Historical House 01

This farm residence on Brakspruit 359IH is fitted with a pitched corrugated iron roof. It was constructed with clay bricks and its walls are plastered.

This residence probably dates from the 1920's. It is associated with an outbuilding which probably served as a garage for a vehicle.

Figure 9- The historical house on Brakspruit 359IH which probably dates from the 1910/20's (above).

6.2.2.2 Historical House 02

This sandstone house on Rietkuil 531IR near the T-junction between the Kinross road with the Leandra-Balfour road is partly constructed with sandstone and possibly with clay bricks as well. It is fitted with a pitched corrugated iron roof and is painted green.

6.2.2.3 Historical House 03

This house on Rietkuil 531IR next to the Leandra-Balfour road was constructed during the 1930/40's and was built with clay bricks and cement. The walls of the house were plastered with cement and it is fitted with a pitched corrugated iron roof. It belongs to the De la Rey family.

Figure 10- A wagon shed constructed with sandstone on Rietkuil 531IR next to the Leandra-Balfour road (above).

6.2.2.4 Historical House 04

This house on Rietkuil 531IR next to the Leandra-Balfour road was constructed during the 1930/40's and was built with clay bricks and cement.

The front part of HH04 is fitted with a gable. The walls of the house were plastered with cement and it is fitted with a pitched corrugated iron roof. This residence belongs to the De la Rey family.

6.2.2.5 Wagon shed

This wagon shed on Rietkuil 531IR was constructed with sandstone and fitted with a pitched corrugated iron roof.

6.2.2.6 Cattle enclosures

Two cattle enclosures are located on the high ridge where the proposed overland conveyor belt will be constructed. Both enclosures were constructed with dolerite stone and are rectangular in ground plan.

The two enclosures (CE01, CE02) are respectively associated with GY16 and GY17.

It is highly likely that the two enclosures were associated with farm dwellings as well as with the graveyards but that the original farm dwellings have been demolished a long time ago.

Figure 11- One of two cattle enclosures built with dolerite stone in the Sasol Project Area (above).

Historical structures	**Coordinates**	**Significance**
Farmstead complex (FC01) This farmstead complex on Kromdraai 128IS consists of the following structures: Main residence (FC01a) Wagon shed (FC01b) Rondavel (FC01c) Cattle kraal (FC01d)	26° 27.026' 29˚ 00.328' 26° 27.001' 29˚ 00.855' 26° 27.021' 29˚ 00.331' 26° 27.022' 29˚ 00.364'	**HIGH**
Farmstead complex (FC02) This farmstead complex on Winkelhaak 139IS consists of the following structures: Main residence (FC01a) Wagon shed (FC02b) 'Bywonershuis' (FC02c)	26° 25.507' 29˚ 04.590' 26° 25.500' 29˚ 04.624' 26° 25.499' 29˚ 04.645'	**HIGH**
Farmstead complex (FC03) This farmstead complex on Witkleifontein 181IS is associated with the Pieterse family and consists of the following structures: Main residence (FC03a) Wagon shed (FC03b) 'Bywonershuis' (Cool room) (FC03c) Elongated cattle enclosure (FC03d)	26° 29.761' 29˚ 04.209' 26° 29.723' 29˚ 04.204' 26° 29.756' 29˚ 04.216' 26° 29.747' 29˚ 04.166'	**HIGH**
Farmstead complex (FC04) This farmstead complex on Zandfontein 190IS is occupied consists of the following structures: Main residence Wagon shed 'Bywonershuis'	26° 29.209' 29˚ 02.037'	**HIGH**
Farmstead complex (FC05) This farmstead complex on Brakspruit 359IH holds the following structures: Main residence (1930/40's) (FC05a))Three Wagon shed (FC05b)	26° 30.616' 29˚ 59.995'	**HIGH**
Farmstead complex (FC06) This farmstead complex on Springbokdraai 277IS holds the following structures: A wagon shed constructed with corrugated iron (FC06a) A dilapidated sandstone house (FC06b)	26° 32.400' 29˚ 01.283' 26° 32.376' 29˚ 01.256'	**HIGH**

Farmstead complex (FC07) This farmstead complex on Springbokdraai 277IS holds the following structures: A wagon shed constructed with sandstone A residence constructed with sandstone A diary constructed with sandstone A stand for a water tank	26° 33.971' 29˚ 01.538'	**HIGH**
Historical House 01 Farm house on Brakspruit 359IH	26° 28.156' 29˚ 00.453'	**HIGH**
Historical House 02 Farm house on Springbokdraai 277IS	26° 32.290' 29˚ 01.043'	**HIGH**
Historical House 03 Farm house on Rietkuil 531IR next to the Leandra-Balfour road (De la Rey)	26° 31.666' 29˚ 00.720'	**HIGH**
Historical House 04 Second farm house on Rietkuil 531IR next to the Leandra-Balfour road (De la Rey)	26° 27.825' 29˚ 58.364'	**HIGH**
Wagon shed (WS) Wagon shed on Rietkuil 531IR constructed with sandstone next to the Leandra-Balfour road	26° 28.119' 29˚ 58.687'	**HIGH**
Cattle enclosure (CE01)	26º 31.636' 29º 02.027'	**HIGH**
Cattle enclosure (CE02)	26º 31.962' 29º 02.257'	**HIGH**

Table 1- Coordinates and significance rating for historical structures in the Middelbult Mining Area (above).

6.2.3 Graveyards

The following graveyards were observed in the Middelbult Mining Area:

6.2.3.1 Graveyard 01

This large informal cemetery is located at a crossing between several rural villages and squatter camps on Langverwacht 282IS and holds hundreds of graves. It seems as if the graveyard is divided into two sections.

6.2.3.2 Graveyard 02

This graveyard is located on the southern perimeter of a rural village on Grootspruit 479IS near Eskom's existing power lines and holds as many as forty graves. Most of the graves are fitted with cement headstones and a few with granite headstones.

Inscriptions on a few of the headstones read as follow:

- 'Jonas Ramokhampe Oompie Mooketsi O hlahle ka 24-10-1937 A hlokahahla KA 16-01-1962'
- 'Andries Mfungeni 18-4-1963 20-12-1963'
- 'Alfred Mawela Mofokeng 1905 1975-09-28'

6.2.3.3 Graveyard 03

This graveyard is located on the northern shoulder of the road on Middelbult 289IS that runs to Sasol's main gate. It contains approximately twelve graves. A few of the graves are demarcated with red clay bricks and fitted with cement head stones. No inscriptions are visible on any of the headstones of the graves.

Figures 12 & 13- GY02 is a historical graveyard located in close proximity of Eskom's existing power lines (above). GY03 is located on the northern shoulder of the road running to one of Sasol's entrance gates (below).

6.2.3.4 Graveyard 04

This historical graveyard is located near the abandoned farmstead complex of J.C. Kruger on Witkleifontein 138IS and holds the remains of six visible graves two of which are covered with piles of stone; three are fitted cement head and tombstones and one is decorated with a granite tombstone and headstone. The inscription on the headstone reads as follow:

- ‘Hier rus ons moeder Jaenetta Jacoba Nel Gebore Gouws 18-3-1895 Oorlede 21-12-1939’

Figure 14- The historical graveyard on Witkleifontein 138IS dates from the 20th century and even possibly from the 19th century.

6.2.3.5 Graveyard 05

This informal graveyard on Witkleifontein 138IS is located in the midst of a squatter camp. It holds the remains of approximately twenty individuals. Most of the graves are covered with piles of stone. A few cement headstone occur.

Figure 15- An informal graveyard on Witkleifontein 138IS which is barely visible in the midst of a squatter camp (above).

6.2.3.6 Graveyard 06

This historical graveyard on Witkleifontein 138IS is associated with Farmstead Complex 03 and holds the remains of approximately twelve individuals, mostly from the Pieterse family.

GY06 is located in open veldt some distance from the farmstead complex. Most of the graves are covered with cement tombstones. A few granite headstones occur as well as a marble headstone. The inscriptions on these headstones read as follow:

- ‘Hier rus my dierbare eggenoot ons vader en grootvader Gielaum Jacobus Pieterse Gebore 28-10-1892 Oorlede 28-?-1954 Jes 40:7 Die gras verdor die blom verwelk’
- ‘Hier rus ons moeder en grootmoeder Elizabetha Magrietha Pieterse Gebore van den Berg 7-12-1895 Oorlede 17-3-1958 Uit liefde vir al u sorg en trou’
- Hier rus my geliefde eggenoot Barend Paul Pieterse Gebore 19 Julie 1835 Oorlede 23 November 1916 Gesang 62 Heilig Jesus Heilig my’

Figure 16- Historical graveyard 06 of the Pieterse family near farmstead complex (FC03) in open veldt. Some of the graves have been vandalised (above).

6.2.3.7 Graveyard 07

This informal graveyard on Kromdraai 128IS is located within a patch with cosmos flowers. The graveyard is overgrown but holds the remains of at least ten individuals.

Inscriptions on some of the granite headstones read as follow:

- ‘Dlamini Finose *22-09-1942 †19-04-1992 Lala Ngokuthula Siyakuthanda’
- ‘Mashiyane Jabulane Born 25-08-1943 Died 16-01-1990 lala ngo xolo’
- ‘In memory of our mother Merriam Moldieni Mashiane *01-03-1937 28-02-1948’

Figure 17– An informal graveyard with at least ten graves in a field with cosmos flowers on Kromdraai 128IS (above).

6.2.3.8 Graveyard 08

This informal graveyard Kromdraai 128IS is located next to a border fence and contains approximately ten graves. Only two of the graves are fitted with cement headstones with no inscriptions.

6.2.3.9 Graveyard 09

This historical graveyard on Kromdraai 128IS is currently overgrown with popular trees. It may hold as many as ten or more graves, most of which comprises of heaps of dolerite stone.

One of the graves is fitted with a cement head stone which bears the following inscription:

- ‘Hier rust Sameul Pieter Marthinus Mulder BG 16 Januarie 1882 Gesneuveld 12 Mei 1901 Gs 22 Rus my siel u God is koning wees tevrede met u lot’

A second gave contains a weathered sandstone headstone with the following inscription:

- ‘Jan Simon Venter Voortrekker’

6.2.3.10 Graveyard 10

This informal graveyard on Brakspruit 359IH contains as many as fifty graves. Most of the graves are covered with piles of stone. Some are fitted with cement headstones.

6.2.3.11 Graveyard 11

GY11 is a historical graveyard on Brakspruit 359IH and is located near Eskom’s 400kV power line. This small demarcated graveyard is overgrown but may hold as many as six graves.

Inscriptions on some of the headstones read as follow:

- ‘J.J. Oberholster 1880-1945 Hier rus Josea Jacobus Oberholster Gebore 19 Februarie 1892 Oorlede 22-?-1895 Ges 29 V3’
- ’Hier rus ons moeder Magdalena Dreyer Gebore Jun1895 Overlede 5 Julie 1933 Ges V1’

Figure 18– A historical graveyard on Brakspruit 359IH in open veldt near Eskom’s power lines (above).

6.2.3.12 Graveyard 12

This graveyard on Zandfontein 230IS is located near the Kinross road which is linked with the road running between Leandra and Balfour. It is also situated near Eskom’s 400kV power line. GY12 holds approximately seven graves consisting of three heaps of stone, two with granite headstones and two with cement headstones and cement edges.

Inscriptions on two of the granite headstones read as follow:

- 'Mathebesi Mahlangu washona 1969-05-22 Lala ngoxolo sobona na kwelizayo yimi u sesi stand 3556 x10 Leskie'
- 'Miss Sara Mndawesi Born 1918 Died Nov 1962'

6.2.3.13 Graveyard 13

This graveyard is located on Springbokdraai 277IS in a soya field next to the road running to Leandra. It holds an unknown number of graves. The following can be distinguished: four graves with cement head stones; two graves with granite headstones and at least two stone piles.

Inscriptions on the granite headstones read as follow:

- 'Lizz Mathakwende 20-10-1977'
- 'Oubaas James Mathakwende 1948'

6.2.3.14 Graveyard 14

This is a large historical graveyard on Roodebank 329IS which is located on the eastern shoulder of the R547.

Most of the graves are decorated and are fitted with sandstone, marble and granite headstones and other decorations.

At the time of the survey the graveyard could not be accessed to obtain inscriptions on the headstones due to heavy downpours.

Figure 19- GY14 is a large historical graveyard on Roodebank 329IS on the eastern shoulder of the R547 (above).

6.2.3.15 Graveyard 15

GY15 is located in a Blue Gum plantation near the western shoulder of the road running to Kinross further to the north. It holds the remains of at least eleven individuals. All the graves are covered with piles of stone. Only one is fitted with a granite headstone with the following inscription:

- 'Maria Mahlangu 31-12-1974'

6.2.3.16 Graveyard 16

This historical graveyard is situated on the higher ridge where the proposed conveyor belt will be constructed. GY16 holds at least seven graves of which four are lined with cement strips and fitted with headstones. Inscriptions on the headstones are indecipherable. Three graves are covered with piles of stone.GY02 is demarcated with a low wall which was constructed with dolerite.

6.2.3.17 Graveyard 17

GY17 is demarcated with a solidly constructed dolerite wall and is also located on the high ridge where the proposed conveyor belt will be constructed.

This graveyard holds at least five or six graves which all have been vandalised. Only one cement headstone is still standing. It has the following inscription:

- ‘Hier rus Jan Hendrik Adriaan Roets Geb 24 Mei 1859 Oorl 28 Sept 1940 Ges 182:1’

Figure 20- GY17 is one of two historical graveyards located on a ridge in close proximity of Sasol’s proposed new conveyor belt (above).

6.2.3.18 Graveyard 18

GY18 is located on the northern shoulder of the tar road running to the Middelbult West Shaft. It contains as many as thirteen graves mostly covered with piles of stone. A few of the graves are fitted with cement headstones which have the following inscriptions:

- ‘Dorema Bhava wala Ngoaku Lusa lalango xolo’
- ‘Musafa Macuva washona 14-2-1971’

Figure 21- GY18 holding approximately thirteen graves next to the road running to the Middelbult West Shaft (above).

6.2.3.19 Graveyard 19

This graveyard contains approximately fifty graves which are located on both sides (west and east) of the border fence for the Springbok Reserves. Several of the graves are covered with stones while another number are fitted with granite and concrete headstones and edged with the same material.

Inscriptions on a few of the headstones read as follow:

- ‘Mokgathle Raborifi 12-12-62 – 39-03-63 Robala Kakootso’
- ‘Robala ka kgotso Ntate wa Rona JMK, born 17-12-901 Died 18-5-1979 Segopotso sa Raborifi’
- ‘* 1949-11-30 † 1950-02-02 Mamojakgomo robala kakgotso phuti Robala ka khotso Masipati R Nyakale Born 20-2-1872 Died 2-12-1949’

Figure 22- GY19 on both sides of a fence holds at least fifty graves, some of which seems to have been vandalised in the more recent past (above).

6.2.3.20 Graveyard 20

This historical graveyard is demarcated with a low wall which was constructed with dolerite stone of which the outer surface was chiselled and chipped in order to obtain a roughened surface which was darkened with some substance. The top of the wall was constructed with sandstone. GY07 contains the graves of three children of the Bezuidenhout family. The headstones of the graves were manufactured from sandstone and bear the following inscriptions:

- ‘Hier light begraven ons geliefd zoontje Geboren 22 November 1891 Overleden 19 April 1892 Zoon van EJ Bezuidenhout en WCJ Bezuidenhout’
- ‘Hier light begraven on steer geliefd dochtertjie Jacomina Hendrina Johanna Bezuidenhout Geboren 27 Februyarie 1885 Overleden 19 Februarie 1886’
- Hier rust onze geliefde dochter Anna Magdalena Bezuidenhout Geboren 7 Augustus 1882 Overleden 22 Julie 1892’

6.2.3.21 Graveyard 21

Graveyard 21 is a historical graveyard which holds the remains of the Du Plooy and Booysen families. Six graves can be identified. They are all fitted with marble (one), sandstone (three) and cement headstones (three). These headstones bear the following inscriptions, namely:

- 'Hier rus ons geliefde eggenote en vader Frederik Carel Booysen Geb 30 Mei 1885 Oorl 28 Junie 1944 Openb 14 V13 Salig is van nouaf die dode wat in die Here sterwe MCB'
- 'Hier rus Francois N Booysen Geb 8-2-1930 Oorl 30-11-1939'
- 'Cornelle Johannes Du Plooy Geb 14 Junie 1927 Ovl 7 April 1929 Veilig in Jesus Armen Rus in Vrede'
- 'Petrus Nuclaas Johannes Du Plooy Geb 6 April 1922 Ovl 3 April 1928 Gez 181 Vers 4'
- 'Hier rus Frederik J Botha Geb 5-8-1871 Ovl 30-8-1938'

Figure 23- The wall that demarcates GY20 is constructed with dolerite stone and capped with sandstone trimmings (above).

Graveyards	Coordinates	Significance
GY01. Large graveyard on Langverwacht 282IS between villages	26° 33.081' 29˚ 05.181'	**HIGH**
GY02. Graveyard on Rietkuil 333IS close to Eskom's power lines on outskirts of village		**HIGH**
GY03. Graveyard on Middelbult close to one of Eskom's entrance gates	26º 33.021' 29º 06.294	**HIGH**
GY04. J.C. Kruger's abandoned farmstead complex on Witkleifontein 181IS with six graves	26° 29.095' 29˚ 03.740'	**HIGH**
GY05. Graveyard on Witkleifontein 181IS in squatter camp.	26° 28.845' 29˚ 03.902'	**HIGH**
GY06. Pieterse graveyard on Witkleifontein 181IS in open veldt near historical farmstead complex	26° 29.656' 29˚ 04.158'	**HIGH**
GY07. Graveyard on Kromdraai 128IS in patch with cosmos flowers	26° 26.288' 29˚ 02.421'	**HIGH**
GY08. Graveyard on Kromdraai 128IS next to a border fence	26° 26.940' 29˚ 00.491'	**HIGH**
GY09. Voortrekker graves on Kromdraai 128IS	26° 26.965' 29˚ 00.371'	**HIGH**
GY10. Informal graveyard on Brakspruit IH	26° 28.573' 29˚ 59.750'	**HIGH**
GY11. Voortrekker graves on Brakspruit IH near Eskom's power lines	26° 29.284' 29˚ 00.225'	**HIGH**
GY12. On Zandfontein 230IS next to Kinross road and Eskom's 400kV power line.	26° 31.999' 29˚ 01.658'	**HIGH**
GY13. Next to road running between Leandra and Balfour on Springbokdraai 277IS.	26° 31.509' 29˚ 00.658'	**HIGH**
GY14. Graveyard on the eastern shoulder of the R547	26º 35.689' 28º 59.972'	**HIGH**
GY15. Approximately 11 graves in a Blue Gum plantation next to tar road.	26º 30.679' 29º 01.969'	**HIGH**
GY16.Historical graveyard on ridge. (Four corner posts, use one coordinate)	26º 31.682' 29º 02.036' 26º 31.684' 29º 02.029' 26º 31.680' 29º 02.031' 26º 31.691' 29º 02.036'	**HIGH**
GY17. Second historical graveyard on ridge. (Four corner posts, use one coordinate)	26º 31.842' 29º 02.281' 26º 31.844' 29º 02.256' 26º 31.835' 29º 02.259' 26º 31.835' 29º 02.254'	**HIGH**
GY18. Approximately 13 graves next to tar road	26º 33.675' 29º 03.375'	**HIGH**

running to the Middelbult West Shaft		
GY19. Approximately 50 graves located on both sides of the western border of the Springbokdraai Reserves	26º 30.650' 29º 56.515'	**HIGH**
GY20. Holds the remains of three children of the Bezuidenhout family	26º 31.548' 28º 56.282'	**HIGH**
GY21. Holds the remains of the Du Plooy and Booysen families	26º 31.701' 28º 57.450'	**HIGH**

Table 2- Coordinates and significance rating for graveyards in the Middelbult Mining Area (above).

6.2.2.3 Commemorative beacon

A commemorative beacon for mine workers who died in a mine accident on 16 September 1986 is erected within the confines of Harmony's No 8 Shaft complex. This granite tombstone bears the following inscription:

- 'In memory of the employees who died in the disaster 16 September 1986. Erected 16 September 1995'

A Karee tree (*Rhus Lancea*) was planted next to the commemorative beacon to commemorate this event on 16 September 1994.

Figure 24- A commemorative beacon in honour of mine workers who died during a mine disaster on 16 September 1986 in the No 8 Shaft of Harmony gold mine (above).

Heritage resource	Coordinates	**Significance**
Commemorative beacon	26° 27.312' 29˚ 03.924'	**HIGH**
Karee tree	26° 27.312' 29˚ 03.924'	**HIGH**

Table 3- Coordinates and significance rating for commemorative beacon and Karee tree in the No 8 Harmony gold shaft in the Middelbult Mining Area (above).

7 THE SIGNIFICANCE, POSSIBLE IMPACT ON AND MITIGATION OF THE HERITAGE RESOURCES

7.1 Types and ranges of heritage resources

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

- Farmstead complexes associated with historical houses, outbuildings and cattle enclosures.
- Informal and formal graveyards.
- A commemorative beacon.

7.2 The significance of the heritage resources

It is possible that a farmstead complex (FC04), graveyards (GY15, GY16, GY17 and GY18) as well as a cattle enclosure (CE02) may be affected (impacted) by the Sasol Project. The significance of the various types and ranges of heritage resources in the Sasol Project Area therefore is indicated whilst mitigation measures are outlined for those heritage resources which may be affected by the Sasol Project.

The significance of the heritage resources in the Sasol Project Area is indicated by means of stipulations derived from the National Heritage Resources Act (No 25 of 1999).

7.2.1 The farmstead complex and cattle enclosure

The historical farmstead complexes as well as the cattle enclosure are older than sixty years and therefore are protected by Section 34 of the National Heritage Resources Act (No 25 of 1999). The significance of the historical farmsteads complexes as well as the cattle enclosures therefore has been indicated as high (Table 1).

The level of significance of these heritage resources is determined by means of criteria such as their historical, cultural (social), aesthetic, technological and scientific value in relation to their uniqueness, state of preservation and research potential. Heritage resources which have low significance are viewed as fully recorded during this survey. Any impact on these heritage resources therefore are considered to be low. Heritage resources with medium to high significance will require further mitigation and/or management measures.

7.2.2 Graveyards and graves

All graveyards and graves can be considered to be of high significance and are protected by various laws (Table 2). Legislation with regard to graves includes Section 36 of the National Heritage Resources Act (No 25 of 1999) whenever graves are older than sixty years.

The act also distinguishes various categories of graves and burial grounds. Other legislation with regard to graves includes those which apply when graves are exhumed and relocated, namely the Ordinance on Exhumations (No 12 of 1980) and the Human Tissues Act (No 65 of 1983 as amended).

7.2.3 A commemorative beacon

The commemorative beacon in the No. 8 Harmony gold shaft in the Middelbult Mining Area will not to be affected by future coal mining activities and are therefore not further discussed.

7.3 Mitigating the heritage resources

The following mitigation measures have to be followed whenever FC04, CE02 and GY15 to GY18 are to be affected by the Sasol Project.

7.3.1 The farmstead complex and cattle enclosure

The farmstead complex and cattle enclosure may not be affected (demolish, renovate, alter) by the Sasol Project *prior* to their investigation by a historical architect in good standing with the South African Heritage Resources Agency (SAHRA). The historical architect has to acquire a permit from SAHRA before any of these structures may be affected (demolish, alter, renovate) as a result of the Sasol Project.

7.3.2 Graveyards and graves

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

8 CONCLUSION AND RECOMMENDATIONS

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

- Farmstead complexes associated with historical houses, outbuildings and cattle enclosures.
- Informal and formal graveyards.
- A commemorative beacon.

Remains from the recent past also occur in the Sasol Project Area but have no historical significance and therefore were not geo-referenced or mapped and are not discussed in this report.

These heritage resources were geo-referenced and mapped (Figure 2, Tables 1-2).

The significance of the heritage resources is indicated and mitigation measures are outlined for those heritage resources which may be affected by the Sasol Project.

The significance of the heritage resources

It is possible that a farmstead complex (FC04), graveyards (GY15, GY16, GY17 and GY18) as well as a cattle enclosure (CE02) may be affected (impacted) by the Sasol Project. The significance of the various types and ranges of heritage resources in the Sasol Project Area therefore is indicated whilst mitigation measures are outlined for those heritage resources which may be affected by the Sasol Project.

The significance of the heritage resources in the Sasol Project Area is indicated by means of stipulations derived from the National Heritage Resources Act (No 25 of 1999).

The farmstead complex and cattle enclosure

The historical farmstead complexes as well as the cattle enclosure are older than sixty years and therefore are protected by Section 34 of the National Heritage Resources Act (No 25 of 1999). The significance of the historical farmsteads complexes as well as the cattle enclosures therefore has been indicated as high (Table 1).

The level of significance of these heritage resources is determined by means of criteria such as their historical, cultural (social), aesthetic, technological and scientific value in relation to their uniqueness, state of preservation and research potential. Heritage resources which have low significance are viewed as fully recorded during this survey. Any impact on these heritage resources therefore are considered to be low. Heritage resources with medium to high significance will require further mitigation and/or management measures.

Graveyards and graves

All graveyards and graves can be considered to be of high significance and are protected by various laws (Table 2). Legislation with regard to graves includes Section 36 of the National Heritage Resources Act (No 25 of 1999) whenever graves are older than sixty years.

The act also distinguishes various categories of graves and burial grounds. Other legislation with regard to graves includes those which apply when graves are exhumed and relocated, namely the Ordinance on Exhumations (No 12 of 1980) and the Human Tissues Act (No 65 of 1983 as amended).

A commemorative beacon

The commemorative beacon in the No. 8 Harmony gold shaft in the Middelbult Mining Area will not to be affected by future coal mining activities and are therefore not further discussed.

Mitigating the heritage resources

The following mitigation measures have to be followed whenever FC04, CE02 and GY15 to GY18 are to be affected by the Sasol Project.

The farmstead complex and cattle enclosure

The farmstead complex and cattle enclosure may not be affected (demolish, renovate, alter) by the Sasol Project *prior* to their investigation by a historical architect in good standing with the South African Heritage Resources Agency (SAHRA). The historical architect has to acquire a permit from SAHRA before any of these structures may be affected (demolish, alter, renovate) as a result of the Sasol Project.

Graveyards and graves

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

DR JULIUS CC PISTORIUS
Archaeologist & Heritage Consultant
Member ASAPA

9 SELECT BIBLIOGRAPHY

Bergh, J.S. (red.) 1998. *Geskiedenisatlas van Suid Afrika. Die vier noordelike provinsies*. J.L. van Schaik: Pretoria.

Erasmus, B.P.J. 1995. *Oppad in Suid Afrika. 'n Gids tot Suid Afrika, Streek vir Streek*. Jonathan Ball Uitgewers Bpk.

Evers, T.M. 1981. The Iron Age in the Eastern Transvaal, South Africa. In Voight, E.A. (ed). *Guide to archaeological sites in Northern and Eastern Transvaal.* Pretoria: South African Association of Archaeologists, 64-109.

Mason, R.J. 1968. Transvaal and Natal Iron Age settlement revealed by aerial photography and excavation. *African Studies*. 27:167-180.

Naude, M. 1993. The use of stone on farmsteads on the eastern Transvaal. *Africana Society of Pretoria* (11): 49-55.

Naude, M. 2000. Vernacular stone buildings and structures on farmsteads in the southern districts of the Mpumalanga Province. *South African Journal of Cultural History*. 14(2): 31-64

Pistorius, J.C.C. 2002. *A Heritage Impact Assessment (HIA) study for a new power line on the farm Rietvallei 397JS between Middelburg and Arnot in the Mpumalanga Province of South Africa*. Unpublished report done for Eskom, Menlyn.

Pistorius, J.C.C. 2003. *A Heritage Impact Assessment study for the proposed 22kV Duvha Colliery power line deviation near Middelburg in the Mpumalanga Province of South Africa.* Unpublished report done for Eskom, Menlyn.

Pistorius, J.C.C. 2004. *A Heritage Impact Assessment (HIA) study for the EMP Amendment for Douglas Colliery in the Mpumalanga Province of South Africa.* Unpublished report for Pulles, Howard and De Lange.

Pistorius, J.C.C. 2004. *A Heritage Impact Assessment (HIA) study for the proposed new Optimum Colliery on the farm Schoonoord 164IS in the Mpumalanga Province of South Africa*. Unpublished report done for African EPA.

Pistorius, J.C.C. 2005. *Results of a Phase II Heritage Impact Assessment Study: An investigation of a historical sandstone farmstead and outbuildings on the banks of the Olifants River on the farm Kleynkopje 15IS within the boundaries of Douglas Colliery in the Mpumalanga Province of South Africa*. Unpublished report for the South African Heritage Resources Authority (SAHRA), Pulles Howard and De Lange (PHD) and Douglas Colliery.

Pistorius, J.C.C. 2007. *A Phase I Heritage Impact Assessment (HIA) study for the proposed deviation of a tributary of the Riet River in the Matla Colliery mining area on the Eastern Highveld in the Mpumalanga Province of South Africa.* Unpublished report for Golder.

Pistorius, J.C.C. 2008. *A Phase I Heritage Impact Assessment (HIA) study for the proposed new Harmony South underground mine near Leandra on the Eastern Highveld in the Mpumalanga Province of South Africa*. Unpublished report prepared for Turgis Consulting and Harmony.

Pistorius, J.C.C. 2008. *A Phase I Heritage Impact Assessment (HIA) study for Sasol's South Block on the Eastern Highveld in the Mpumalanga Province of South Africa. Unpublished report for Clean Stream Environmental Services.*

Pistorius, J.C.C. 2008. *A Phase I Heritage Impact Assessment (HIA) study for Sasol's North Block on the Eastern Highveld in the Mpumalanga Province of South Africa. Unpublished report for Clean Stream Environmental Services.*

Pistorius, J.C.C. 2008. *A Phase I Heritage Impact Assessment (HIA) study for Sasol's proposed new shaft complex on Strybult 542 and for the North Block on the Eastern*

Highveld in the Mpumalanga Province of South Africa. Unpublished report for Clean Stream Environmental Services.

Pistorius, J.C.C. 2008. *A Phase I Heritage Impact Assessment (HIA) study for Sasol's proposed new gas and liquid pipelines (along a corridor) from Sasol Synfuels in Secunda (Mpumalanga) to Sasol Infrachem and Natref in Sasolburg (Free State) on the Highveld in the Republic of South Africa. Unpublished report for Nature and Business Alliance Africa (Pty) Ltd.*

Pistorius, J.C.C. 2008. *A Phase I Heritage Impact Assessment (HIA) study for Sasol's proposed new conveyor belt running from the Strybult Shaft Complex to the Sasol Secunda Plant on the Eastern Highveld in the Mpumalanga Province of South Africa. Unpublished report for Clean Stream Environmental Services.*

Pretorius, Fransjohan. 1999. *Life on commando during the Anglo Boer War 1899-1902*. Human & Rousseau: Cape Town.

Smith, Quinton. 1997. Kimton, My land my life. (Published by the author).

10 SPOKESPERSONS CONSULTED

Solly Ndlof. Farm labourer on Kromdraai 128IS

Mike Combrick. Farm owner of several farms in the Middelbult Mining Area

Willie Oosthuizen. Tenant of farmstead complex on Winkelhaak 139IS

Robbie Bekker. Farm owner on Brakspruit 359IH

Francois Bekker. Farm owner on Brakspruit 359IH

Steve Shabangu. Resident on Witkleifontein 138IS

Hennie Pretorius. Farm owner on Springbokdraai 277IS

Boet Conradie. Environmental Manager, Harmony Gold.

Wynne Song. Farm owner Brakspruit 359JR.

Frans Els. Farm owner Wildebeesspruit 356JR

Alfred Kudeka. Farm worker Wildebeesspruit 356JR

APPENDIX 5.16(A)

APPROVED SOCIAL AND LABOUR PLAN

Annexure D

Gesertifiseer as 'n ware afskrif van oorspronklike dokument/
Certified a true copy of original document
248 pages hereof

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

sasol
reaching new frontiers

136 MR
137 MR
138 MR
139 MR

Sasol Mining (Pty) Limited

Social and Labour Plan

for the

Sasol Mining Secunda Complex

In support of the application for the conversion and consolidation
of
old order mining rights in terms of the Mineral and Petroleum Resources Development Act, 2002
(Act 28 of 2002)

License 27/1998 - Area 1
License 18/2003 - Area 2
License 12/2003 - Area 3
License 14/2001 - Area 4

18 June 2009

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

sasol
reaching new frontiers

Index

sasol
Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

sasol reaching new frontiers

List of Annexures

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

L	Employment equity 5 year plan
M	Women in mining
N	Hostel menu
O	Agreement in respect of the revised Local Economic Development Projects

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
***Ex Officio:* RSA**

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

sasol
reaching new frontiers

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Acronyms

ABET	adult basic education and training
BBBEE	broad based black economic empowerment
BEE	black economic empowerment
BEEP	black economic empowerment procurement
CEPPWAWU	Chemical, Energy, Paper, Printing, Wood and Allied Workers' Union
CSI	corporate social investment
DOL	Department of Labour
DME	Department of Minerals and Energy
FY	financial year
GDP	gross domestic product
GDP	graduate development programme
GMM	Govan Mbeki Municipality
GSDM	Gert Sibande District Municipality
HDSA	historically disadvantaged South African
IDP	integrated development plan
LED	local economic development
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act No 28 of 2002)
MQA	Mining Qualifications Authority
NQF	National Qualifications Forum
PGDS	Provincial Growth and Development Strategy
PDP	personal development plan
Sasol	Sasol Group of companies
Sasol Mining	Sasol Mining (Pty) Ltd
Sasol Secunda	Companies of the Sasol group of companies active in Secunda
Sasol Synfuels	Sasol Synfuels (Pty) Ltd
Secunda Complex	Sasol Mining (Pty) Ltd operating in Secunda
SETA	Sector Education Training Authority
SEDA	Small Enterprise Development Agency
SLP	Social and Labour Plan
SMME	small, micro and medium enterprise
SOIL	Sasol Institute of Learning
Trade union	a recognised and registered trade union in terms of the Labour Relations Act (Act 55 of 1995)
UPUSA	United People's Union of South Africa

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

VII

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

INTRODUCTION

The Sasol group has its roots deeply implanted in South Africa. Grown from the soil of this country and, there is a profound realisation that Sasol is sustained by the tremendous contribution of South Africa and its people, especially those in the communities where the various companies that comprise Sasol companies operate.

As with the past, the future of Sasol Mining, in particular, lies in developing South Africa and the communities where mining activities are undertaken to ensure a better future for everyone in South Africa. More than ever, Sasol acknowledges the sensitive co-existence of companies and their stakeholders.

On 10 September 2007 Sasol Limited announced a proposed broad based black economic empowerment (BBBEE) transaction which was implemented during June 2008. It has a value of about R26 billion and once completed, will entail the transfer of approximately 10% of the shares of Sasol Limited to:

- members of the black South African public (3%);
- selected BEE groups (1,5%);
- Sasol employees below managerial level, comprising 60% black and 40% white employees, as well as black managers and black non-executive directors (4%); and
- the newly formed Sasol Foundation (1,5%).

The announcement of this transaction in September 2007 was a significant milestone in Sasol's history. In addition, Sasol Mining has achieved significant progress with meeting the ownership targets of the Mining Charter (more than 26%), most notably the women in mining transaction announced by Sasol Mining on 11 October 2007 (the Ixia Coal venture)

Sasol's annual contribution towards the national gross domestic product (GDP) of South Africa is about R40 billion, of which R22 billion is a direct contribution. Sasol's contribution equates to an annual saving of about R30 billion in foreign exchange to the country and Sasol produces about 38% of the country's liquid fuel requirements. To enable the production of much of South Africa's liquid fuels (eg petrol, diesel, jet fuel and illuminating paraffin), Sasol Mining produces at least 20% of the country's saleable coal annually.

Sasol contributes more than R6 billion annually to the South African Government through taxes and levies, excluding fuel and employee taxes. Furthermore, Sasol's commitment to corporate social investment is seen in a further contribution of more than R100 million annually to social investment, sport sponsorship and university bursaries.

Against this backdrop, Sasol Mining, as part of Sasol, contributes significantly to the South African economy and intends to continue its contribution as a cornerstone of Sasol's business. It remains paramount for Sasol Mining to ensure sustainable growth in communities, the country and Sasol's business.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

i) The purpose of this document

Sasol Mining is a major coal producer at the Sasol Mining Secunda Complex. The company consists of five mining operations in Mpumalanga. In addition, Sasol Mining produces coal close to Sasolburg in the Free State.

This social and labour plan (SLP) has been developed in accordance with the provisions of the Mineral and Petroleum Resources Development Act, 2002 (MPRDA), the requirements of Part II of the Regulations promulgated under the MPRDA. In addition, the SLP was amended in terms of the guidelines provided by the Department of Minerals and Energy (DME), during August 2007 and updated in accordance with the requirements stipulated at the DME and Sasol Mining workshop at the Indaba Hotel, on 13 and 14 November 2007 and the various discussions with DME representatives.

The document has been prepared.

- to motivate the conversion of the current old-order mining rights to a new mining rights; and
- to request the consolidation of the existing four mining licences into a single mining right.

This SLP has been compiled for the Secunda Complex. The Secunda Complex comprises five operations that supply coal to Sasol Synfuels and the export market. The Secunda Complex is situated on the outskirts of Secunda, a town that falls within the jurisdiction of the Govan Mbeki Local Municipality and is situated in the wider Gert Sibande District Municipality.

The SLP includes the following old order mining rights:

- Area 1 - mining licence no 27/1998 (including rights acquired over the areas known as Block 2, Block 3 and Block 5),
- Area 2 – mining license no 18/2003 (including rights acquired over an area known as Block 8),
- Area 3 – mining license no 12/2003 (including rights acquired over an area known as Kriel South); and
- Area 4 – mining license no 14/2001 (including rights acquired over an area known as Portion 54 of the farm Frischgewaagd 294 IS).

For ease of reference these areas are indicated in diagram 1 below.

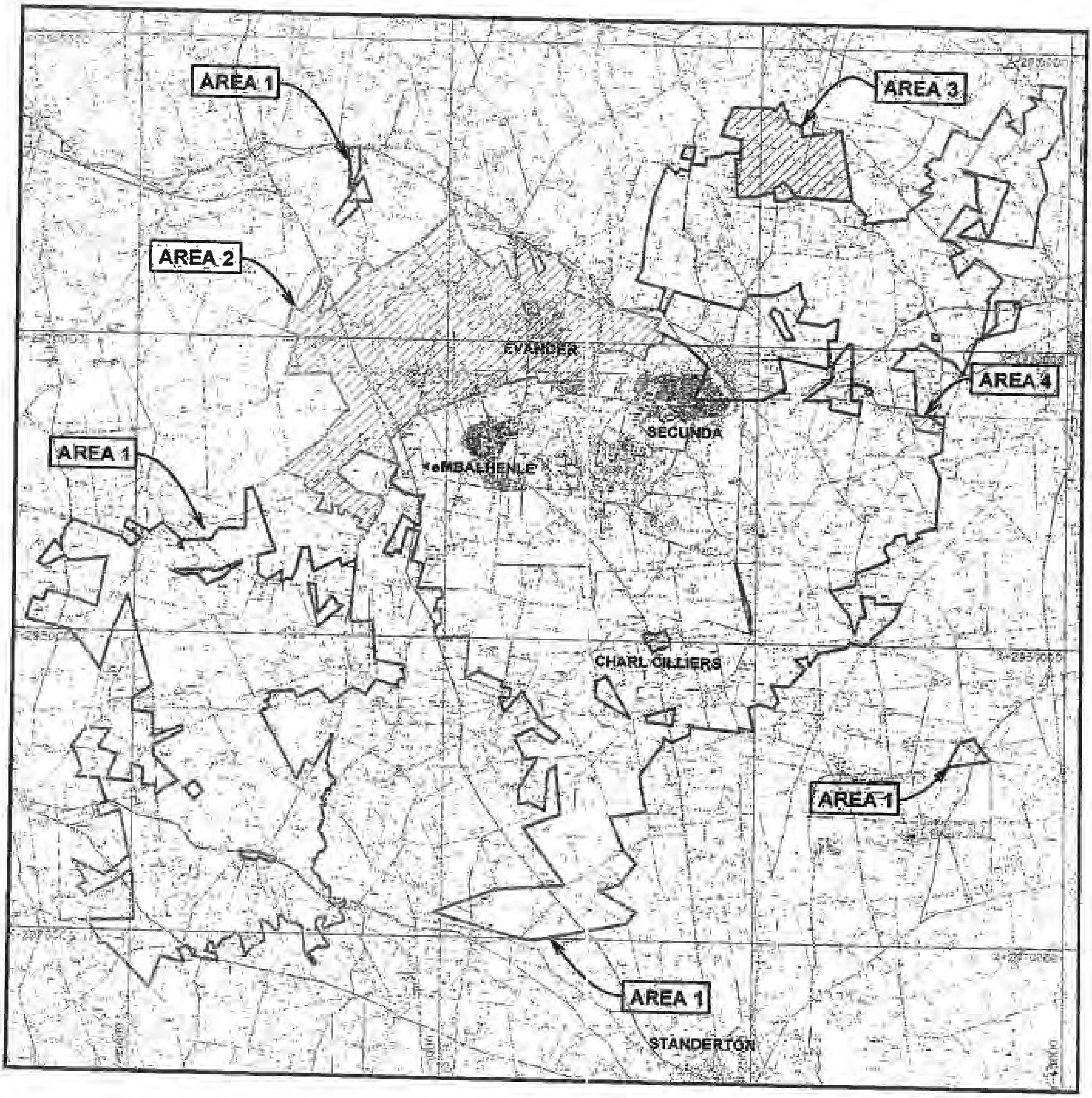
YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Diagram 1

Locality plan: Secunda Complex licence areas

- Area 1 – licence 27/1998
- Area 2 – licence 18/2003
- Area 3 – licence 12/2003
- Area 4 – licence 14/2001



YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio RSA

ii) Background to Sasol Mining's activities at the Secunda Complex

Sasol Mining has been mining coal in the Secunda area of Mpumalanga, for almost 30 years. Coal is mined by five production operations: the Twistdraai, Bosjesspruit, Brandspruit, Middelbult and Syferfontein operations. In addition, the development of the Thubelisha shaft (Block 3) and the Block 2 shaft are well advanced. All of the aforementioned operations are situated in the Sasol Mining Secunda Complex mining area.

The coal mined by these operations situated within the Secunda Complex is supplied primarily to the Sasol Synfuels coal-to-liquid (CTL) plants which beneficiate about 39 million tons of coal a year, through various processes, into a wide range of products including petrol, diesel and jet fuel, as well as solvents, comonomers, polymers and other chemicals. Based on existing technology, infrastructure, equipment and labour strength, the indications are that Sasol Mining's coal supply in the Secunda area will continue for another 39 years. The area will be mined by the board-and-pillar method, but pillar extraction, using Sasol Mining's novel Nevid method, will also be undertaken where appropriate.

The Twistdraai Operation, is situated partially in Area 1 and the whole of Area 4. It mines run-of-mine (ROM) coal at a rate of about 10 million tons (Mt) a year, for downstream beneficiation. About 4 Mt a year of the coal is exported and a further 4 Mt a year of middlings is supplied to the Sasol Synfuels plants. The remaining 2 Mt a year constitute discard.

iii) The current old order mining rights

Because the Secunda Complex constitutes one mining area, it has always been Sasol Mining's intention to have one mining right over the total mining area. Mining licence no 27/1998 was originally obtained and at the time, it covered all of the activities in the Secunda Complex. This area hereafter is referred to as Area 1 and is demarcated in diagram 1 (see page 3).

Due to constraints imposed by previous mining legislation it was not possible to expand mining authorisations to accommodate further expansions. Therefore new mining authorisations had to be acquired, for these expansions. This resulted in the acquisition of mining licence no 18/2003 to include the rights acquired over the area known as Block 8, hereafter referred to as Area 2, which is demarcated in diagram 1. Area 2 forms a natural extension of the Secunda Complex's Middelbult Operation. Middelbult Operation, is mining in Area1 and Area 2.

To incorporate the rights obtained over the Kriel-South area, mining licence no 12/2003 was granted to Sasol Mining. This expansion of the Secunda Complex is referred to as Area 3 and is demarcated in diagram 1. The mining activities in Area 1 and Area 3 are conducted by Sasol Mining's Syferfontein operation.

Mining licence no 14/2001 was granted over Portion 54 of the farm Frischgewaagd 294 IS. This area hereafter is referred to as Area 4 and is demarcated in diagram 1. Some of the Twistdraai Operation's mining is conducted in Area 4, although most of this operation's activities of this mine are situated in Area 1.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Furthermore, the five operations are managed centrally from the Brandspruit management block and share many services, including:

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

- environmental management and rehabilitation;
- mining rights and properties;
- security services;
- procurement and supply services;
- human resources services;
- budgeting and planning;
- financial services and governance;
- legal services;
- information management services; and
- projects and technology

In the light of the above, it is evident that the Secunda Complex consists of five interdependent operations and a range of strategically placed shafts, that enable the optimal exploitation of the relevant coal reserves. These operations do not constitute independent collieries.

In the light of the aforementioned applications is made that the four old-order mining rights be consolidated into one mining right upon conversion of the old-order rights, because all the operations are interlinked and share some essential management functions, infrastructure and services and that this integrated SLP be approved in respect thereof.

iv) Presentation of the Social and Labour Plan (SLP)

The Sasol Mining Secunda Complex, with its five mining operations, is a single integrated mining area.

The mining activities at these operations cannot be separated from one another and the individual operations therefore cannot be treated as standalone operations. Furthermore, each individual operation can also not be separated from the mining activities of the total operations of Sasol Mining. In view of this, an integrated approach has been adopted in compiling this SLP. For ease of reference, the SLP has been compiled to provide detail on all the relevant areas described in paragraph iii above.

The data and figures quoted in this document are based on the data and figures as at June 2007. Some minor deviations may occur in these figures due to a number of updates since the original preparation of the document.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

1. SECTION 1 : PREAMBLE

Name of the company/applicant	Sasol Mining (Pty) Ltd
Name of production operation	Sasol Mining Secunda Complex
Names of Operations comprising the production unit	• Bosjesspruit Operation; • Middelbult Operation; • Syferfontein Operation; • Twistdraai Operation; • Brandspruit Operation; and • future expansions in the existing mining area, including, but not limited to Thubelisha Shaft and Block 2.
Physical address	Brandspruit Management Block Sasol Mining Brandspruit Farm, Secunda, 2302
Postal address	c/o Dr SA Booyens SMRD PO Box 699 Trichardt 2300
Telephone number	(017) 614 8003 or 082 452 0928
Fax number	(011) 522 5173
Email Address	sarel.booyens@sasol.com
Location of mine or production unit	Province: Mpumalanga Local municipality: Govan Mbeki District municipality: Gert Sibande
Commodity	Coal
Life of mine or production unit	39 years with expected closure in 2046
Breakdown of employees per sending area as at 30 June 2007	**Total number of employees = 6410** (as at 30 June 2007) • Govan Mbeki Local and Gert Sibande District Municipality = 5823 • Lesotho = 182 • Mozambique = 267 **Areas outside the Gert Sibande District Municipality** • Eastern Cape = 22 • Gauteng = 35 • Mpumalanga (Nelspruit) = 25 • Free State = 41 • KwaZulu Natal = 13 • Limpopo = 2
Financial year	1 July to 30 June

Annexure A provides additional information on the labour areas of origin

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

2. SECTION 2: HUMAN RESOURCES DEVELOPMENT PLAN

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

2.1 Skills development plan

The skills development plan provides information on the various aspects of skills development and is provided in respect of the development of skilled and unskilled employees.

2.1.1 Definition

"A plan is a formulated/organised method by which a thing is to be done" according to the *Oxford English Dictionary*. The Sasol Mining skills development plan outlines the intended method through which the development of human resources will be implemented the five years from 2008 to 2012.

2.1.2 Objectives of the human resources development plan

- to increase current employees literacy levels;
- to address skills shortages in the mining industry;
- to develop current and future competency levels of employees;
- to meet the unique skills needs of the Sasol Mining and South Africa; and
- to ensure alignment with National Qualifications Forum (NQF) requirements.

2.1.3 Compliance with skills development legislation

Sasol Mining has implemented the following measures, and will continue with these measures over the life of mine, to ensure and improve compliance with the relevant skills development legislation:

- Sasol Mining is registered with the Mining Qualifications Authority (MQA) SETA (registration number: L380714123);
- Mr AH Loggenberg is the appointed skills development facilitator;
- The Sasol Institute of Learning's Maintenance Academy (SOIL) is a registered training provider accredited by the MQA. (registration number: 16/MQA/0011/AC4/070605);
- Sasol Mining has been submitting annual training reports to the MQA since April 2000 (please refer to Annexure B for the training report of March 2007);
- Sasol Mining claims grants according to the guidelines set by the MQA. Sasol Mining has complied with all the requirements in terms of the Skills Development Levies Act, 1998 (Act 79 of 1998). (see Annexure C for levies received and grants available.
- Sasol Mining participates in technical reference groups for the mining industry, and contributes expert knowledge, best practices and inputs in the areas of:
    - learning material;
    - assessment guides;
    - unit standards; and
    - classification of qualifications obtained.

  Sasol Mining is represented on the technical reference groups by its:
    - manager: engineering services for engineering;
    - manager: training for generic standards;
    - a skills development facilitator for electrical engineering;
    - a training officer for mechanical engineering;

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

- manager: training and a superintendent of training for underground coalmining.

- A skills audit was done in accordance with the following:
  - OSI accreditation; and
  - MQA processes

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

2.1.4 Educational levels of the workforce

The SLP forms the foundation of the Sasol Mining human resources development plan. The educational levels at Sasol Mining, (at 30 June 2007), were as follows:

- 1720 employees have no formal qualifications (formal schooling status is unknown).
- 1448 employees have general education and training (GET) without formal schooling;
- 2713 employee have post matriculation qualifications, further education and training (FET); and
- 529 employees have higher education training (HET) which includes technikon and university qualifications.

The detailed breakdown of the number and education levels of employees are included in Table 1 below and Form Q. It is evident that Sasol Mining faces a challenge to improve the educational levels of employees, especially those with no schooling. To address this challenge, the company is implementing ABET programmes for employees and the surrounding communities.

Table 1
Summarised education levels of the workforce at 30 June 2007

Description	Females				Males				Total
	Black		White		Black		White		
	No.	%	No	%	No	%	No	%	
No formal qualifications (1720) and general education and training (GET) (1448)	14	0.4	0	0.2	3031	97	39	1.8	**3168**
Further education and training (FET)	186	7	133	5	1353	48	1125	40	**2713**
Higher education and training (HET)	70	13	52	10	157	30	250	47	**529**
Total	**270**	**4.2**	**185**	**2.9**	**4541**	**70.8**	**1414**	**22.1**	**6410**

Legend
No. = Number of
% = expressed as the total number of GET, FET, HET and no formal qualification.

2.2 Sasol Mining skills development programmes

Sasol Mining offers various skills development programmes for employees to develop current employees' skills, enhance performance and provide a skills pipeline to address the hard-to-fill vacancy challenge.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 667 Kerkstraat · Pretoria
Ex Officio: RSA

Some of Sasol Mining skills programmes are offered to external/community members to contribute towards skills development in, but not limited, to the local community and the country.

2.2.1 List of Sasol Mining skills development programmes

Sasol Mining's skills development programmes are described in detail below, outlining the definition, policy guidelines, Sasol Mining context, costs and five (5) year plan for intervention, where applicable.

2.2.1.1 Hard-to-fill vacancies

Sasol Mining context

The mining industry is faced with a severe skills shortage, which results in a number of hard-to-fill positions. The skills shortage is mainly due to increased economic activity and implementation of major projects, such as Coega, Gautrain and the FIFA World Cup 2010 initiatives. It must be emphasised that the relevant hard-to-fill vacancies may change from time to time, depending on labour marker trends and economic activity.

Definition

Positions occupied mainly by qualified, skilled and competent employees required to execute core functions in mining, based on the following criteria:

- criticality to mining business;
- filling of vacancies takes six months or longer;
- availability in the market is limited; and
- the length of time required to develop individuals to fill the position takes longer.

Sasol Mining identified the following hard-to-fill vacancies in relation to its operations:

- mine manager;
- manager engineering services;
- underground manager;
- shaft manager;
- mine overseer;
- mining engineers;
- electro mechanics;
- miners; and
- single-trade artisans.

In addition to Sasol Mining's procurement strategy, hard-to-fill vacancies are addressed through Sasol Mining's learnership programmes as well as bursary and study aid allocations. The development of personnel to fill these vacancies are achieved through individual personal development programmes, leadership development programmes, and mentorship and coaching, which is supported by integrated career development and career progression plans. All these programmes are described in more detail in the section below.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

2.2.1.2 Adult basic education and training (ABET)

Intent

Sasol Mining has an in-house ABET facility, located in Secunda and accredited with the Mining Qualification Authority (MQA) and the Department of Education, which can accommodate up to eighty learners at a time. To ensure effective training, the ABET training facility uses professional educators to facilitate the classes. In terms of the MQA's Mining and Minerals Sector ABET statement of intent, employees who are insufficiently equipped to participate for ABET 4/NQF Level 1 qualification are considered functionally illiterate and innumerate. Refer to Form Q.

Objectives

The main objectives of the Sasol Mining ABET facility are:

- to ensure each company employee is trained up to a minimum of ABET 4/NQF Level 1 qualification;
- to offer an opportunity for all employees to become functionally literate and numerate;
- to broaden the scope and opportunity for the development of employees; and
- to improve competency levels of employees and enhance their performance.

Policy guidelines

- All employees who, after an assessment, have shown to be below NQF Level 1 are encouraged to attend ABET classes, for six months.
- ABET training is open voluntarily to all wage employees below NQF Level 1.
- Employees are allowed to attend ABET classes during working hours.
- Employees attend ABET with full pay, including production bonuses.
- Employees on ABET training are replaced by hired labour from labour brokers, on fixed-term contract basis.

Sasol Mining context

- ABET training will take place over the life of mine.
- Sasol Mining has 1720 employees with no formal qualification, (unskilled level).
- Employee turnover, the number of new employees appointed, and their level of education on appointment will affect the number of employees who attend ABET training each year. In terms of Sasol Mining's recruitment policy,only employees with a Grade 10 qualification are considered.
- All employees are encouraged to attend ABET; there however, will be a small percentage of employees who are not willing to attend ABET training.
- In addition, a minimum of 10% non-Sasol Mining employees, identified from members of the local community, will also be trained at the Sasol Mining ABET facility with full support, including transportation, beverages and access to learning support.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Cost implications

Total cost each year includes actual ABET cost and the costs incurred for labour replacement to replace employees participating in ABET programmes. The total annual cost, including hired labour, for the 2007 financial year amounted to R7,036,536.00.

Needs analysis and target plan

A detailed analysis will be done during 2008 to verify the accuracy of the qualification levels of employees and the number that requires ABET training.

The current training facility only has a capacity to accommodate 80 employees per training session. To address this, measures to increase the capacity of the training facility will be investigated during 2009.

This plan also has taken into consideration that the new employees will already be at Grade 10 level and will not require ABET.

Table 2 below provides the detail of ABET training to be conducted during the 2008 to 2012 period. Due to Sasol Mining's recruitment policy only literate and numerate employees are appointed. The table below takes into consideration the training capacity of the training academy as well as the number of employees that will retire during the next 5 years. During this period approximately 1000 employees will receive ABET training and it is estimated that, as a result of personnel turnover and retirement, the number of employees to be trained after 2012 will amount to approximately 700.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Table 2
Sasol Mining ABET Five-Year Plan from 2008 – 2012

ABET level	2008				2009				2010				2011				2012			
	Male		Female		Male		Female		Male		Female		Male		Female		Male		Female	
	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White
Employees requiring ABET Training	1720	0	0	0	1560	0	0	0	1381	0	0	0	1181	0	0	0	957	0	0	0
Planned ABET Training	160	0	0	0	179	0	0	0	200	0	0	0	224	0	0	0	224	0	0	0
ABET 1	56	0	0	0	56	0	0	0	56	0	0	0	56	0	0	0	56	0	0	0
ABET 2	32	0	0	0	56	0	0	0	56	0	0	0	56	0	0	0	56	0	0	0
ABET 3	35	0	0	0	32	0	0	0	56	0	0	0	56	0	0	0	56	0	0	0
ABET 4	46	0	0	0	35	0	0	0	32	0	0	0	56	0	0	0	56	0	0	0
TOTAL ABET 1 - 4	**169**	0	0	0	**179**	0	0	0	**200**	0	0	0	**224**	0	0	0	**224**	0	0	0
BUDGET	**R 7,036,536**				**R 7,452,844**				**R 8,327,200**				**R 9,326,464**				**R 9,326,464**			

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

2.2.1.3 Skills Plan for unskilled employees

All employees at the unskilled level are taken through the skills programme as indicated in Annexure G. New employees, who join Sasol Mining with no previous experience, also receive training in terms of the same skills programme.

- All unskilled employees start on the Maintenance Phase Operator Helper level, for a minimum period of six months, during which the employee is exposed to on the job training. After six months an assessment is done before the employee can progress to Maintenance Phase Operator Phase 1. This process is repeated up to Maintenance Operator Phase 5. Each phase takes a minimum period of six months. Employees are allowed a second opportunity to pass a specific phase, should they fail the first time.

- An employee must demonstrate the experience as described in Table 3, fully, before he/she can move to the next level.

- The successful completion of the programme renders an employee eligible for learnership either in engineering or mining.

The Sasol Secunda Complex has a life expectancy of more that 30 years and skills development will take place on a continues basis, until all employees have received a basic skills level. The total number of unskilled employees will gradually reduce over time, due to natural attrition and the revised recruitment programme. Table 4 below outlines the number and targets of the skills programme for unskilled operators over the next five years.

Table 3
Career path for maintenance operators

Designation	NQF Level	Competencies	Experience
Maintenance Operator Phase 1	NQF Level 1	Grade 10	Workplace safety
			Use of basic hand-tools
			House keeping (spares box and oil store)
Maintenance Operator Phase 2	NQF Level 1	Competencies of Maintenance Operator Phase 1	Pre-use inspection of equipment
			Top-up of oil levels on equipment
Maintenance Operator Phase 3	NQF Level 2	Competencies of Maintenance Operator Phase 2	Lubrications and daily maintenance
			Assist with breakdowns - under supervision of Artisan
Maintenance Operator Phase 4	NQF Level 2	Competencies of Maintenance Operator Phase 3	Assist with weekly maintenance
			Repair minor breakdowns
			Replace hydraulic hoses and change 10SC22 wheels
			Test and change of cables
Maintenance Operator Phase 5	NQF Level 3	Competencies of Maintenance Operator Phase 4	Minor faultfinding and change of sub-assemblies
			Change of sub-assemblies such as valve banks and drive chains and sprockets

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio SA

Table 4 below outlines the number and targets of the skills programme for unskilled operators over the next five years.

Table 4
Skills development plans for unskilled maintenance operators

Designation	2008				2009				2010				2011				2012			
	M		F		M		F		M		F		M		F		M		F	
	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White
Maintenance Operator Phase 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	6	7	0
Maintenance Operator Phase 4	0	0	0	0	0	0	0	0	0	0	0	0	10	6	7	0	15	8	7	2
Maintenance Operator Phase 3	0	0	0	0	0	0	0	0	10	6	7	0	15	8	7	2	20	10	12	3
Maintenance Operator Phase 2	0	0	0	0	10	6	7	0	15	8	7	2	20	10	12	3	25	10	15	5
Maintenance Operator Phase 1	10	6	7	0	15	8	7	2	20	10	12	3	25	10	15	5	25	15	30	7
Total per category	**10**	**6**	**7**	**0**	**25**	**14**	**14**	**2**	**45**	**24**	**26**	**5**	**70**	**34**	**41**	**10**	**95**	**49**	**71**	**17**
Grand totals per year	23				55				100				155				232			

Future Career Opportunities

Employees currently in the service of Sasol Mining, who have gone through the abovementioned skills plan, are given preferential treatment for Learnerships in either engineering or mining.

Newly appointed employees with Grade 12 mathematics and science are eligible for a Learnership.

2.2.1.4 Learnerships

Sasol Mining fully participates in the mining learnership programs to mitigate the shortages of hard-to-fill vacancies for mining core skills.

Objectives

- To provide a skills pipeline for positions within the hard-to-fill vacancies category, particularly the electro-mechanics, diesel mechanics and learner miners.
- To provide a skills pipeline to support the Sasol Mining employment equity plan.
- To mitigate the impact of the shortage of skills within the company and South Africa.
- To meet current and future demand for skilled artisans and miners.

Sasol Mining context

- The Sasol Mining learnership programme is conducted over a period of 36 to 40 months, while the intake of learners is done periodically.
- Candidates are drawn from local communities of the Govan Mbeki Municipal area.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

- On completion and qualification from the learnership programme, learners are offered permanent employment at Sasol Mining.
- Employees who do not complete or reach the required competency levels at the allocated time, are given two additional opportunities to rewrite their examinations. The contract is terminated if a learner fails the competency test three times.
- Factors such as race and gender are taken into consideration when recruiting learners, in line with Sasol Mining's needs.

Electro mechanic learnership

The learnership programme for electro-mechanics is a long-term output programme, because learners are expected to reach the required competency levels after 36 months. To meet its requirements, Sasol Mining intends to train about 760 electro mechanics between 2008 and 2012. Table 5 below summarises the planned training between July 2008 and June 2012.

Learner miners

The duration of the learner miner training programme is between nine and 12 months. The learner miner training programme is aligned with the MQA. Sasol Mining intends to train 300 learner miners between 2008 and 2012.

Table 5 below summarises the planned training complement of learner engineers and miners between July 2008 and June 2012.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Table 5
Periodic plan for learnership intake from July 2008 to June 2012

INTAKE	2008				2009				2010				2011				2012			
	Male		Female		Male		Female		Male		Female		Male		Female		Male		Female	
	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White
Miners	30	10	15	5	25	10	20	5	25	10	20	5	25	10	20	5	25	10	20	5
Electro mechanics (EMs)	60	15	35	10	60	15	35	10	60	15	35	10	60	15	35	10	60	15	35	10
Engineers In Training	20	10	12	7	20	10	12	7	20	10	12	7	20	10	12	7	20	10	12	7
Women in Mining	0	0	50	13	0	0	50	13	0	0	50	13	0	0	50	13	0	0	50	13
Internships (Experiential Trainees)	10	10	10	5	10	10	10	5	10	10	10	5	10	10	10	5	10	10	10	5
TOTAL	**120**	**45**	**122**	**40**	**115**	**45**	**127**	**40**	**115**	**45**	**127**	**40**	**115**	**45**	**127**	**40**	**115**	**45**	**127**	**40**

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887/Kerkstraat • Pretoria
Ex Officio: RSA

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Table 6
Periodic plan for learnerships intake from July 2008 to June 2012

	2008 (Nov)				2009				2010				2011				2012 (Till June)			
	Male		Female		Male		Female		Male		Female		Male		Female		Male		Female	
	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White
Learners (Mining)	9	1	4	1	13	7	8	2	24	15	17	4	22	15	18	5	11	7	9	3
Learners (Engineering)	14	7	7	2	39	23	23	5	48	30	34	8	44	30	36	10	21	15	19	5
TOTAL	23	8	11	3	52	30	31	7	72	45	51	12	66	45	54	15	32	22	28	8

Total Per Gender	31	14	82	38	117	63	111	69	54	36

Total Per Intake	45	120	180	180	90

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 88?/Kerkstraat • Pretoria
Ex Officio: RSA

2.2.1.5 Portable skills development

Objective

To ensure that Sasol Mining's employees are equipped with skills that can be used outside the mining industry, in the event of mine closures and retrenchments.

Sasol Mining context

- The current total number of Sasol Mining unskilled personnel will remain the same for the next 39 years.
- Sasol Mining is not planning any retrenchments or downscaling for the next five years and beyond. Rather, Sasol Mining is undergoing a growth phase.
- The skills park intake will remain 100 employees a year, for the period 2008 to 2012.

Portable skills training

Sasol Mining will offer portable skills training to 100 identified employees a year for the period 2008 to 2012. All portable skills training courses will be provided through the Sasol skills park, which will be established during the 2008/2009 financial year. As Sasol Mining is currently in a growth phase and no retrenchment or downscaling are envisaged within the next five years, this training will be offered to employees who are less than ten years from retirement, with no formal skills.

Sasol Mining reskilling centre

Studies have shown that many new business ventures were implemented in the Gert Sibande region in recent years, but few were sustainable. Small-business owners often lack a clear understanding of the market expectations, the industry within which they operate and the financial aspects that will ensure the success of the venture.

In this context, the Sasol Mining reskilling centre initiative is being designed to make a meaningful contribution to the reskilling and upskilling of Sasol Mining employees to fulfil wider market needs. The Govan Mbeki Municipal area is experiencing significant growth and development, which creates opportunities for developing the skills needed to service this growing market.

The Sasol Mining human resources department, in consultation with trade unions, will identify the employees using the aforementioned criteria, and will liaise with those employees scheduled to undergo training. The Sasol Mining reskilling centre will offer the following courses:

- ***Electrical appliance repair (theory only)***

i. SMME development: electrical appliance repair with technical and business skills.
ii. SMME development: electrical house wiring theory and business skills.
iii. Electrical engineering NQF L2 (ESETA-accredited) (with on-the-job training being excluded).
iv. Electrical engineering NQF L3 (ESETA-accredited)

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

- ***Other***

i) Trade test preparation.

- ***Skills programmes - construction (short courses)***

i) Road construction (general overview).
ii) Plastering.
iii) Plumbing.
iv) Bricklaying.
v) Carpentry

- ***Skills programs – welding (short courses)***

i) Welding basic manufacturing skills (arc welding and gas welding).
ii) Learnerships (Employer responsible for OJT)
III) Welding NQF L 2 (Merseta-accredited).
iv) Welding NQF L 3(Merseta-accredited).

- ***Skills programmes – carpentry***

i) Furniture manufacturing.
ii) Furniture manufacturing with tools and business skills.

- ***Technical skills training***

i) Landscaping (skills programme).
ii) General maintainer (repairing, painting, basic plumbing, basic electricity and basic wood working hand tools).
iii) OHASA (OSH Act-related occupational health and safety induction) (safety).
v) First aid.
vi) Community house building NQF L2 (CETA-accredited).).
vii) Construction contractor NQF L3 (CETA-accredited).

- ***Non-technical skills training***

i) Train the trainer (trainer development).
ii) HIV/Aids awareness.
iii) Life skills.
iv) Unemployed person basic business skills (SMME development).
v) Project management (basic).
vi) Financial management for non-financial managers.
vii) Business start up skills.
viii) Driver training (practical only).
ix) Plastic welding.
x) Waitering/waitressing.
xi) Bar tendering.
xii) Beadworking.
xiii) Leatherworking.

All these will be offered in the Sasol Mining re-skilling Centre.

Sasol Mining Reskilling Programme

The Sasol Mining reskilling programme is being designed ~~to make~~ a meaningful contribution to the reskilling and upskilling of Sasol Mining employees to fulfil wider market needs. The Govan Mbeki Municipal area is experiencing significant growth and development which creates opportunities for developing the skills needed to service this growing market.

NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Sasol Mining will offer portable skills training to 100 identified employees a year for the period 2009 to 2013. All portable skills training courses will be provided through the Sasol Mining Reskilling programme, which will be established during the 2008/2009 financial year. As Sasol Mining is currently in a growth phase and no retrenchment or downscaling is envisaged within the next five years, this training will be offered to employees who are less than ten years from retirement, with no formal skills. The programme plan will have annual milestones. Together with the Human Resources department, the employee will have the option of choosing from the following categories of courses, after which training will be arranged.

- Electrical appliances (theory only)
- Trade test preparation
- Skills programmes – construction (short courses)
- Skills programmes – welding (short courses)
- Skills programmes – carpentry
- Technical skills training
- Non-technical skills training

The re-skilling programme will be available for all the Sasol Secunda site business units, of which Sasol Mining will contribute 14% of total costs of training per annum. The programme will be a component of the HRD portable skills part of the Social and Labour Plan. The development of the Sasol Mining Re-skilling Programme are described in more detail in Table 7.

Note: The employees will be assisted and advised in choosing which portable skills to be trained in.

Table 7
Sasol Mining Re-Skilling Programme

Programme	**2009 budget estimate**	**2010 budget estimate**	**2011 budget estimate**	**2012 budget estimate**	**2013 budget estimate**	**Forecast Total budget**
Re-skilling programme	R500 000	R500 000	R500 000	R500 000	R500 000	**R2.5m**
1. Development of Memorandum of Understanding with service providers and MQA and FET colleagues.	By December 2008					
2. Identify and contract training service providers.	By January 2009					
3 Finalise contracts with service providers	By February 2008					
4. Conduct an internal training needs analysis (for training matrix)	By February 2009					

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Programme	2009 budget estimate	2010 budget estimate	2011 budget estimate	2012 budget estimate	2013 budget estimate	Forecast Total budget
5. Twice per annum, identify and inform employees who are due for training, assist them choose courses.	June 2009 December 2009	June 2010 December 2010	June 2011 December 2011	June 2012 December 2012	June 2013 December 2013	
9. Training rollout (100 trained p/a)						
10. Do yearly training programme reviews	November 2009	November 2010	November 2011	November 2012	November 2013	
11. Total projected expenditure per annum for 100 trainees	R500 000	R500 000	R500 000	R500 000	R500 000	**R2.5m**

2.3 Personal development plans (PDP)

Definition

An individual-based list of training needs, solutions and delivery time-lines that are based on an assessment of the current situation, recognising where the individual's competency gaps are against expected job competencies. The PDP focuses mainly on job-related, personal growth and career advancement and to equip employees to potential address the hard-to-fill vacancies.

Every employee has to be proactive about his or her development. The key reasons for wanting to develop yourself include the need to:

- learn new business and life skills
- cope with work- and market-related changes;
- making the best of one's individual potential; and
- advance the progress of one's career.

All Sasol Mining employees have PDP's in place and a typical example is attached hereto as Annexure D. These PDP's are reviewed at least once a year, to ensure that it addresses each individual employee's development needs.

2.4 Leadership development programme

Definition

The Sasol group human resources team has developed an integrated talent development model for all employees from the unskilled level to the highest level in all business units and all core disciplines. Sasol's group vision, values and strategic growth objectives have shaped the development of this new model and it is core to Sasol's nature, objectives and enduring success.

NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Policy guidelines

- Needs are identified and approved as part of the individual employee's personal development plan.
- The employee's level in Sasol Mining must be in line with the selection criteria for the relevant leadership programme.

Objectives

- to build the vital talent capacity needed for business growth and improvement;
- to ensure that Sasol Mining is well equipped and prepared to meet its current and future talent needs;
- to enhance leadership performance;
- to develop and orientate newly appointed managers into Sasol Mining; and
- to create the leadership critical mass needed for succession planning and to reach diversity (employment equity) targets.

In terms of the leadership development programme, nominations are done annually, from those employees in the newly appointed pool, who meet the selection criteria.

The following tables summarise the numbers of employees currently participating in the various Sasol Mining, programmes. The numbers of employees to be included in these programmes for the period 2009 to 2012 are also provided. Details of the particular employees are provided annually, as part of the annual report. The current and five year plan for 2008 to 2012 is outlined in Table 8 below.

Table 8
Sasol Mining leadership development programmes

Program	2008	2009	2010	2011	2012	Total
Accelerated management development programme	9	8	8	8	8	41
Sasol executive develop programme	2	2	2	2	2	10
Business Women in leadership	8	6	6	6	6	32
Sasol leadership development programme	20	0	20	0	20	60
Certificate of Competency Assistance Programme	16	30	19	22	22	109
Manager self development programme	21	27	35	40	41	164
Manager of others development programme	5	21	27	35	40	128

For detailed information of employees currently partaking in these programmes please refer to Annexure E.

2.5 Integrated career development plan

Description

A plan that combines three key aspects of employee development that comprises:
- individual development;
- succession management; and
- a mentorship programme.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

It is important to note that the integrated career development plan is aligned with, but not limited to hard-to-fill vacancies, diversity needs and competency development.

Objectives

- To ensure continuity on key business functions through planned capacity and talent building;
- to proactively provide a long-term plan for future business requirements, especially for critical and hard-to-fill vacancies;
- to ensure scope for growth for individual employees, thereby resulting in staff retention;
- to identify replacement needs in critical leadership and specialist positions;
- to provide growth and development opportunities for high potential employees;
- to continuously meet the skills-related challenges faced by the business and contribute to Sasol Mining's strategic goals and objectives; and
  to provide for emerging skills in line with Sasol Mining's future business focus.

Sasol Mining context and criteria for selection of positions and individuals

- Positions are linked to Sasol Mining's core skills and competencies
- Skills in the market (internal/external) are not readily available
- There is high staff turnover in such positions
- Comprehensive preparation is required prior to filling the position
- Selected individuals possess an ability to maintain/improve performance in critical positions
- Employees possess or are in a process of achieving relevant and credible formal qualifications and experience in line with Sasol Mining's diversity guidelines.

A summary of the integrated career development programme within each business unit is provided in Annexure F.

2.6 Mentorship plan and coaching

Definition of mentorship and coaching

Mentorship refers to a developmental relationship between a more experienced and competent employee referred to as a mentor, and a less experienced employee referred to as a mentee or protégé. A mentee is guided and protected by a mentor to foster a continuous growth in the organizational culture, values, knowledge and relevant behavioral attributes. Coaching is on the job training on lower levels between a more experienced and competent employee referred to as a coach and a less experienced employee at the unskilled and semi-skilled levels.

Sasol Mining has developed a mentorship-training programme to empower mentors and mentees. The programme is aimed primarily at candidates who are identified to have leadership qualities and are targeted for management levels. For lower levels namely the unskilled and the semi-skilled a coach is an immediate supervisor of the employee and has to ensure transfer of skills and development.

Objectives of the mentorship programme and coaching

- To speed up development for newly appointed employees;
- to share organizational knowledge, culture, vision and objectives;

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 307 Kerkstraat • Pretoria
Ex Officio: RSA

- to empower employees to develop to their fullest potential and future career aspirations;
- to build employees depth in terms of skills, knowledge and competence;
- to encourage on the job exploration while also monitoring continued responsibility for performance; and
- to strengthen employee retention.

Coaching must translate in transfer of skills leading to a career path. For detailed information on the current internships and bursaries, please refer to the list of students on internships and bursaries, attached hereto as Annexure H.

Sasol Mining context

The programme entails the following:

- All engineers-in-training undergo mentorship to optimise their training experience.
- A mentor was appointed to assist females on the Sasol Mining programme for women in mining.
- All appointed graduates are part of the graduate development mentorship programme (GDP), to ensure exposure to specific disciplines within Sasol Mining.
- A mentorship framework for HDSA employees have been developed and implemented.
- All unskilled and semi-skilled employees have a coach who is the immediate supervisor. In some instances the immediate supervisor also plays a role of a mentor. Please refer to the Maintenance Operator Training Path (Coaching Process for lower levels), attached hereto as Annexure G.

For information on mentorship please refer to Annexure F. Table 9 provides the characteristic of the graduate trainees in the mentorship programme.

Table 9
Characteristics of graduate trainees in the mentorship programme at 30 June 2007

	Females				Males				Total
	Black		White		Black		White		
	No.	%	No.	%	No.	%	No.	%	
Engineering*	2	9	1	4	5	23	14	64	22
Mining	1	6	0	0	6	33	11	61	18
Surveyors	0	0	0	0	0	0	0	0	0
Geologist	1	50	1	50	0	0	0	0	2
Total	**4**	**10**	**2**	**5**	**11**	**26**	**25**	**59**	**42**

*Engineering = electrical, mechanical and industrial
Legend: No = number of learners
% = Number of workforce category expressed as % of all graduate trainee

2.7 Internship and bursary plan

Bursary programme

Definition

A programme aimed at providing financial aid to grade 12 and/or current university students, with maths and science on higher grade, who will pursue their studies in the mining disciplines at a university or a technikon (university of technology). Suitable

LANDI COETZEE NOTARIS NOTARY GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

candidates are identified at the relevant high schools or applications received. Bursary recipients study full time and the bursary continues until the student graduates.

Objective

- To provide a skills pipeline for hard-to-fill vacancies;
- To provide assistance towards the tertiary training of students who demonstrate the potential to succeed; and
- to contribute towards community skills development.

Sasol Mining context

- Students who are awarded bursaries are drawn, as far as practically possible, from the local communities of the Govan Mbeki Municipal area and wider Mpumalanga area. The selection of students is based on the minimum entry requirements, which will alos result in the allocation of bursaries to students outside these areas.
- The number of students who are awarded bursaries, is aligned with Sasol Mining skills pipeline.
- The bursary programme intends to address Sasol Mining future skills requirements as well as diversity needs, in terms of gender and race.
- On completing their studies, the students are placed on an internal Sasol Mining internship programme to gain practical experience in their field of study.
- For the 2008 year, 78 bursary (67 university and 11 technikon) students are receiving bursaries from Sasol Mining, of which two are from the Gert Sibande Municipal area. The number of students from the Gert Sibande District Municipal area will be gradually increased over the next five years, as indicated in Table 7.
- Out of the aforementioned number, only 55 students are currently enrolled. Nine are first-year, 13 are second-year, 15 are third-year and 18 are post graduate students.
- If a student fails to complete his or her studies, the student is obliged to repay the bursary.
- Sasol Mining, through Sasol Corporate Affairs have already embarked on, and will continue to create relationships with schools within the immediate Gert Sibande district and Mpumalanga Province, to target students on grade 10 to create an awareness of a career in mining.
- Sasol Mining will embark on advertising within the Mpumalanga region for prospective bursary holders to attract students within the Mpumalanga region.
- Currently branding on adverts is underway for bursaries and careers in other discipline with the mining environment.

Table 10 below provides information on the number of bursaries allocated and the plan for the period 2008 to 2012.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Table 10
Allocation of bursaries for the period 2008 to 2012

	2008	2009	2010	2011	2012
Total number of Sasol Mining bursaries	**78**	**80**	**80**	**80**	**80**
Secunda - Students from Mpumalanga and elsewhere	**76**	**76**	**74**	**74**	**74**
• Students from Gert Sibande District municipal area	2	8	14	14	14
• Mpumalanga Province (excluding Gert Sibande District)	7	11	16	16	16
• Percentage of total intake from Gert Sibande District	2.6%	10.0%	17.5%	17.5%	17.5%
• Percentage of total intake from Mpumalanga (excluding Gert Sibande District)	9.0%	13.8%	20.0%	20.0%	20.0%
• Students from elsewhere	67	57	44	44	44
• Percentage of total intake from elsewhere	85.8%	71.2%	55.0%	55.0%	55.0%
Students from the Free State	**2**	**4**	**6**	**6**	**6**
• Students from Metśimaholo and Ngwathe municipal areas	2	2	3	3	3
• Free State Province (excluding Metsimaholo and Ngwathe municipal areas)	0	2	3	3	3
• Percentage of total intake	2.6%	5%	7.5%	7.5%	7.5%

Internship programme

Definition

A programme aimed at providing practical work experience within the Sasol Mining environment to students or recent graduates. The students and recent graduates admitted into the internship programme are mainly Sasol Mining bursary recipients and external students, who applied to do practical work at Sasol Mining.

Objectives

- To provide students and recent graduates with practical experience;
- to provide a transition between theoretical studies and work and the practical work environment;
- to develop and entrench a work culture, desired workplace values and enhance participants' performance when they are appointed; and
- to attract non-Sasol bursars to Sasol Mining on completion of their studies.

Sasol Mining context

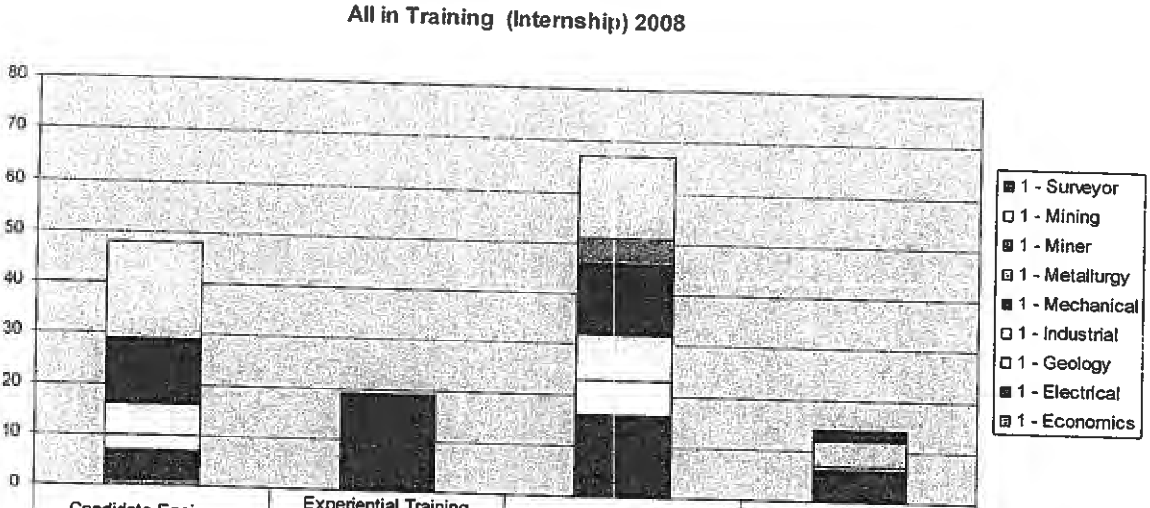
- Graduates will be employed at Sasol Mining on permanent basis on completing their internship programme.
- These graduates form part of the integrated skills pipeline.
- Sasol Mining also provides the opportunity to some students to become part-time interns to gain experience and exposure to the workplace environment without any employment commitment.
- Students who are not recipients of a Sasol bursary, may be awarded bursaries to help them to complete their studies

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Diagram 2 below provides information on the number of internship training for 2008

Diagram 2
Number of internship training for 2008



	Candidate Engineer	Experiential Training Student	University Student	Experiential Training Bursar
1 - Surveyor		10		2
1 - Mining	19		16	5
1 - Miner		9		
1 - Metallurgy			5	1
1 - Mechanical	13		14	1
1 - Industrial	6		9	
1 - Geology	3		7	
1 - Electrical	6		6	5
1 - Economics	1			

For detailed information on the current internships and bursaries, please refer to the list of students on internships and bursaries, attached hereto as Annexure H. Table 11 below provides information on the number of internships and the plan for the period 2008 to 2012.

Table 11
Sasol Mining Internship Five Year Plan

Five Year Plan	2008	2009	2010	2011	2012
Experiential Trainees (Internships)	31	36	38	40	44
Percentage of intake	15.8%	18.4%	19.4%	20.5%	22.5%

2.8 Study aid programme

Definition

A programme aimed at providing financial aid to Sasol Mining employees to further their tertiary education. Sasol Mining has for many years offered study aid to employees who study part-time. 452 employees are currently benefiting from this scheme.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Objectives

- To develop and grow employees knowledge in their current positions;
- to increase the scope of knowledge and qualification of employees to meet their career aspirations, in line with their personal development plans;
- to enhance employees knowledge and to add value to Sasol Mining business and growth; and
- to retain employees.

Policy guidelines

- The study aid is awarded to permanent employees at all levels.
- The employees' choice of courses is aligned with, but not limited, to employees current jobs and career aspirations, as outlined in their personal development plans and approved by managers.
- Employees who fail their studies pay back the amount owed plus interest from the date it was granted, unless they have proof of registration for re-examination and they pass such re-examination.

Sasol Mining context

- Employees study part-time.
- Special preference is given to individuals who occupy, or have a potential to be appointed into hard-to-fill vacancies.
- Employees who have passed ABET Level 4 are eligible for study aid to obtain a formal tertiary qualification.
- There is no five year plan for awarding study aids, instead it is based on the individual development plan, based on individual choices within guidelines and it is reviewed annually.
- The duration of individual employee courses range between three months to five years.

Information of the current employees on the study aid programme is attached in Annexure I.

2.9 Career progression plan/path

Definition

Sasol Mining's career path provides a developmental course in which jobs are aligned for employee recruitment, promotion and development into senior positions. It also aims to identify employees with high potential of moving into management and core positions and to develop employees to address the hard-to-fill vacancies.

Objectives

- The objective of identifying career paths is to ensure alignment of the skills pipeline, succession management and individual development, to identified career paths;
- To assist managers and employees when structuring and making decisions or choices on employees development; and
- To enhance competencies by ensuring a progressive and aligned growth from lower- to high-level positions.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

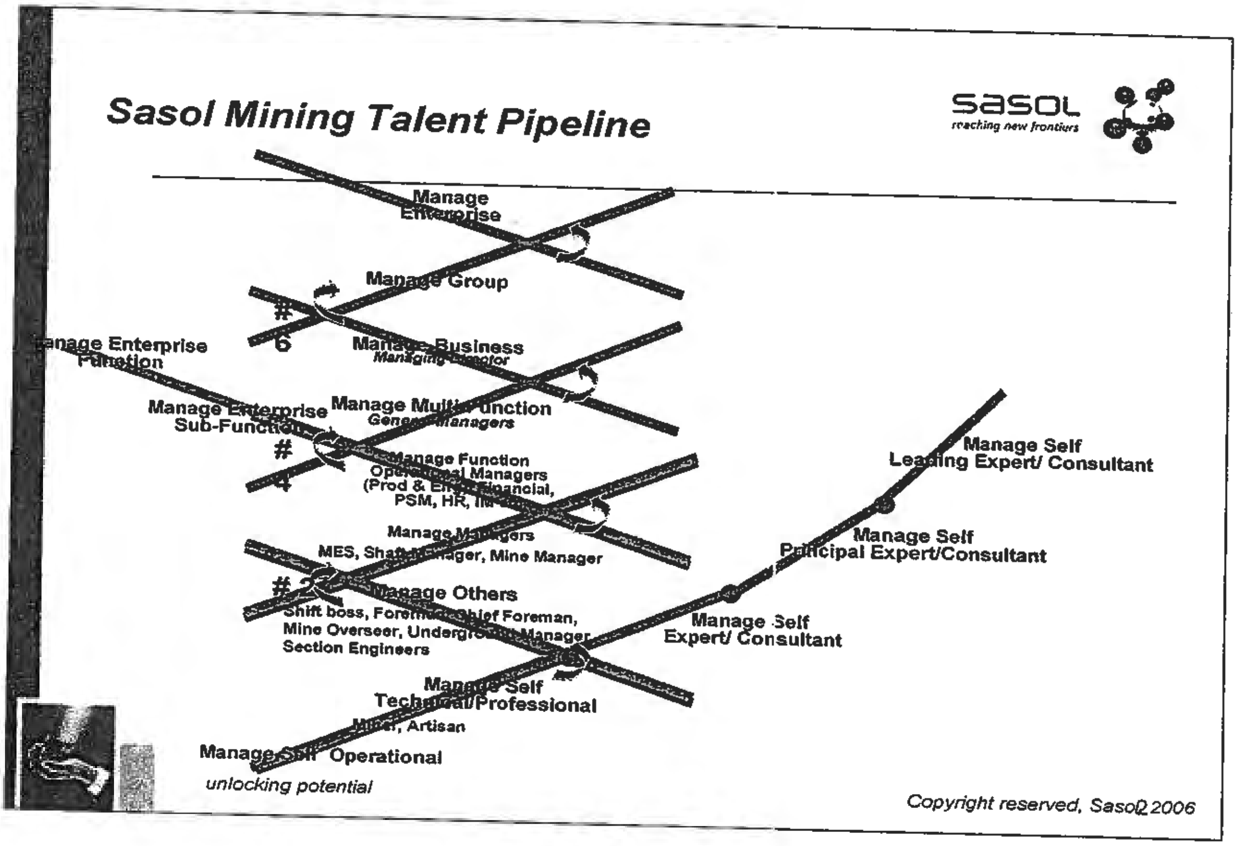
Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Sasol Mining context

- Employees and managers will use identified career paths as a basis for development.
- Employees can move, and have moved from one career path to another provided they meet the entry qualification requirements.
- The development of a talent pool with employees with high potential, to be fast tracked.

For more information on career progression paths, please refer to the comprehensive flow diagram (Diagram 3) below, which depicts the career paths and relevant qualification requirements for each discipline. Please refer to Annexure J for details.

Diagram 3
Career Path Flow Diagram



Detail of the HDSA high potential candidate talent pool and employees currently on the fast tracking plan are contained in Annexure K, High Potential Candidates.

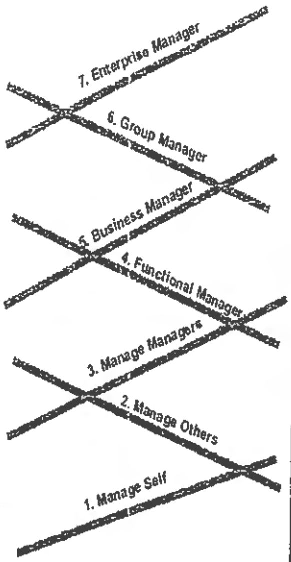
Please refer to Diagram 4 for the criteria for placing employees on progression levels. The time frames for movement from between levels is based on minimum 12 months within each level and on individual performance with 3 – merit rating (full performance)

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ed
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretori.
Ex Officio: RSA

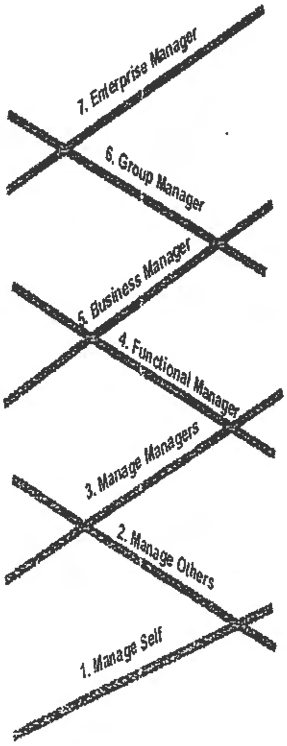
Diagram 4
Talent pipeline layers

Guiding principles of the Talent Pipeline layers



Manage Enterprise	1. Getting results through comprehensive enterprise leadership and statesmanship. 2. World class governance and regulatory compliance. 3. Builds a unified Sasol. 4. Global strategy achievement.
Manage Group	1. Getting results through business managers. 2. Connect and align business with enterprise 3. Value the success of business managers. 4. Adopts a financial analyst's perspective. 5. High level strategic review and coaching capability. 6. Portfolio management. 7. Constructive working relationships with strategic partners and governments. 8. Development of the organisation beyond personal success.
Manage Business	1. Getting results through comprehensive business leadership and management. 2. Valuing and understanding all functions. 3. Changing mindset from a functional to a profit, customer and competitive advantage perspective. 4. Valuing both short-term results and long-term business sustainability. 5. Proactively enhancing credibility of business through effective stakeholder relationships.
Manage Enterprise Function	1.Getting results through an enterprise wide function. 2. Ensuring that the function adds differentiated competitive advantage to the enterprise. 3. Enterprise functional excellence and credibility. 4. Constructive working relationships with strategic partners, stakeholders and business leaders.
Manage Enterprise Sub-Function	1. Getting results through functional expertise. 2. Leading and developing functional capability. 3. Ensuring enterprise sub-functional alignment and support for enterprise vision and strategy. 4. Constructive working relationships with key stakeholders. 5. Centre of excellence.
Manage Function	1. Achieving results through an integrated and flexible function. 2. World-class functional strategy to achieve competitive advantage for the business. 3. Valuing work of one's own experience. 4. Creating synergies between departments. 5. Taking other functional concerns and needs into consideration. 6. Making trade-offs within the function that supports business strategy (rather than just supporting functional success).
Manage Managers	1. Getting results through managers. 2. Selecting effective managers of others. 3. Assisting and providing environment for managers of others to grow. 4. Results through multiple teams. 5. Cross-department teamwork.

Guiding principles of the Talent Pipeline layers..cont.



Manage Others	1. Getting results through other individuals. 2. Engaging, training & serving others. 3. Removing obstacles inhibiting team performance. 4. From teamwork to teambuilding. 5. Taking accountability for success of others. 6. From personal planning to annual planning for team results. 7. From individual results to providing customer results.
Manage Self Expert Consultant	1. Getting results through individual expert contribution, influence, effort and self management. 2. Active participation, engagement and professional networking. 3. Ongoing reassessment and development of own skills. 4. Displaying professional and productive work practices.
Manage Self Leading Expert / Consultant	1. Getting results through recognized expertise 2. Getting results through directing & influence of stakeholders /network members 3. Getting results through optimal integration and business model requirements 4. Getting results through the integration of different bodies of expertise 5. Focused development by creating, building and participation in expert network 6. Focused reassessment and development of own expertise 7. Add to the body of knowledge in the field of expertise 8. Optimizing and displaying professional & productive work practices 9.Improving the utilization of company resources.
Manage Self Operational	1. Getting results through individual contribution, effort and self management. 2. Active participation and earning respect and credibility from the team. 3. Personal responsibility for development and skill mastery. 4. Displaying disciplined, safe and productive work practices. 5. Utilizing company resources responsibly.
Manage Self: Principal Expert Consultant	1. Getting results through individual expert contribution, influence, effort and self management. 2. Active participation, engagement and professional networking. 3. Ongoing reassessment and development of own skills. 4. Displaying professional and productive work practices.
Manage Self professional	1.Getting results through individual contribution, effort and self management. 2. Active participation, engagement and professional networking. 3. Ongoing reassessment and development of own skills 4. Displaying professional and productive work practices. 5. Utilizing company resources responsibly.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

2.10 Employment Equity Plan

Definition

A method and guideline aimed at assisting Sasol Mining to achieve its set target for employment equity (EE) in alignment with Section 20 of the Employment Equity Act (Act 55 of 1998).

Objectives

To achieve an equitable representation of people from designated groups at all levels within Sasol Mining.

Sasol Mining context

- Employment equity is a business imperative for Sasol Mining.
- Achievement of set employment equity targets are an integral part of the Sasol Mining leadership incentive programme.
- A responsible person, the manager diversity, is appointed and responsible for monitoring and implementing the employment equity plan, helping managers to meet employment equity targets and creating an enabling environment for diversity.

The EE strategy for Sasol Mining forms part of the overall Sasol Group Strategy and is set by Sasol Head Office. The current Sasol Mining five-year EE plan covers the period from 2008 to 2012.

Targets and timeframes

The Sasol Mining EE five-year plan, referred to above, for the period 2008 to 2012, is outlined in Annexure L.

2.10.1 HDSA's in Management

Sasol Mining reached the 40% HDSA target during June 2008 and has set a new target of 42.5% for HDSA in management during 2009. This target caters for middle management to top management. For detailed targets for the five-year period from 2008 to 2012, please refer to Annexure L. Form S reflects this status as at January 2009. The total workforce is 7411, as at 31 January 2009, of which 1350 employees are at management level. Of the 1350 employees at management level, 593 are HDSA's (excluding 188 white women). Therefore Sasol Mining currently has 43.9% HDSA's in management.

Guidelines

1) The staff establishment has been reviewed to make provision for the 2008/2009 budget requirement.
2) The current and expected vacancies will be utilised to address the business needs taking into cognisance all critical skills. The filling of vacancies will be used in a responsible manner to ensure that management targets are met.
3) The targets set in the Mining Charter will be used for the initial target set for 2009 and thereafter Sasol Mining will continue to increase the level of HDSA's in management:

YOLANDI COETZEE NOTARIS NOTARY GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

- 40% HDSA in management (D-band and higher) and 10% women in all job levels by April 2009; and
- after the 30 April 2009, Sasol Mining will strive to improve the HDSA participation in management by 2,5% a year.

4) The talent management strategy focuses on the attraction, development and retention of the underrepresented groups - specifically career management and promotions.
5) Under-represented groups that have been with the company for more than three years and having received an above-normal merit rating with relevant qualifications will be managed through the high potential candidate process.
6) Skills transfer is imperative for retention.
7) A tool to measure and reward transfer of skills for women in mining will be investigated.

Principles

1) Replacement and filling of vacancies will be used to increase HDSA participation in management. If in the filling of a vacancy a HDSA do not replace a HDSA, the relevant department or mine must table a plan on how HDSA's participation will be achieved and thus plan must be approved by senior management, before the vacancy is filled.
2) Sasol Mining will use vacancies responsibly, as a method of continually increasing HDSA participation in management.
3) Recruitment, promotions, bursaries and learnerships will be used to ensure that Sasol Mining meets the Mining Charter targets. Sasol Mining will strive towards achieving an equitably representative pool on bursaries and learner ship with focus to achieving 10% of women at all levels.
4) The transformation opportunities (vacancies) that exist within the staff establishment will be used to align Sasol Mining to Mining Charter targets.
5) Target of 1,5% of the total workforce, of people with disabilities (PWD) have been set. Due to constraints imposed by mining activities, PWD will be accommodated in surface services areas of Sasol Mining.
6) Ensure the current principle of going beyond staff establishment, is utilised to increase HDSA representation. The Sasol Mining policy indicates that Sasol Mining may exceed the approved staff establishment by 2%, to ensure that HDSA targets are met.
7) The Mining Charter targets are used as a main guideline tool when filling a vacancy and to improve the under-representation of the designated groups. The mining industry EAP of May 2007, will be used for benchmarking purposes.

2.10.2 Women in mining (WIM)

Definition

Sasol Mining has drawn a distinction between women in support function positions (women at mining) who are operating in non-core business and the women in mining who work in core mining and other immediate production positions. Women at a mine starts as operators in underground sections and will be fast tracked upwards in the organisation, taking into consideration their performance and development. Specialist and professional positions such as engineering, geology, rock engineering and environmental are also regarded as part of the core mining business.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887/Kerkstraat • Pretoria
Ex Officio: RSA

Sasol Mining context

- Women in mining include women from all racial groups at all levels.
- Sasol Mining has implemented a programme of recruiting 30 women per quarter, being trained as underground operators. This programme will continue at least until May 2009. As far as possible these women are drawn from the Govan Mbeki Municipal area.
- Specialist and professional women are recruited from the industry as well as the appointment of bursary holders.
- A mentor has been specifically appointed to help women to adjust to the underground mining environment.
- The workplace facilities have been adjusted to accommodate women in the previously male-dominated environment

Targets and timeframes

Sasol Mining's staff establishment amounted to 6410 as at 30 June 2007. Sasol Mining is committed to achieve the Mining Charter target of 10%, for women-in-mining, by April 2009. The current number (as at 30 June 2007) of women in mining (core positions) is two hundred and fifty one (251), which translates to 3.97% of the total workforce of women in core functions. Please refer to Annexure M for details on women in mining and women at Sasol Mining.

The plan to achieving 10% target of women in mining, by April 2009 are contained in Table 12 below.

Table 12
Plan for achieving 10% women in mining by 2009

	June 2007	**Sept 2007**	**Dec 2007**	**April 2008**	**June 2008**	**Sept 2008**	**Dec 2008**	**April 2009**
WIM intake per quarter	15	15	15	15	15	15	15	15
Total and percentage	251 3.97%	242 4.25%	323 4.94%	375 5.25%	419 6.11%	458 6.66%	500 6.70%	583 7.00%
Gap	3.03%	2.75%	3.71%	3.40%	3.00%	2.45%	4.41%	3.00%
Target	**491 (7.00%)**	**491 (7.00%)**	**645 8.65%**	**722 8.65%**	**675 9.11%**	**675 9.11%**	**759 9.11%**	**833 10%**

The table above indicates a shortfall of 3% by April 2009 to reach the set target of 10%. Sasol Mining has measures in place to exceed the set projections by targeting on employer branding to attract more women in core functions and contracting with schools in Govan Mbeki and Mpumalanga to raise awareness of opportunities that exist within the mining industry for women. The appointment, development and progression of WIM is closely monitored via the monthly diversity forums at the Mines which is attended by Management and recognised Unions for all employees especially WIM progression by race level and gender to ensure equitable representavity.

YOLANDI COETZEE NOTARIS NOTARY GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

3. SECTION 3: LOCAL ECONOMIC DEVELOPMENT PLAN

3.1 Social and economic background

The Sasol business units in Secunda are participating in the local economic development (LED) programme and through this they have aligned many Sasol projects with the integrated development programme (IDP) of the Govan Mbeki Municipality (GMM) in an effort to eradicate poverty and to create jobs. The majority of these Sasol Secunda projects are focussed towards the Govan Mbeki Municipality in the Gert Sibande District Municipality (GSDM).

In this context, Sasol Mining Secunda participates in LED and corporate social investment (CSI) programmes that are aligned with the IDP, within the GMM area.

All CSI and LED programmes are developed in partnership with key community stakeholders and are concentrated in regions where Sasol has the largest footprint. Where possible, the stated objective is also to involve employees in community activities. The aim of these projects is to stimulate economic growth, create jobs and alleviate poverty in the region.

The success of these programmes is measured and determined by their ability to deliver sustainable development and economic benefit to the broader community, especially the poorest people in the GMM area of the wider GSDM region, while taking into account community needs, IDP and Provincial Growth and Development Strategy (PGDS) alignment

It is important to note that Sasol Mining's major labour sending areas are the GMM and the GSDM. Therefore, the company's LED is focused on these areas.

Job creation and capacity building

Sasol invests both financial and non-financial support to emerging micro-enterprises, especially those belonging to women and youths in rural communities. Skills development and capacity building is facilitated through focused training programmes.

The GMM is a category B municipality, which is both modern and rural in nature and that has in its jurisdiction a major petrochemical industry, and the occurrence of coal and gold in the region. The GMM has an executive manager and six departments (finance, public safety, environment and tourism, engineering services, corporate services and health and community services). The poverty rate, as defined by GMM, is determined by the number of people who are unable to pay for their municipal services. These people are called "indigents".

Diagram 5 below provides information of the labour markets within GMM, whilst Diagram 6 provides information on the labour market status.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Diagram 5

GMM labour market status 1

(Economically active population STATSSA 2006)

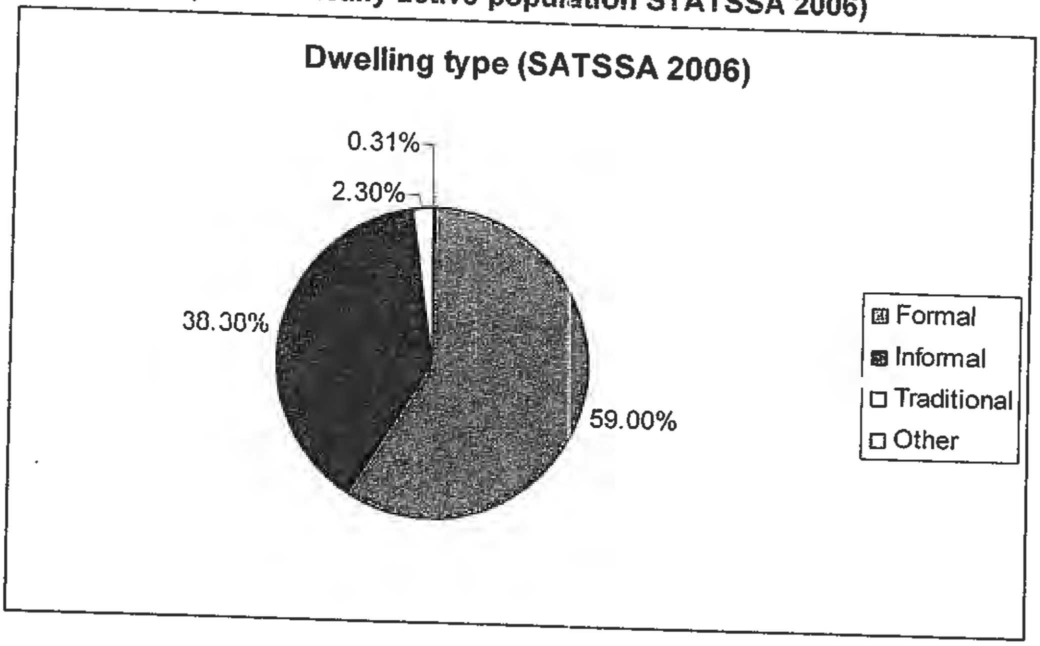
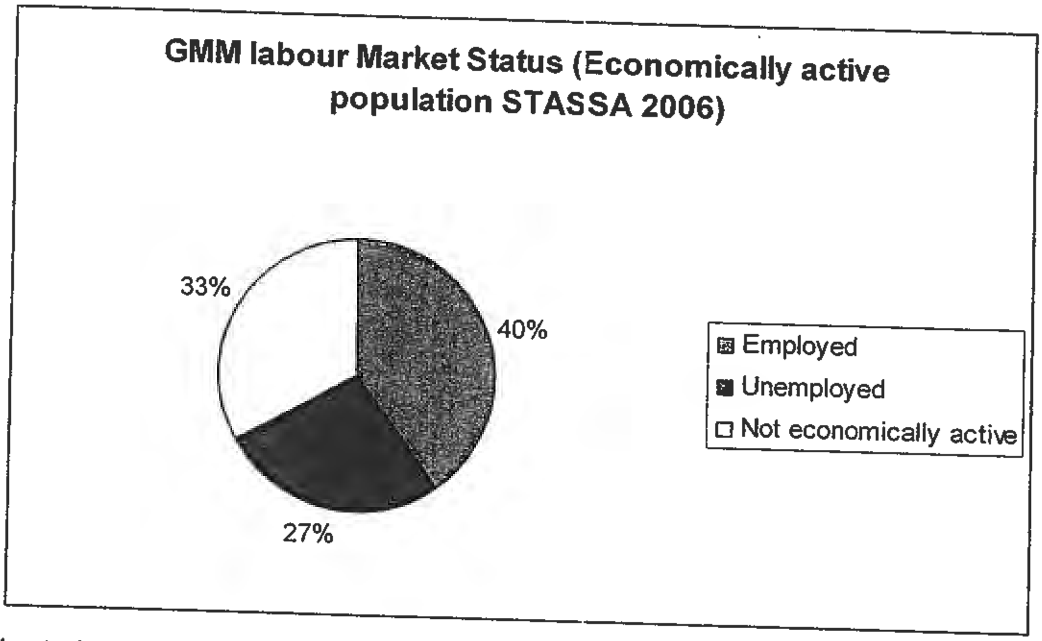


Diagram 6



The chart above reflects the labour force in the municipal area and demonstrates a huge challenge on the number of economically active population, not employed or engaged in any economic activity.

The extent, population and people below the minim living standard, as well as the household income, are provided in Table 13 below.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ed
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretor
Ex Officio: RSA

Table 13
Extent, population and people below minimum living standard and household income

Extent (ha)	Population Stats SA 2006	Population below minimum living standards	% People below minimum living standards	Total households income R	% to total household income for GSDM
295 470	221 731	102 287	45,83	3,115,704,748	43,36

The Govan Mbeki Municipal budget (total budget of R686,326,600.00) for 2007/2010 is as follows:

- operational budget: R604,771,600.00; and
- capital budget: R81,555,000.00 for 2007/08 financial year, as well the medium term (indicative budgets) for 2008/2009 and 2009/2010 financial years.

Note: This information was obtained from the GMM IDP for 2007-2011 and the GMM budget 2007/08 to 2009/10 medium-term revenue and expenditure framework.

3.2 Key economic activities within the Govan Mbeki Municipality

The GMM is the area from which Sasol Mining sources about 95% of its workforce. The GMM, a category B municipality, has both urban and rural economic realities. The key economic activities in the Govan Mbeki Municipality are:

- mining;
- farming;
- petrochemical industries; and
- industrial tourism.

3.3 Definition of local economic development (LED)

LED must improve the infrastructure in impoverished areas and improve living conditions of communities at large. It must be focused on projects through which employment is created and poverty alleviated.

LED projects - infrastructure

- LED projects should focus on infrastructure development such as services and housing.
- Projects selected must fit the profile (and profit) of the company.
- LED is required to improve the quality of life of all South Africans.
- Benefits must reach the host community and major labour-sending areas.

LED projects - job creation and poverty alleviation

- People should be able to continue earning an income once the mine closes down, which includes employment.
- These projects must be aligned with portable skills training and procurement progression.
- A mining company such as Sasol Mining must be catalyst for economic growth and social development.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

3.4 Proposed LED projects

Sasol Mining has embarked on an extensive consultative process with the GMM, to identify and agree upon suitable LED projects. Projects were identified and discussed by a working committee specifically created for this purpose. The working committee comprised of representatives from the GMM and Sasol Mining. The LED projects include proposals from GMM and as contained in the regional IDP.

It is important to note that even though a number of projects were selected from the GMM IDP, the costs and timeframes reflected in the IDP was used as baseline information only. Projects will be implemented using a proper project management approach and timeframes will not necessarily correspond with the timeframes in the IDP. Areas requiring urgent attention will receive priority. Sasol Mining is also committed to implement the projects described in this document and therefore the costs provide should be seen as indicative and Sasol Mining will ensure that the project is implemented fully. It will be ensured that sufficient funds are available, even if it exceeds the estimates indicated below.

The Govan Mbeki Municipality and Sasol Mining entered into an agreement with respect to the LED projects to be implemented over the next five years. Subsequent to various discussions with the DME, the proposed LED projects was revised to ensure that a balance is maintained between infrastructure development projects and poverty alleviation and job creation projects. A copy of the agreement in respect of the revised Local Economic Development Projects is attached hereto as Annexure O.

In respect of all the LED projects, Sasol Mining will manage each project until completion thereof, where after it will be handed over to GMM or the appropriate beneficiaries, to ensure effective project implementation.

A summary of the LED projects are contained in Table 14 below.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Table 14
Summary of LED projects for the period 2008 - 2012

Name	Location	No of Beneficiaries	Objectives	Main Activities	% of funding committed	Expected start date	Training needs analysis	Links with development initiatives	Sustainability plan	SMME opportunities	Project Plan
Storm water drainage	Leandra Ward 6	13 491 households	Provision of infrastructure to avoid flooding of houses	Construction of storm water drainage	100% of R2.5m	Last quarter 2008 – completion 2010	Not applicable	Technical and Engineering Services (Govan Mbeki Municipality)	To be handed over to municipality once construction is completed	Procurement in terms of the strategy described in paragraph 3.7	Please refer to Table 15
Foot bridges	eMbalenhle Wards 14 and 26	32 200 households	Provision of access across river, to enable community members to access schools, shops, etc.	Construction of foot bridges	100% of R2.5m	Last quarter 2008 – completion 2010	Not applicable	Technical and Engineering Services (Govan Mbeki Municipality)	To be handed over to municipality once construction is completed	Procurement in terms of the strategy described in paragraph 3.7	Please refer to Table 16
Community health centre	Bethal Extension 23	22 996 households	Provision of a proper health care facility to replace existing insufficient facility	Construction of community health centre	100% of R4m	Last quarter 2008 – completion 2010	Not applicable	Govan Mbeki Municipality Health & Social Services	To be handed over to municipality once construction is completed	Procurement in terms of the strategy described in paragraph 3.7	Please refer to Table 17
Agro based project	GMM Rural Area	± 216 000 households in GMM rural areas 60 jobs (15 farmers, each creating 3 additional jobs)	Poverty alleviation and job creation	Farming, marketing and skills development	100% of R4.4m	Last quarter 2008	Capacity building in crop production and farm production including financial management	Provincial Department of Agriculture's (Masibuyele eMasimini campaign)	To be used as incubation for farmers, exit strategy to be developed and reviewed.	Procurement in terms of the strategy described in paragraph 3.7 Supply produce to Hawkers and local supermarkets	Please refer to Table 19
Buy-back recycling project	Secunda, to be expanded to other areas	135 jobs will be created (Potential to expand significantly)	Poverty alleviation and job creation	Establishment of waste recycling facility, business linkages, business incubation and mentorship	100% of R4.4m	Last quarter 2008	Capacity building and training of staff and management; waste management and disposal: Environmental management :and Marketing	Govan Mbeki Health and Community Services	Four years support to the centre(s). These include financial and business skills training. Monthly Recruit more customers. Operational reports required to investigate areas of concern for the business.	Transport SMME's and procurement in terms of the strategy described in paragraph 3.7	Please refer to Table 20

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

3.4.1 Storm-water drainage

The storm-water project is an infrastructure project as identified in the GMM IDP. It will benefit the poorest people in the GMM area and will provide immediate relief to people exposed to flooding in the rainy season. This infrastructure development project will improve storm-water services for the community, avoid storm-water damage to other infrastructures and avoid flooding. IDP No TES 28 Leandra Ward 6 (including the wards/towns that may be agreed upon). Even though the project is contained in the IDP, it will be implemented as priority and not according to the planned IDP timeframes

Sasol Mining will project manage the implementation of this project, working together with the Govan Mbeki municipality. The breakdown of figures is based on estimated costing over a period of two years from the beginning to completion of the project. The project plan will have annual milestones (2008 - 2010).

Upon completion of the construction, the storm water drainage structures will be handed over to the municipality at a handover ceremony to be arranged. Thereafter the maintenance and upkeep pf the structures shall be the responsibility of the municipality.

Detail relating to the activities and costs, per activity and phase, are provided in the two-year plan for the construction of the storm water drains, which appears as Table 15 below.

Table 15
Storm-water project: 2 year plan

Project	2008/09 budget estimate	2009/10 budget estimate	Forecast Total budget
2 .STORM-WATER	R1m	R1.5m	**R2.5m**
1. Stakeholders' engagement. - Local government - Community - Draw up an MOU	By Dec 2008		
2. Set up project teams and governance structures	By October 2008		
3. Finalise structural design / architecture and Land surveying, civils, and all legal aspects.	R100,000		Note: Saving if existing plans with the local dept of Technical Services are used.
4. Project scoping	R100,000		
5. Construction phase (ward 30,14,12)	From February 2009	By March 2009	**R2.5 m**
5.1 - Build first storm water drain	R700,000		
5.2 - Build second storm water drain		R700,000	
5.3 - Build third storm water drain		R800,000	
6. Handover ceremony	First quarter of 2010		
7. Cutting of the ribbon	First quarter of 2010		

YOLANDI COETZEE NOTARIS NOTARY GAUTENG

Note: Money will only start flowing once construction commences. GMM to assist with surveying, structural designing and legal aspects.

3.4.2 Footbridges

The footbridges project is an infrastructure project that will ensure safer and easier access for the community. Currently the local community needs to cross a river to access schools, shops and other facilities. It is intended to benefit the broader community with easy and safe access to infrastructure for economic development and other amenities e.g schools, clinics etc.

Sasol Mining will project manage the project from start to completion but working closely with the local government. Through the local government, the department of Public Works will be involved; the benefit thereof is transfer of skills to local community. (TES 25 at eMbalenhle Wards 14 and 26)

Detail relating to the activities and costs, per activity and phase, are provided in the two-year plan for the construction of the footbridges, which appears as Table 16 below.

Table 16
Footbridges: 2 year plan

Project	2008/09 budget estimate	2009/10 budget estimate	Forecast Total budget
3. FOOTBRIDGES	R1.35 m	R1.15 m	**R2.5m**
1. Stakeholders' engagement. - Local government - Community - Draw up an MOU	By December 2008		
2. Set up project teams and governance structures	By October 2008		
3. Finalise structural design / architecture and Land surveying, civil, and all legal aspects.	R100,000		Note: Saving if existing plans with the dept of Technical Services are used.
4. Project scoping	R100,000		
5. Construction phase (ward 14, 26)	From February 2009	By March 2010	**R2.5m** (up to planned completion date)
5.1 - Build a footbridge in Embalenhle	R1.15m		
5.2 - Build a footbridge in Mzinoni		R1.15m	
6. Handover ceremony	First quarter of 2010		

Note: Money will only start flowing once construction commences. GMM to assist with surveying, structural designing and legal aspects.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

3.4.3 Community Health Centre Upgrade

This is an infrastructure development project for the community. It will benefit the broader community by providing people with access to primary health care services, which is a critical basic need.

Sasol Mining will take the lead in project management until the project is completed.

Health services are currently provided from a Community Centre not properly equipped as a health facility. The project is aimed at providing a proper health care facility and thereby allowing the Community Centre to be used for its intended purpose. The current facility is sufficiently resourced and the Department of Health is already involved; the nursing staff is available and currently operating from the Community Centre. It would have no budget or staffing implications for the Department of Health, as the resources are already allocated and in use. The project milestones will be measured on a bi-annual basis starting 2009.

The clinic facility will be handed over to Govan Mbeki municipality upon completion, maintenance and upkeep will be the responsibility of the local council.

Detail relating to the activities and costs, per activity and phase, are provided in the two-year plan for the construction of the community health centre, which appears as Table 17 below.

Table 17
Community health centre: 2 year plan

Project	2008/09 budget estimate	2009/10 budget estimate	Forecast Total budget
COMMUNITY HEALTH CENTRE	R2m	R2m	**R4m**
1. Stakeholders' engagement. - Local government - Provincial dept of Health & Social Services - Draw up an MOU	By January 2009		
2. Set up project teams and governance structures	By January 2009		
3. Finalise structural design / architecture and Land surveying, civils, and all legal aspects.	R100,000		Note: Saving if existing plans with the dept of Health are used.
4. Project scoping	R100,000		
5. Construction phase (ext 23 Bethal)	R1.8 m	R2m	
6. Handover ceremony first quarter of 2010	First quarter of 2010		

Note: Money will only start flowing once construction commences. GMM to assist with surveying, structural designing and legal aspects.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

108

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

3.4.4 Agro-based project

3.4.4.1 Background Motivation

This agricultural project is a poverty-alleviation and job creation project that will benefit the broader GMM community by providing access to farming, marketing and skills development opportunities. It also will help households, small scale and emerging commercial farmers to access vital markets, and more importantly, it will create jobs locally and enable beneficiaries to market their produce for financial gain.

Sasol Mining will provide project management services. It supports the Provincial Department of Agriculture's 'Masibuyele eMasimini' campaign. It is selected because of its broad-based nature and broader community exclusivity. The beneficiaries for this project are ordinary households, small-scale farmers, existing farmers and emerging commercial farmers, women and the youth In the GMM. The project milestones will be measured on an annual basis.

3.4.4.2 Market Identification

The target population for this project will be the broader farming community of the GMM and even Gert Sibande District, where possible, with immediate focus on communities in close proximity of the mining operations, such as Embalenhle, Secunda and Bethal. The key market for this project consist of the local community, various industrial operations, hostels, boarding houses in the vicinity, as well as the fresh produce market in Johannesburg. As the scope of the project grows, local retail supermarkets will also be targeted as potential markets.

Population of GMM Rural Area according to, GMM DEMOGRAPHICS 2006:

GMM consists of various towns which include Eendracht, Leslie and Lebohang. Leandra was established to fulfil a service centre role for either the mining and or agricultural sectors in the district. The district is close to Gauteng and the Witbank-Middelburg complex. The centre benefits directly from spill-over effects from development in these centres. Today, Leandra has approximately 108 277 residents.

It also consist of the rural areas around the build-up towns of Secunda, Evander, and eMbalenhle, Charl Cilliers, Kinross, Trichardt, Bethal and Leandra.

A large amount of land (39.5%) in the study area is used for dry land arable farming. The GMM Rural Area is known for its large production of maize, sorghum and sunflower. Most of these products are grown in summer and are therefore reliant on the generally higher summer rainfall in the study area. Table 18 below provides detail in this regard. The current vacant areas will be targeted initially.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Table 18

Agricultural land use

GMM (ha) Total Area	**142 300**
Arable land	
Dry land: Utilised	56 226
Vacant	6 472
Irrigation: Utilised	2 000
Vacant	3 000
Planted grazing	
Dry land: Utilised	
Vacant	5 621
Irrigation: Utilised	44 497
Vacant	0
Natural grazing	20 001
Forestation	0
Non-agricultural land	4 483

Detail relating to the activities and costs, per activity and phase, are provided in the five-year plan for the establishment of agro-based projects, which appears as Table 19 below.

Table 19
Agro-based project: 5-year action plan

Projects Milestones	2008 budget estimate	2009 budget estimate	2010 budget estimate	2011 budget estimate	2012 budget estimate	Forecast Total budget
5. AGRO-BASED PROJECT	R300,000	R1.6m	R800,000	R1m	R700,000	**R4.4m**
1. Do a feasibility study - land survey - soil survey - water requirements -determine type of farming etc - determine market demand - resources needed - project scoping and costing	Up to beginning 2009 R300 000 →					
2. Stakeholders' engagement. - Local government - community representatives -other government departments * Department of Agric, Econ Dev & Planning, DEAT	By Dec 2008					
3. Draw up and finalise MOU/ TOR's with all role players.	By Dec 08					
4. Land / area identification and acquisition process and approvals.		By Jan 09 R300,000				
5. Establish project teams and governance structures.	By Dec 08					
6. Identify who are the existing farmers, small-scale farmers and emerging commercial farmers in the area.		By Jan 09				

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio RSA

Projects Milestones	2008 budget estimate	2009 budget estimate	2010 budget estimate	2011 budget estimate	2012 budget estimate	Forecast Total budget
- potential investors / partnerships in the projects						
7. Conduct capacity building workshops for all role players.		Mid 09 R300,000				
8. Do project specific stakeholders' grid.	Dec 08					
9.Finalise business model - e.g establish a Trust etc		Feb 09				
10. Determine market demand and export probabilities (in conjunction with dept of Econ Dev & Planning)		Dec/Jan 09				
11. Determine related industries that have a stake in the project.		Jan 09				
12. Determine project sustainability by evaluating potential for : - impact on economic development in the area, - impact on social development , - eco-'friendliness' of the project, determine if there are any upstream projects that can be linked to this one.	Dec 08					
13. Project roll out/ implementation. - Construction of site facilities: fit for purpose. (e.g. ablution facilities, warehouse, tilling the land etc)		Mid 09 - 2012 R1m	Mid 09 - 2012 R800,000	Mid 09 - 2012 R1m	Mid 09 - 2012 R700,000	
14. Develop project exit strategy, mentoring, capacity building, change management and maintenance plan		End 09				
15. Monitor and Evaluate		Ongoing from end 2009	Ongoing from end 2009	Ongoing from end 2009	Ongoing from end 2009	

Note: Low cost manure production from sewage sludge could be linked to this down stream production.

3.4.5. Buy-back recycling project:

3.4.5.1 Background Motivation

This project entails the establishment of a waste recycling facility(ies) in the GMM area which will create 135 jobs and reduce poverty. Initially the main beneficiaries will come from the GMM area with initial focus on Secunda and surrounding towns as large volumes of waste is produced in this area. The proven benefits of the Buy-back project include:

- Job creation for unskilled people in the community including women and the disabled.
- It has potential to create about 25-30 full-time jobs per centre, and 100 collectors per centre.
- Effective and efficient operation of the centres is expected to have a turnover of approximately R300 000,00 to R400 000,00 per month.
- A centre is expected to collect approximately 100-500 tons of recyclable waste

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • **Pretoria**
Ex Officio: RSA

- Necessitates a down stream establishment of a facility to produce refuse bags for sorting of waste, that could be sold to the community, e.g. Yellow bags for bottle, Green bags for paper etc
- It has a potential to grow and employ a large number of people, however, indirectly, it provides income to the whole community through the buy-back system.
- The buy-back model can be replicated in the area.
- Small transport SMME will benefit. (Transportation of waste to the recycle centres.)

3.4.5.2 Market Identification

The GMM business community such as retail supermarkets, factories and the local municipality will be targeted as areas for waste collection. This will increase efficiency and service delivery and keeping of a clean environment. The initial markets identified for the recycled waste would be buyers of plastics, glass, cardboard, paper, cans, etc. which is already established in the area. As a second phase the project will be escalated with the establishment of a recycling plant which will be able to process waste and the products will then be sold as feedstock to manufactures of plastic products, etc. This market will be extensively investigated and developed during project implementation.

Detail relating to the activities and costs, per activity and phase, are provided in the five-year plan for the establishment of the buy-back recycling project, which appears as Table 20 below.

Table 20
Buy back project: 5-year action plan

Project	2008 budget estimate	2009 budget estimate	2010 budget estimate	2011 budget estimate	2012 budget estimate	Forecast Total budget
Buy – back project	R400,000	R1.8m	R1m	R600,000	R600,000	**R4.4m**
1. Benchmark visit to existing sites in Mpumalanga (once off)	By Nov 2008					
2. Do a feasibility study - land survey - resources needed	R200,000	Up to beginning 2009				
3. Stakeholders' engagement. - Local government - community representatives -other government departments * Department of Agric, Econ Dev & Planning, DEAT – ('green environment linkages')	Finalised by Dec 2008	Ongoing yearly engage-ments	Ongoing yearly engage-ments	Ongoing yearly engage-ments	Ongoing yearly engage-ments	Ongoing yearly engage-ments
4. Project planning - site identification - land surveying - Structural and architectural design.	R200,000	Finalised by Feb 2009				
5. Draw up and finalise MOU/ TOR's with all role players.	By Dec 2008					
6. Establish project teams and governance structures.	By Jan 2008					
7.Finalise business model	By Jan 2008					
8. Determine market demand and export probabilities (in conjunction with dept of Econ	By Jan / Feb 2008					

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ed
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretori
Ex Officio: RSA

Project	2008 budget estimate	2009 budget estimate	2010 budget estimate	2011 budget estimate	2012 budget estimate	Forecast Total budget
Dev & Planning)						
9. Determine related industries that can be involved.	By Dec 2008					
10. Determine project sustainability by evaluating potential for : - impact on economic development in the area,(number of jobs to be created) - impact on social development , - Impact on eco-system.		By Jan / Feb 2009		Review project sustaina-bility		
11.Facility development - fit for purpose		R1.5m	R1m	R500,000	R600,000	
12. Determine other business linkages (Transportation)		By Feb 2009				
13. Project roll out/ implementation.						
14.Develop exit strategy maintenance plan		By Jan 2009		Review by June 2011		
15.Recruitment of staff, collectors and management including		R100,000				
16.Appoint training providers		March 2009				
17.Train management and staff		R200,000		R100,000		
18. Implement business incubation and mentorship programme			Ongoing from end 2009	Ongoing	Ongoing	Ongoing
17.Monitor and Evaluate		Ongoing from end 2009	Ongoing	Ongoing	Ongoing	Ongoing

3.5 Measures to address housing and living conditions

Sasol Mining has integrated the following measures into its policies and practices:

- New operations:

  As far as practically possible, Sasol Mining will not build any new settlements for new operations, in the Secunda area. If possible, Sasol Mining will ensure that employees have accommodation in nearby existing townships and that adequate transport to their residential areas exists.
- Existing operations:
  - convert empty blocks into family units for visiting families;
  - reduce the average number of people per room;
  - discourage new employees from staying in Sasol Mining hostels; and
  - lease housing to Sasol Mining employees.

Table 21 provided a breakdown of houses leased to Sasol Mining employees.

YOLANDI COETZEE NOTARIS NOTARY GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Table 21
Housing leased to employees

Township	Houses	Family units	Flats	Leased-in units	Hostels
Secunda	88	44	19	65	37
Kinross	48	51	6		
eMbalenhle	23	108	3		62
Townhouses	78				
Temporary units	32				
Brandspruit		120			882
Twistdraai		84			400
eMbalenhle		60			
Synfuels North					
Synfuels South					

Sasol Properties (Pty) Limited had initiated on a five-year project to improve the living conditions of Sasol employees living in Sasol owned accommodation. The cost of the project is R119.4 m. Added to this will be a contribution from Sasol Mining (Pty) Ltd to the value of R9.05m, to be expended over five years.

Sasol Properties has also approved the allocation of 30, two-bedroom units, in eMbalenhle to Sasol Mining and recently has also approved an additional 32 units to be allocated to Sasol Mining. This contributes positively towards the dire need to provide adequate family accommodation for Sasol Mining employees.

The declining number of employees who reside in the Brandspruit and Twistdraai hostels is positive sign of the changing times: the move away from single hostel accommodation. With the recent xenophobic attacks, however, some employees may return to the mine hostels.

3.5.1 Status of the mining hostels at Sasol Mining's Brandspruit and Twistdraai Operations

The hostels at the Brandspruit and Twistdraai operations require upgrading. The scope of the work required to upgrade the above complexes has been prepared and construction work commenced in October 2007. An amount of R3.7m was allocated for the financial year 2007/08 and R3.4m will have been spent for the financial year ending June 2008.

Measures also have been taken to improve living conditions for hostel residents. The maximum number of occupants per room has been reduced from four to two. Sasol Mining intends to increase the number of family units and the programme for these conversions is as indicated in Table 22 below:

Table 22
Conversion of single rooms into family units

Hostel	Current	Increase	Value	Duration
Brandspruit	120	60	R1.2m	2008/2009
Twistdraai	24	24	R1.2m	2008/2009
Total	**144**	**84**	**R2.4m**	

Legend: m = million

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Upgrading and conversion of hostel blocks into family units

Due to the underutilisation of the mine hostel facilities (Brandspruit and Twistdraai), the business is investigating the alternative scenarios to optimise the utilisation. This will involve two options and the most suitable option will be selected after thorough consultation with all the relevant stakeholders:

Option 1

If all the residents are relocated from the Twistdraai hostel to the Brandspruit Hostel the cost of improving the existing two hostel facilities will amount to **R21.86m.** This amount will be spent on improving living conditions for employees by upgrading the single and family (visiting) hostel facilities.

Option 2

If the status quo remains that is the hostels operate at current capacity and with the upgrading of the facility more employees may opt to stay at the premises, the cost to upgrade and hence improve the living conditions would amount to **R26m.**

Sasol Mining has also embarked on a process to improve the recreational facilities for residents and encourage greater participation in recreational activities.

3.5.2 Govan Mbeki municipality residential developments

An area to the west of Secunda has been earmarked for residential development by GMM. If the full extent of land is made available 17 000 stands could be provided for development. Sasol Mining is participating in this process and could relinquish its mining rights at huge cost to support essential residential development in this area. It is expected that about 6000 units will be developed in this area for the Sasol Secunda site. These units will vary from stand alone units to high-density units and will cater for all income groups. This portion of land will also address the greater social needs of the Govan Mbeki Municipality.

3.5.3 Improvement of living condition of employees in hostels

Sasol Mining is in the process of converting single male hostels into family visiting facilities. Sasol Mining also plans to increase the visiting family units from 144 to 228 by end of June 2009. These units will accommodate visiting family members.

3.5.4 Promotion of home ownership for employees

The following are the four primary measures Sasol Mining has implemented to encourage employee home ownership:

- Sasol has commenced with the process of developing housing to promote home ownership and is currently engaged is acquiring land to construct housing units.
- There is also engagement with developers to sell units directly to employees through a process facilitated by Sasol.
- Sasol Mining has a policy to promote employee home ownership by giving employees an option to rent or buy units.
- Sasol Mining's employment policy enables all employees to participate in the housing allowance scheme.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Table 23 below indicates the ratio of new units to be developed in the next five years that can be leased or purchased:

Table 23
New housing units to be developed from 2009 to 2012

Portfolio	Leased units	Home ownership	Value	Duration	Values escalated at 12% per annum	Cost per unit
95 units	57	38	R40m	Aug 09	R50m	R528,168.00
185 units	111	74	R86m	Sep 10	R109m	R591,549.00
185 units	111	74	R92m	Oct 11	R123m	R662,534.00
275 units	165	110	R145m	Nov 12	R204m	R742,039.00
740 units	**444**	**296**	**R363m**		**R486m**	

3.6 Measures to address nutrition

The following measures have been implemented to ensure that Sasol Mining hostel residents receives balanced nutrition:

- Currently 1173 employees are residing in the two hostels which constitute 18.2% of the total workforce of 6410.
- The menu provided to hostel residents is evaluated annually by a qualified dietician to ensure compliance with recommended daily dietary requirements.
- The current daily menu and lunch packs have been revised and implemented.
- There are monthly meetings between trade unions, the hostel committee and mine management to discuss resident's nutritional grievances and needs.
- The hostel committee members are elected from the residents by the residents. Their responsibilities are to ensure that diet, living conditions and recreational facilities are available for residents.
- An action plan has been developed with the service provider to ensure deviations from standards and agreements are addressed daily. One hostel officials is designated to ensure adherence to the menu list and recipes.
- The feeding committee double-checks the menu list to ensure compliance by the service provider. The feeding committee consist of a hostel official, a hostel resident and the service provider. See Annexure N for the dietician-recommended menu list.
- Once the labour unions, hostel residents and mine management have agreed to the new menus, food preparation and serving of food arrangements, the successful service provider will be appointed.
- The estimated value in respect of the contract for providing sufficient nutrition and a wholesome diet for a year, amounts to R15m

3.7 Procurement Progression Plan

3.7.1 Economic development in South Africa and within the local communities

Through the implementation of various poverty alleviation and infrastructure development projects, Sasol Mining aims to stimulate economic growth and alleviate poverty in the region.

How many additional jobs does Sasol Mining create?

Sasol Mining has the following impact on direct and indirect job creation in the region:

- **6410** direct jobs provided by Sasol Mining.
- **6500** additional jobs created indirectly through procurement from SMME's.
- **R1.6** billion wage bill per annum.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

3.7.2 South African economic contribution

Sasol Mining and Sasol in general believe strongly that its existence has been made possible by the contribution South Africa, its people and therefore also the local communities where Sasol operates.

The Sasol group contributes more than R6 billion annually to the South African government through taxes and levies, excluding fuel and employee taxes and commit at least R100 million annually to social investment, sport sponsorship and university bursaries.

3.7.3 Overview of Local Economic contribution on Black Economic Empowerment Procurement by Sasol

Black Economic Empowerment Procurement (BEEP) spend totalled R1.15 billion on consumables and services, of which R416 million which was spent in the GMM area.

Sasol Mining as part of Sasol, is absolutely committed to the progression of Black Economic Empowerment goals. The specific contribution of Sasol Mining to BEEP is discussed in more detail further below.

3.7.4 Sasol Mining BEEP strategy and plan

Shortly after the release of the Broad Based Socio Economic Empowerment Charter for the Mining Industry in October 2002, it became apparent that Preferential Procurement growth strategy could not be achieved by merely pursuing spends targets.
Sasol Mining designed a BEEP Programme as a solution, providing a strategy, comprising of six separate but integrated elements, to ensure delivery on long-term results. The focus of the programme is to enable effective preferential procurement and enterprise development through the supply chain.

The six elements of the BEEP Programme acknowledge the need to focus in a structured manner on the drivers and support functions that enable transformation through BEEP, whilst managing the interfaces and relationships between the elements:

- A valuable Sasol BEEP knowledge base, populated through environmental scanning and interpretation of information and networking, including alignment and contribution to the design of the Sasol Group strategy;
- The mining Charter and Broad-Based BEE Scorecard compliance of the Sasol businesses in Secunda through the specific elements of Preferential Procurement and Enterprise Development;
- Utilising an Supplier and Enterprise Development strategy;
- Working participation with the GMM and Mpumalanga Provincial Government in an effective LED initiative, linked to appropriate Procurement opportunities;
- Management of stakeholder relationships and communication of the positive Sasol BEEP initiatives; and
- Effective change management, regarding the emotions of participants, actions and attitudes and policies and procedure in dealing with Broad-based BEE.

Sasol Mining is a partner in the BEEP Programme through the BEEP Coordinator, who plays a vital role in the Programme on the Secunda site, but also has the specific responsibility to implement and anchor the Programme in Sasol Mining. Alignment with the Sasol Group and other Sasol businesses on the Secunda site is ensured through the programme.

YOLANDE COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

The BEEP programme has been the vehicle driving the strategy and plan for the development of HDSA businesses as suppliers to Sasol Mining.

3.7.5 Progress on the BEEP strategy and plan

All figures reported are based on the Mining Charter requirements, divided into three areas of spend, namely Capital Goods, Services and Consumables.

3.7.6 The analysis of the financial year 2006/2007

Table 24 provides an analysis of the BEEP spend in the financial year 2006/2007.

Table 24
Analysis of financial year 2006/2007

Category	Total spent	Local spent	% of total spend	Total BEE spend	Local BEE	% of total BEE spend
Capital	R330,238,720.58	R50,818,847.82	15%	R38,960 966.91	R11,993,901.07	31%
Consumables	R902,394,461.11	R130,807,015.45	14%	R231,612,645.94	R50,749,090.24	22%
Services	R1,408,350,218.99	R668,954,250.85	47%	R470,502,140.48	R135,733,173.96	29%
Grand total	R2,640,983,400.68	R850,580,114.12	32%	R741,075,753.33	R198,476,165.27	27%

Diagram 7 provides a breakdown of the BEEP spend in respect of capital goods, consumables and services for the financial year 2006/2007.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 667 Kerkstraat • Pretoria
Ex Officio: RSA

Diagram 7
Total BEEP Spend 2006/2007

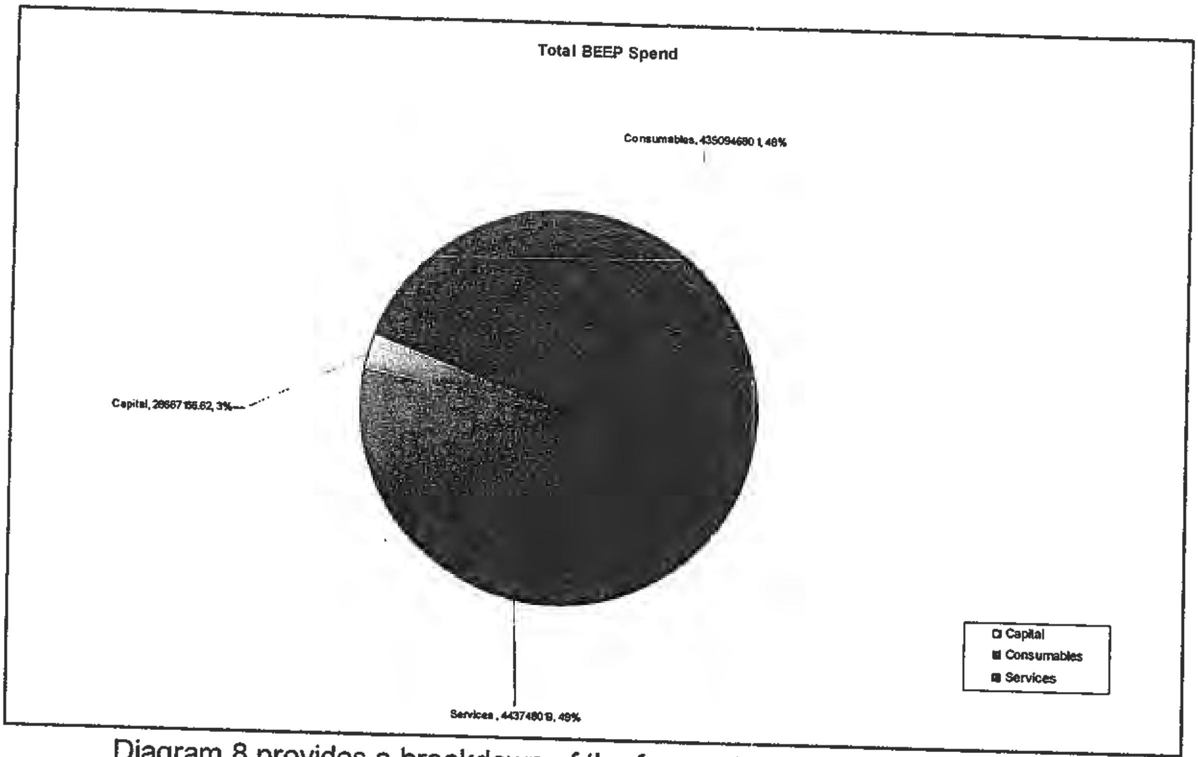
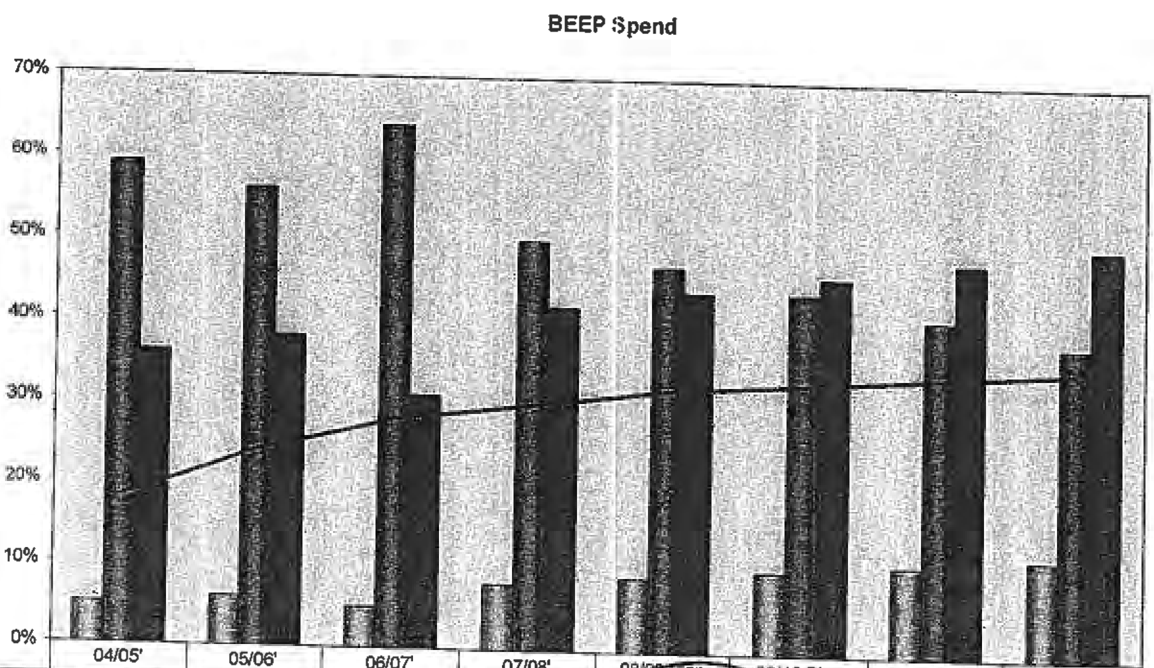


Diagram 8 provides a breakdown of the forecasted BEEP spend in respect of capital goods, consumables and services for the period ending 2012.

Diagram 8
Total forecasted BEEP Spend for the five-year period ending 2012



	04/05'	05/06'	06/07'	07/08'	08/09 Plan	09/10 Plan	09/10 Plan	11/12 Plan
Capital %	5%	6%	5%	8%	[illegible]	10%	11%	12%
Services %	59%	56%	64%	50%	47%	[illegible]	41%	38%
Consumables %	36%	38%	31%	42%	44%	[illegible]	48%	50%
BEEP target	18%	24%	28%	30%	[illegible]	33%	34%	35%

NOTARIS
NOTARY
YOLANDI COETZEE
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria

Diagram 9 provides a breakdown of the forecasted local BEEP spend in respect of capital goods, consumables and services for the period ending 2012.

Diagram 9
Local BEEP Spend for the period ending 2012

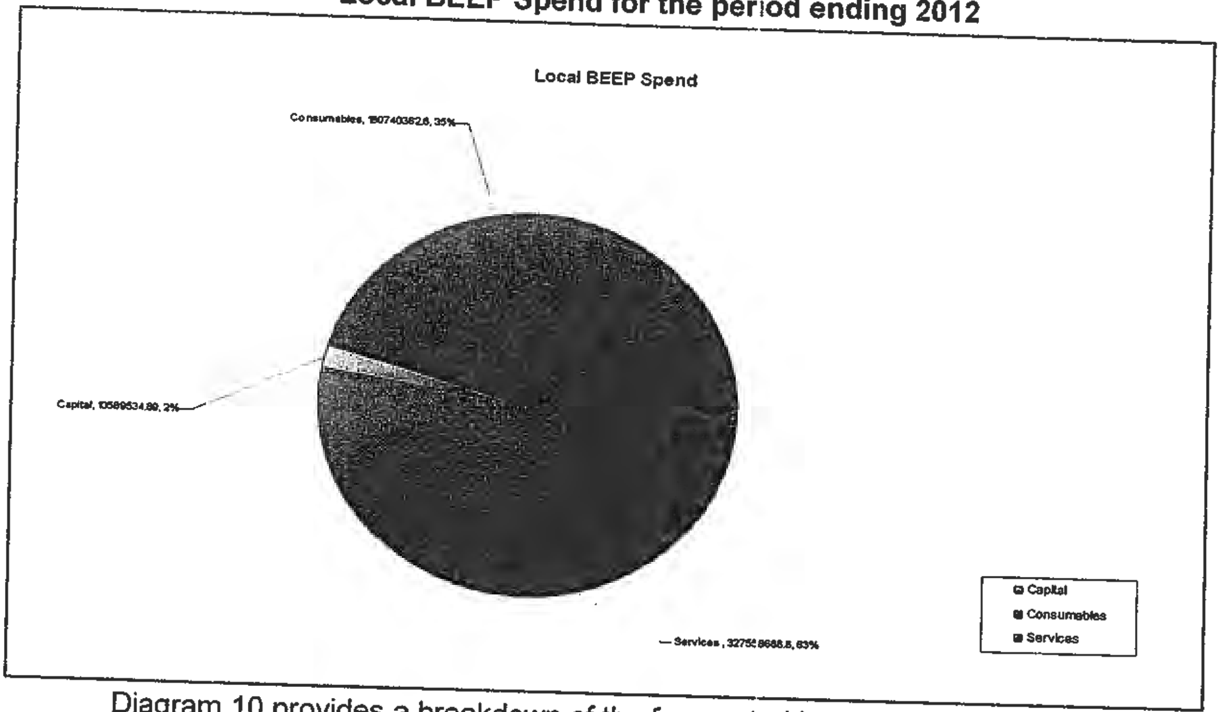
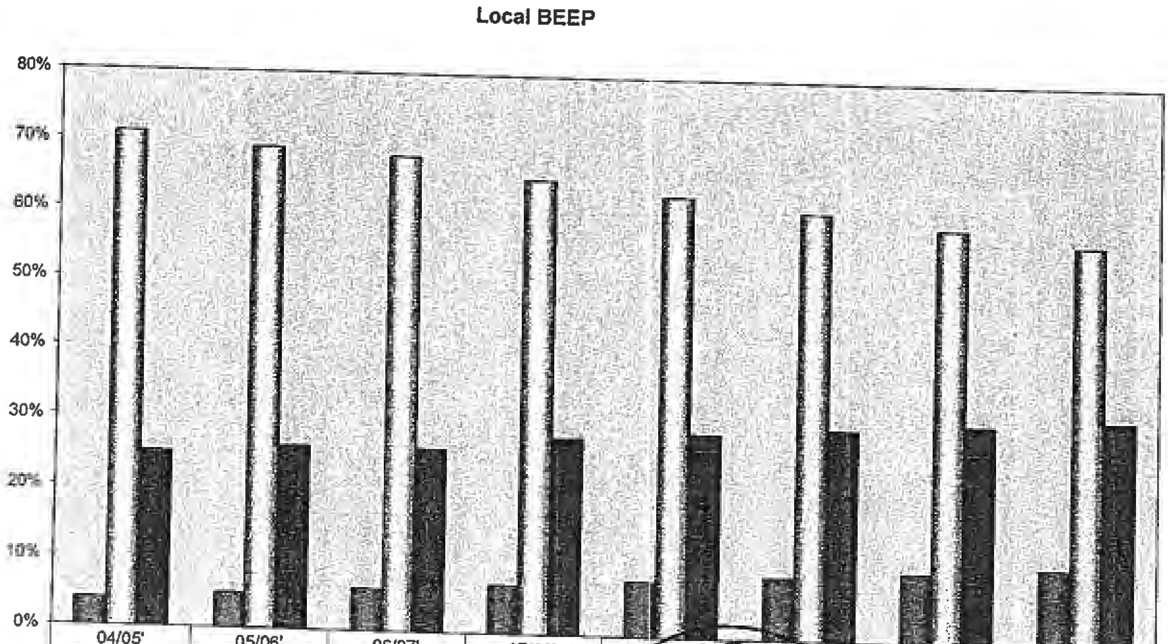


Diagram 10 provides a breakdown of the forecasted local BEEP spend in respect of capital goods, consumables and services for the period ending 2012.

Diagram 10
Local BEEP Spend breakdown for the period ending 2012



	04/05'	05/06'	06/07'	07/08'	[illegible]	[illegible] Plan	09/10 Plan	11/12 Plan
Capital %	4%	5%	6%	7%	[illegible]	[illegible]	10%	11%
Services %	71%	69%	68%	65%	[illegible]	[illegible]	59%	57%
Consumables %	25%	26%	26%	28%	63%	61%	31%	32%

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 8 / Kerkstraat 8, Pretoria
Ex Officio: RSA

The total mining procurement spend for 2006/2007 was R2.64 billion of which R850 million was spent locally with preference given to HDSA suppliers. The total BEE expenditure for the 2006/2007 year is R741 million of which 27% is spent with local BEE suppliers. The detail of this expenditure is attached in the required Form T.

3.7.7 Improvement of BEEP through mentoring and allocation of spend

In the execution of the Sasol Mining BEEP programme and strategy, specific actions were taken to increase procurement with Black-owned businesses which are highlighted below.

a) Set-aside areas:

In areas where there was a need to increase the market penetration by HDSA suppliers or to ensure opportunities to HDSA companies that established themselves, Sasol has exercised the option of setting aside certain areas of consumables and services exclusively for suppliers from the designated groups.

Some of the major areas identified were underground construction work, hydraulic pumps and valves and cylinders, certain categories of civil work, maintenance of grounds and electrical consumables.

This approach has proved to be a very successful vehicle for introducing established HDSA suppliers into Sasol Mining. As stated, in particular areas 100% of the spend was set aside, such as R85 million for underground construction. Secondly, new suppliers could be given opportunities to be mentored and assisted to grow their businesses with the support of Sasol Mining for example in the maintenance of grounds and the supply of protective clothing.

b) Supplier Development and Mentoring: Siyakha BEE Procurement Initiative Trust

Sasol has initiated a "Supplier Development" and mentoring programme to mentor and assist, financially or otherwise, the accelerated growth of Black-owned businesses specifically locally, where the businesses would find it difficult to develop themselves. The Siyakha BEE Procurement Initiative Trust was established to provide support and loan funding to enterprises that Sasol wish to procure from, with the objective of fast tracking their growth to become medium-sized businesses. Three businesses have received loans and development assistance to date. They are HEA Clothing CC, Ezomndeni Gardening Services CC and Baholoane Plumbing CC. Sasol Mining is currently procuring services from these established entities.

c) Supplier Development and Mentoring: Small Enterprise Development Agency

Sasol concluded an agreement with the Small Enterprise Development Agency (SEDA) to open a local branch to provide additional benefits and support to local business. Sasol has remained involved in the activities of the branch and is currently entering into an agreement with SEDA, which may, amongst other matters, facilitate access to Sasol tender and business opportunities for local businesses.

d) Supplier Development and Mentoring: ChemCity

ChemCity is another "enterprise development" initiative aimed at stimulating downstream chemical industry development in South Africa. ChemCity focuses on incubating sound business propositions into viable enterprises through

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 287 Kerkstraat Pretoria
Ex Officio: RSA

South Africa. Through this initiative, there has been a drive towards empowering BEE companies in the new financial year.

e) Mpumalanga large industry initiative.

The Mpumalanga large industry initiative is a Sasol Mining initiative. The purpose of the initiative is to get the large industries in Mpumalanga together and subsequently allocate a portion of their procurement expenditure to Mpumalanga based companies, both existing and potential new entrants. The expected outcome is to help boost the growth of these industries, which will lead to the GDP growth of the province, ensuring both sustainability of industry and the related jobs.

Sasol pro-actively prevents the misrepresentation of the BEE status of suppliers through a rigorous accreditation process, which was designed and implemented to eliminate fronting.

3.7.7.1 Mentoring for the empowerment companies at Sasol Mining

Sasol Mining is fully committed towards the development and upliftment of BEE compliant companies and will continue to contribute positively towards local economic development and continue to engage in socio economic initiatives.

All the attached suppliers were identified through the Mining BEEP Programme, which will then be discussed with Sasol Siyakha and appropriate interventions put in place. The period of support and mentoring is normally linked to our period of investment/funding in the business. This would normally differ from business to business, but the average investment period is five years. This is normally sufficient to facilitate the growth of the suppliers, but also to ensure that there is skills transfer to the business.

There is also a Standard Operating Committee (Sasol structure) that monitors the progress of the business on a monthly basis, and there is also a Business Consultant who is assigned to the business to ensure that any problems that surface are dealt with expeditiously and efficiently. Table 25 below provides a summary of the companies being mentored.

Table 25
Summary of companies mentored by Sasol Mining

Supplier	Type of business	Siyakha intervention
HEA Clothing	HEA Clothing specializes in the manufacturing of quality work wear for Sasol and other contractors in the area. The company is wholly owned by three female partners and constitutes a 51% BEE ownership.	Sasol Siyakha has assisted with the acquisition of the sewing machines and other equipment. We have assisted with the contracts for the supply of overalls to Sasol Mining. Sasol Siyakha will be involved with mentoring the business until the business can run its affairs competently.
Baholoane Business Enterprise	Baholoane specializes in plumbing and related work. The business has a strong focus on the installation and maintenance of underground water lines which involves excavation work. The business is 50% black owned.	Sasol Siyakha has assisted Baholoane with civil contracts. They have also been financed for the acquisition of materials and equipment for the business. Sasol Siyakha will be involved with mentoring the business until the business can run its affairs independently.
CCI Turnkey Projects	The business specializes in welding, mechanical, piping, construction and other engineering related fields. The business is	The business is strategically located in Trichardt, which is closer to its clients where a fully equipped

CHANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Supplier	Type of business	Siyakha intervention
	51% black owned and employs 80 personnel.	workshop and offices are established. Sasol Siyakha has thus far assisted with contracts in almost all of Secunda business units. They have also been assisted with quality management systems and funding for equipments.
RCCH Construction CC	RCCH Construction is a multi discipline organization carrying out various activities in the construction field and services industry. They currently render, piping and construction services. The business started trading from January 2004 and is a 76% black empowered company.	The business currently holds long-term maintenance contracts with Sasol Facilities Management and other units within the Secunda complex. Siyakha assisted the business towards purchasing scaffolding, LDV's and other civil related equipments.
T&P Carpentry	The business renders a range of services including amongst others, cabinet making and installation, plumbing, partitioning and ceilings, steel construction and roofing. The business is 51% black owned and presently employs 80 full time employees.	The business presently has long-term maintenance contracts and various other short-term contracts within the Secunda precinct. Sasol Siyakha will be involved in the mentoring of the business, until they can run their business affairs independently.
JM Sosibo Construction	The company is 100% black owned and it is situated in Embalenhle. The business specializes in civil work which include amongst others, building and maintenance, painting, paving and tiling.	Sasol Siyakha has assisted Sosibo Construction with civil contracts. They have also been financed for the acquisition of materials and equipment for the business. Sasol Siyakha will be involved with mentoring the business until the business can run its affairs independently.
Ken & Muf	Ken & Muf is a 100% black woman owned transport business, contracted for the removal of household waste and gunk. Ken & Muf supplies all labour, services, equipment and materials.	Sasol Siyakha assisted Ken and Muf with waste management contracts, and to comply with Sasol safety requirements.
Siyabonga Civil Works	Siyabonga Civil Works is a 51% black owned business. The business offers services in steel piping, steel welding and civil works. The business currently employs 120 full time employees.	Sasol Siyakha has assisted Siyabonga with civil contracts. They have also been financed for the acquisition of materials and equipment for the business. We will be involved with mentoring the business until the business can run its affairs independently.
ADL Construction	ADL Construction was established in 1997 and commenced trading in 1999. It is a 100% black owned civil engineering business offering services such as general building works, conveyor belt extension etc. The business employs a total staff complement of 180 full time employees.	Sasol Siyakha has assisted ADL Construction with civil contracts. They have also been financed for the acquisition of materials and equipment for the business. We will be involved with mentoring the business until the business can run its affairs independently.

3.7.8 Financial year 2008 and beyond; focus areas and targets

All expenditure is reported on the Sasol financial year from July to June of the following year. The BEE expenditure achieved for the financial year 2006/2007 was 28% of total spend with a forecast of 30% in this financial year.

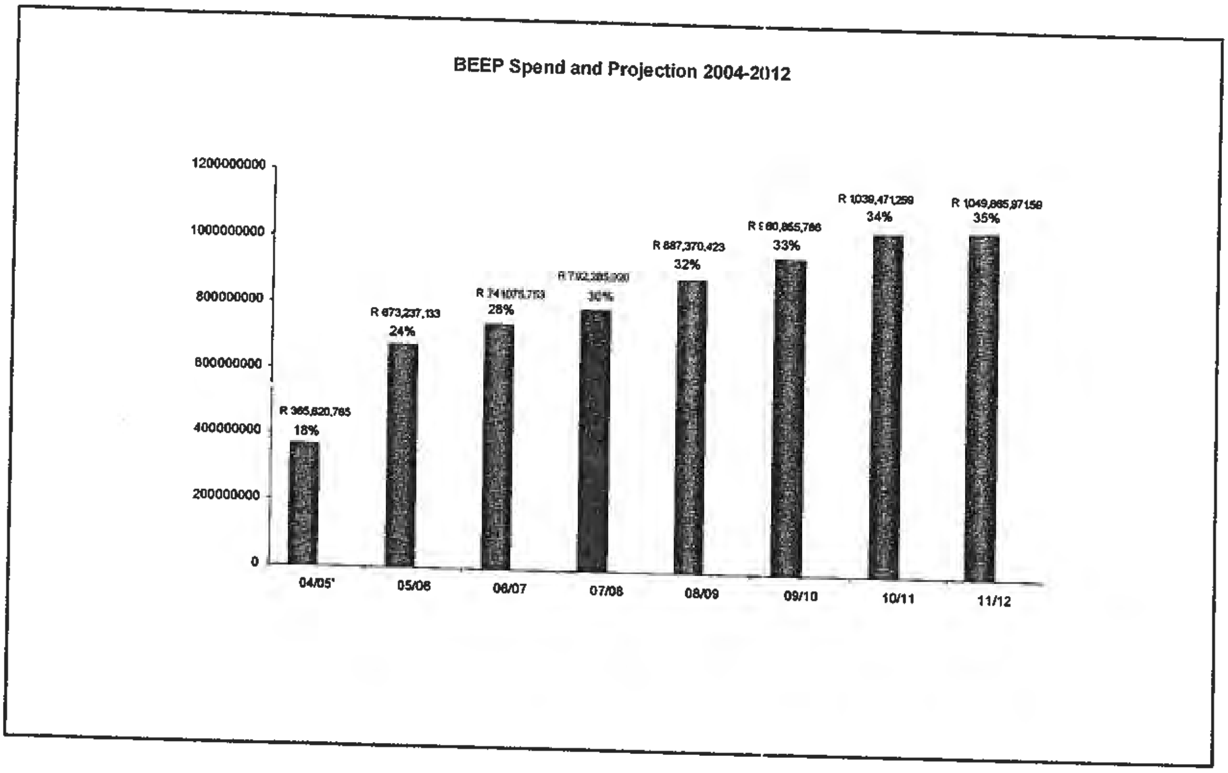
YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

The challenge for financial year 2008 is to strike a balance between maintaining momentum on spend with narrow based BEE according to the requirements of the Mining Charter, on BEE credentials, while progressing in terms of the required actions during the transition period on Broad Based (BBBEE) suppliers.

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Diagram 11 illustrates the forecasted BEEP spend and projection.

Diagram 11
Beep spend 2004 - 2012



The BEEP targets for the period ending 2012 are indicated in Table 26 below.

Table 26
BEEP targets for the period of 2007 to 2012

Year	05/06	06/07	07/08	08/09 Plan	09/10 Plan	09/10 Plan	11/12 Plan
BEE Spend	R673,237,133	R741,075,763	R792,295,020	R887,370,423	R960,855,786	R1,039,471,259	R1,049,865,971
% of Spend	24%	28%	30%	32%	33%	34%	35%

The following key initiatives will ensure sustained BEEP performance, where Sasol will report on all empowerment activities as in the Sasol Sustainability report:

- For Sasol Mining BEEP progress reporting and target setting, measurement will remain based on all spend with suppliers with a black ownership status of (<25%), while progress is tracked separately for BBBEE (>50%), BEE (>25-50%) and BEE (>5%);
- For the financial year 2008 BEEP targets for Sasol Mining will be 30% of total procurement spend with BEE businesses, still measured on the current narrow based approach which focuses on ownership and management;
- Support to and utilisation of Siyakha as a supplier development and mentoring initiative to contribute R10 million to Sasol Mining Preferential procurement

NOTARIS
NOTARY
GAUTENG

Elzle Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

spend, enabled by at least four new participants; and

- Opportunities to grow HDSA suppliers in a sustainable fashion have been identified by means of spend analysis to reach the target set for 2007/2008 financial year.

3.7.9 Encouragement of partnerships

When Sasol Mining started its BEEP initiative, only suppliers with 50%+1 share HDSA shareholding were approved. Later the approach was changed to fit guidelines set by the Strategy for Broad-Based Black Economic Empowerment. As a result, suppliers with shareholding in 5-25% and 25-50% categories were included as well. The intention is to encourage existing suppliers to include HDSA's in their businesses and to grow ownership towards HDSA controlled enterprises.

3.7.10 Developing of HDSA procurement capacity

Supplier Coaching and Mentoring at Sasol Mining

Objective
To develop possible suppliers of goods and services to the Sasol Secunda Complex from the Gert Sibande district.

Method
Part of the process that will be followed will be through mentoring and coaching of potential suppliers by existing suppliers. Existing suppliers will be expected to either adopt potential suppliers as protégés and coach and mentor them themselves or pay for their development at formal educational institutions. We will start by targeting contractors with big contracts and gradually move to the ones with smaller contracts.

Five-year plan

Table 27 shows contract values where suppliers will be expected to have developing suppliers under their wings.

Table 27
Contract values for suppliers supporting developing suppliers

Year 1	Contract value > R10,000,000
Year 2	Contract value > R5,000,000
Year 3	Contract value > R5,000,000
Year 4	Contract value > R5,000,000
Year 5	Contract value > R3,000,000

The process to be followed will help to ease the way of the new suppliers into the business and make their acceptance by end users so much easier if they have been working with a credible existing supplier. This process should augment Sasol's efforts through Siyakha and ChemCity.

Sasol Mining has identified LED as one of the key focus areas in its supplier and enterprise development initiatives as LED creates opportunities for skills development and employment for the local community. In support of local business through potential

ANDI COETZEE NOTARIS NOTARY GAUTENG

challenges they may encounter in their exploration of these opportunities, they may contact Sasol Secunda's LED procurement advisor for assistance.

Adoption of a set of BEEP Guidelines and a BEEP Policy ensures that preferential status is given to suppliers from the designated groups.

Sasol has been offering mentoring to suppliers on an ad-hoc basis and more specialised support through Siyakha and ChemCity.

Sasol Mining is also entering into a memorandum of understanding with the local SEDA branch, in order to jointly address the capacity of HDSA suppliers in terms of the following:

- Safety
- Maintenance and equipment reliability
- Financial management and taxation
- Human resource practises
- Auditing practises
- Mining practises

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

3.7.11 Continuous Improvement and review

The essence of any successful development project is that it should result in sustainable improvement in the lives of the beneficiaries. It is therefore important to note that Sasol Mining is committed to develop entrepreneurs not only to the point of being self-sustaining entities but that they are further assisted to acquire the capacity to grow their businesses to levels of profitability and expansion. The Skills Park will also contribute to achieving this goal.

The BEEP Programme in Sasol Mining has identified LED as one of the key focus areas in its supplier and enterprise development initiatives. Through these two elements of the BEEP Programme, the Sasol procurement environment is constantly scanned for business development opportunities and then evaluated for its suitability for local supply. Sasol Mining is committed to the 5-year target plan and beyond, where Sasol Mining will continually look at ways to improve initiatives, continuously review processes, plans and idea generation in-order to be successful in achieving our objectives and aligning ourselves with the Mining Charter.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

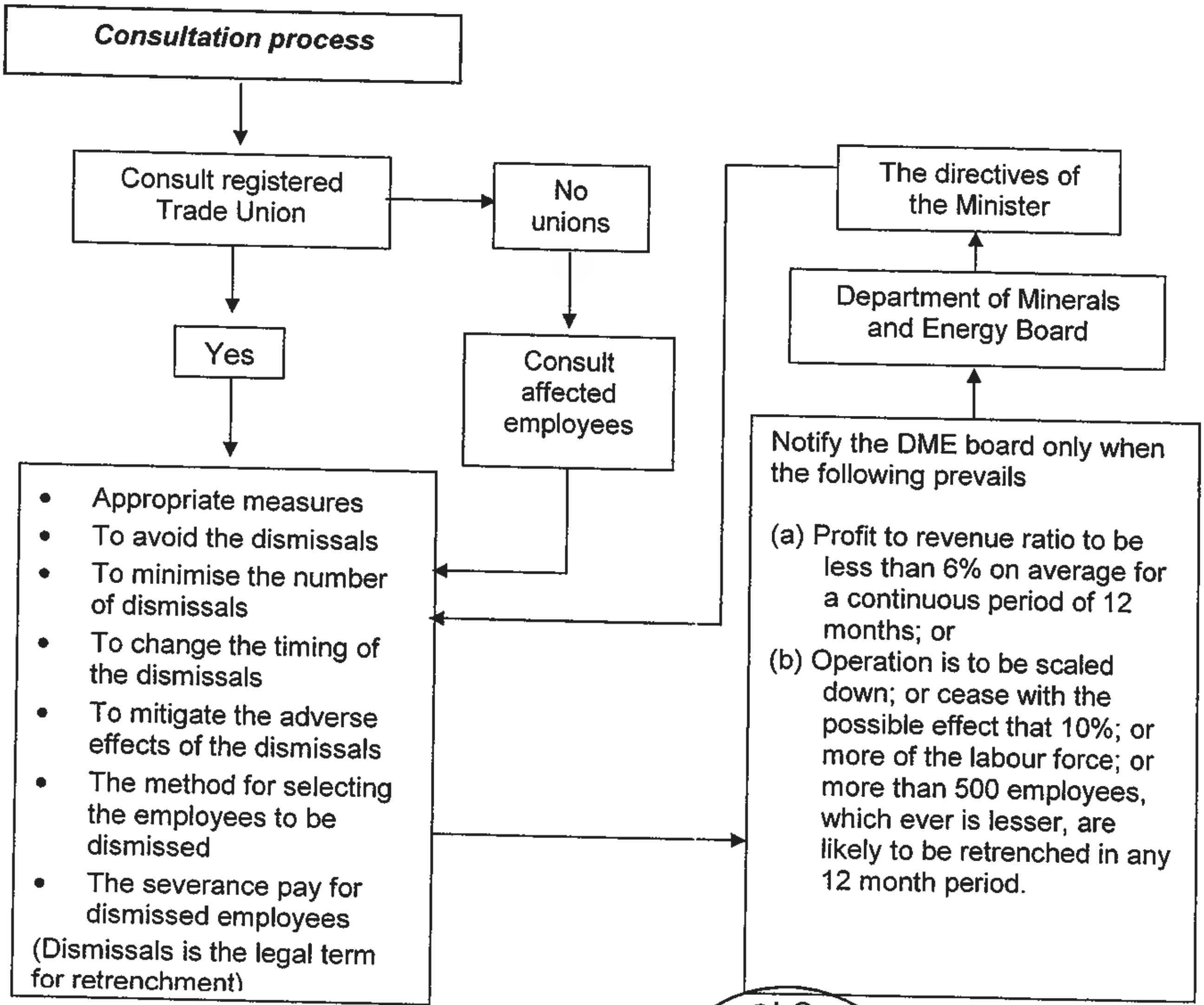
4. SECTION 4: PROCESS PERTAINING TO DOWNSCALING AND RETRENCHMENTS

Sasol Mining has developed processes to be followed in the event of downscaling and retrenchment due to operational requirements. Detailed processes were developed in line with Section 189 of the Labour Relations Act, as amended, read with Section 52(1) of the MPRDA, including Regulation 46(e). It is important to note, however, that no downscaling or retrenchment is envisaged for the period 2008 to 2012, because Sasol Mining is in a growth phase.

4.1 Process to be used in event of downscaling or retrenchments

Diagram 12 below shows the process that will be used in the event of retrenchments or downscaling of the operations.

Diagram 12
Downscaling or Retrenchment Process



YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

4.2 Future forum (Sasol Mining Redeployment Committee)

Sasol Mining has established a Future Forum for the purpose of dealing management of downscaling to address section closures and redeployment of excess employees. The Forum consists of management members and representatives of recognized trade unions. See Table 28 for further details and tasks assigned to the committee. The Forum only meets when deemed necessary. The Future Forum is therefore already constituted and will be effective from the date of approval of the social and labour plan. The Redeployment Committee was formed in 2004 in the event of Sasol Mining having to deal with employee downscaling and redeployment and has been aligned with the requirements of the MPRDA in respect of the Future Forum.

Future Forum Objectives

- To facilitate and monitor the implementation of the SLP's in accordance with the provisions of the applicable regulations.
- To provide information/ reports to the DME in accordance with the provisions of the MPRDA and Regulations.
- To identify training and development programs.
- To consider strategies aimed at improving the life of the mines.
- To enhance the level of engagement.

Future Forum Terms of Reference

- To promote ongoing discussions between employee representatives and the employer, about the future of the mine.
- Examine future scenario to identify problems, challenges and possible solutions, with regard to productivity and employment.
- Identify production and employment turn around strategies.
- Consider interventions which would benefit the community in which the mine operates and major labour sourcing communities.
- Consult and take measures to avoid large-scale job losses.
- Anticipate the possibility of job losses and implement contingency plans.
- Implement measures to negate the social and economic impact of job losses.
- Liaise with the Department of Labour

The process of engagement is described in Table 28 below.

Table 28
Process of engagement – Future Forum

1.	***Objectives*** *To place employees who are over complement into other positions or units across operational units or transfer into other business units of Sasol*
2	***Permanent Forum Members*** *2.1 operations manager - Chairperson* *2.2 mine human resource official - Secretary* *2.3 mine manager* *2.4 Sasol Mining hospital doctor.* *2.5 operations human resource manager* *2.6 employee relations official*

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

2.7 fulltime shaft stewards of the recognised unions

3. Agenda

3.1 medical unfit
3.2 redeployment
3.3 productivity levels and impact of not improving
3.4 downscaling of sections or units
3.5 retrenchment

4. Tasks

4.1 identifying surplus positions and employees across the mines;
4.2 identifying vacancies across the mines;
4.3 send employees for potential assessment to determine training needs;
4.4 retrain or develop employee skills for new or vacant positions;
4.5 communication strategy for the affected employees

5. Placement criteria

5.1 Into the List:
5.1.1 Last in first out principle ***(LIFO).***

5.2 Out of the List:
5.2.1 First in first out principle (FIFO).
If decline the offer
5.2.2 30 day notice to terminate employment contract will commence.

6. Alternative position

6.1 Transfer into similar position and same salary grading –
6.1.1 Employee will be given seven (7) days to accept the offer.

6.2 Transfer into a similar position, but with lower salary grading -
6.2.1 Employee will be given (30 days to accept the offer.
If accepts the offer
6.2.2 During the notice period, the employee will be entitled to –
6.2.2.1 full control amount for three (3) months; and
6.2.2.2 Fixed allowances.
If decline the offer
6.2.3 Retrenchment procedures and processes will commence

7. Compulsory retrenchment

7.1 Management will identify positions or employees to be retrenched
7.2 Inform the committee about the intention and the identification of affected positions
7.3 Identification criteria will be
7.3.1 last in first out (LIFO)
7.3.2 severance pay will be in line with the agreement with the trade unions

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

4.3 Contingency mechanism

4.3.1 Mechanisms to save jobs and avoid job losses and a decline in employment

In the eventuality of any operation being curtailed, the following steps would be taken:

- Placement of affected employees within other operations within Sasol Mining, if possible.
- Consultations - Sasol Mining has aligned its consultative processes with Section 52(1) of the MPRDA. See Section 4 above for a graphical process flow.
- Affected employees will be reskilled via the portable skills to ensure that they are able to have livelihood beyond Sasol Mining. A skills pool has been put in place to ensure that employees are reskilled for business future needs. See Section 4 above and Table 28
- Notification to the Minerals and Mining Development Board... See Section 4 above and Table 28.
- Complying with ministerial directives.
  Sasol Mining commits to comply with any ministerial directives, in the unlikely event of such a directive being issued, by the Minister of Minerals and Energy and aims to conform to and implement corrective measures and present it at the future forum (previously the redeployment committee).

4.3.2 Mechanism to provide alternative solution and procedures for creating job security where job losses cannot be avoided

Sasol Mining commits to implement the processes outlined in Section 4 above and follow processes in Table 28 in the event of scaling down or job losses.

4.3.3 Mechanisms to ameliorate the social and economic impact where retrenchment or closure of the operation is certain

Sasol Mining will follow the same processes set out in Table 28, in the event of job losses due to the lack of profitability of any operation or section.

Mechanisms to ameliorate the social and economic impact on individuals are as follows:

- reskilling of affected employees through the portable skills training programme, to enhance the opportunity of alternative employment in other sectors of the economy;
- developing entrepreneurial skills for those who want to pursue business (self-employment) instead of conventional employment;
- assisting such employees to be 'accredited' by the relevant SETA;
- providing personal financial management training; and
- providing business start-up support.

4.4 The process pertaining to the management of downscaling and retrenchments

There is an existing agreement between Sasol Mining, the Chemical, Energy, Paper, Printing, Wood and Allied Workers Union (CEPPWAWU) and Solidarity on processes to be followed in the event of downscaling and retrenchment. Sasol Mining is in the process of developing a relationship with the new trade union stakeholder, the United People's Union of South Africa (UPUSA). A recognition agreement between UPUSA and management was signed on 15 November 2007 after compiling the initial social and labour plan. UPUSA has since been brought on board regarding the contents of the plan through a consultative process. All current bargaining unit agreements, including the management of downscaling and retrenchment of employees, are in the process of being

NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

reviewed to include UPUSA's point of view. The following are the main points extracted from the agreement:

4.4.1 Managing downscaling

With regard to managing downscaling, the process will be dealt with as described in detail in Table 28, regarding the placement of employees, before redeployment is considered. If redeployment is not possible, the process of retrenchment as described in detail in Diagram 12 will be followed.

4.4.2 Retrenchments

4.4.2.1 Voluntary retrenchments

With regard to voluntary retrenchments, Sasol Mining will provide the trade unions with six months notice, should it not be possible to place the over-compliment of employees at some other operation.

Once agreement is reached with the relevant trade unions, Sasol Mining will proceed to communicate with employees and set up specific selection criteria for acceptance based on skills.

4.4.2.2 Compulsory retrenchment

In the event of compulsory retrenchments, Sasol Mining will provide the trade unions with six months notice, in order to negotiate and explore ideas of mitigating the effects of retrenchments.

Once agreement is reached with the trade unions Sasol Mining will provide the trade unions with a list of affected employees and areas they are operating.

4.4.2.3 Calculation of retrenchment package

Retrenchment package will consist of the following:

- four months salary in lieu of notice;
- three weeks salary for each completed year of service;
- one full year leave bonus pay;
- all accumulated leave days;
- the company settlement of all medical debts up to a maximum of R1 000,00 per employee;
- the company's writing off of all outstanding study loans; and
- the company's provision of portable skills training for all affected employees will be implemented and affected employees will have a choice of training from the portable skills pool for a minimum of R3000.00, up to a maximum amount of R10, 000, 00 per employee.

4.4.2.4 Housing

- Home owners
  Sasol Mining will purchase the retrenched employee's house at 80% of the market value, if the retrenched fails to sell the house within six months after the termination date.
- Hostel accommodation

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

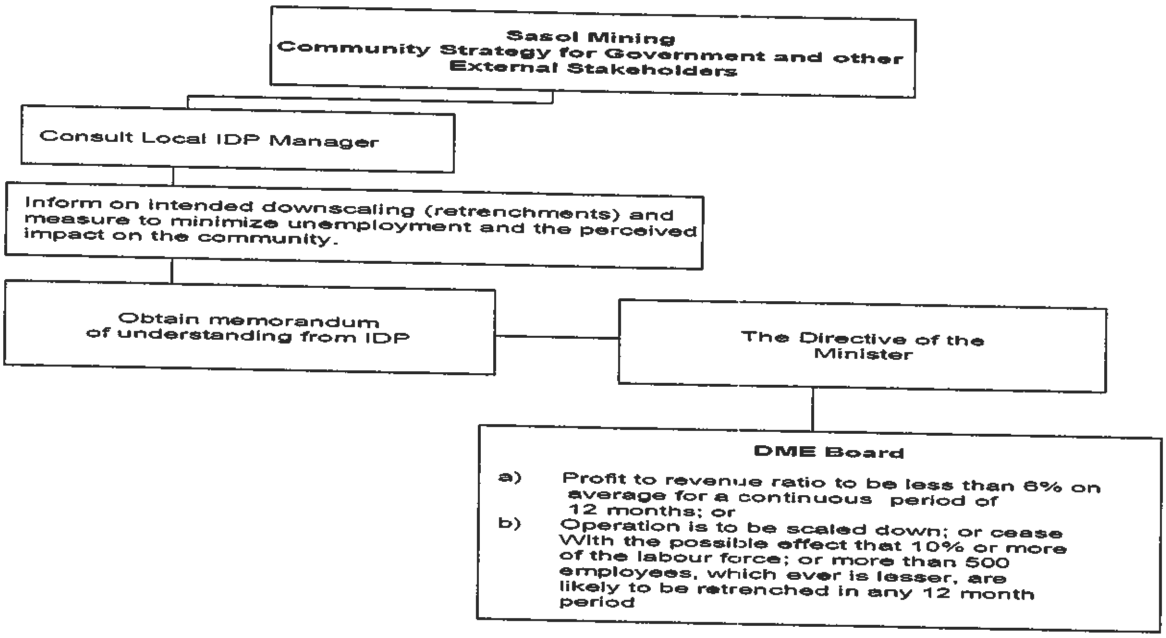
Retrenched employees will vacate the hostel within 14 days of the termination of their service.

- Rental units
  Retrenched employees will vacate the property within two months after the termination date. As from the date of retrenchment, the market-related rates will apply for the unit.

4.4.3 Communication strategy with external stakeholders

The communication strategy is described in Diagram 13 below.

Diagram 13
Communication strategy with external stakeholders



4.5 Possibility of retrenchments

Sasol Mining envisages no retrenchment for the periods from 2008 up to 2012. In the event of sudden economic changes, outside the control of Sasol Mining which may result in the downscaling or closure of operations, Sasol Mining commits to follow all processes contained in this Social and Labour Plan, provided by law, and takes into account the social impact of that decision.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

5. SECTION 5: FINANCIAL PROVISION

Sasol Mining will ensure that funds are available to assist personnel and managers assigned to execute the commitments stated in this Social and Labour Plan through its annual budgeting cycle. It is important to note that all the cost relating the Human Resources Development forms part of Sasol Mining's operating costs and that no special provision is made in this regard. Table 29 provided the financial details.

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
Ex Officio: RSA

Table 29
Financial Provision

Component of the SLP	Time frame					Total
Human Resources Development Plans	**2008**	**2009**	**2010**	**2011**	**2012**	
ABET plans	R 7 036 536	R 7 452 844	R 8 327 200	R 9 327 200	R 9 326 464	R 41 470 244
Skills development plans	R 11 200 000	R 12 220 000	R 13 550 000	R 14 900 000	R 16 390 000	R 68 260 000
Career progression plans	R 7 178 888	R 7 887 000	R 8 675 000	R 9 450 000	R 10 494 000	R 43 684 888
Mentorship plans						
Internship and bursary plans	R 4 700 000	R 5 170 000	R 5 680 000	R 6 240 000	R 6 860 000	R 28 650 000
Employment equity plans	R 540 380	R 585 507	R 645 850	R 708 128	R 761 097	R 3 240 962
Re-skilling	R 500 000	R 500 000	R 500 000	R 500 000	R 500 000	R 2 500 000
Sub total	**R 31 155 804**	**R 33 315 351**	**R 36 878 050**	**R 40 625 328**	**R 43 831 561**	**R 185 806 094**
Local Economic Development Projects						
Storm water drainage	R 1 000 000	R 1 500 000				R 2 500 000
Foot bridges	R 1 350 000	R 1 150 000				R 2 500 000
Community health centre	R 2 000 000	R 2 000 000				R 4 000 000
Agro based project	R 300 000	R 1 600 000	R 800 000	R 1 000 000	R 700 000	R 4 400 000
Buy-back recycling project	R 400 000	R 1 800 000	R 1 000 000	R 600 000	R 600 000	R 4 400 000
Total budget forecast	**R 5 050 000**	**R 8 050 000**	**R 1 800 000**	**R 1 600 000**	**R 1 300 000**	**R 17 800 000**
Procurement spend on BEE companies	**R 792 295 020**	**R 887 370 423**	**R 960 855 786**	**R 1 039 471 259**	**R 1 049 865 971**	**R 4 729 858 459**
Improvement of housing and living conditions						
Conversion of single rooms to family units	**R 7 285 333**	**R 7 285 333**	**R 7 285 333**			**R 21 855 999**
New units to be developed		**R 40 000 000**	**R 86 000 000**	**R 92 000 000**	**R 145 000 000**	**R 363 000 000**
Nutrition provision	**R 15 000 000**	**R 15 000 000**	**R 15 000 000**	**R 15 000 000**	**R 15 000 000**	**R 75 000 000**
Sub total	**R 22 285 333**	**R 62 285 333**	**R 108 285 333**	**R 107 000 000**	**R 160 000 000**	**R 459 855 999**
Management of downscaling and retrenchment	**R 2 629 186**	**R 2 629 186**	**R 2 629 186**	**R 2 629 186**	**R 2 629 186**	**R 13 145 930**
Five year total SLP budget estimate	**R 853 415 343**	**R 993 650 293**	**R 1 110 448 355**	**R 1 191 325 773**	**R 1 257 626 718**	**R 5 406 466 483**

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG

Elzie Maria Wilken
Commissioner of Oaths/Kommissaris van Ede
Candidate Attorney/Kandidaat Prokureur
Church Street 887 Kerkstraat • Pretoria
***Ex Officio:* RSA**

6. SECTION 6: UNDERTAKING

Sasol Mining (Proprietary) Ltd represented herein by **Hermann Wenhold** in his capacity as **Managing Director**, duly authorised thereto, undertakes to take all reasonable steps to adhere to the information, requirements, commitments and conditions as set out in this Social and Labour plan.

Signed at Secunda on this **30th** day of **January 2009**

Signature of responsible person ____________________ 30/1/09
H Wenhold
Managing Director

YOLANDI COETZEE
NOTARIS
NOTARY
GAUTENG