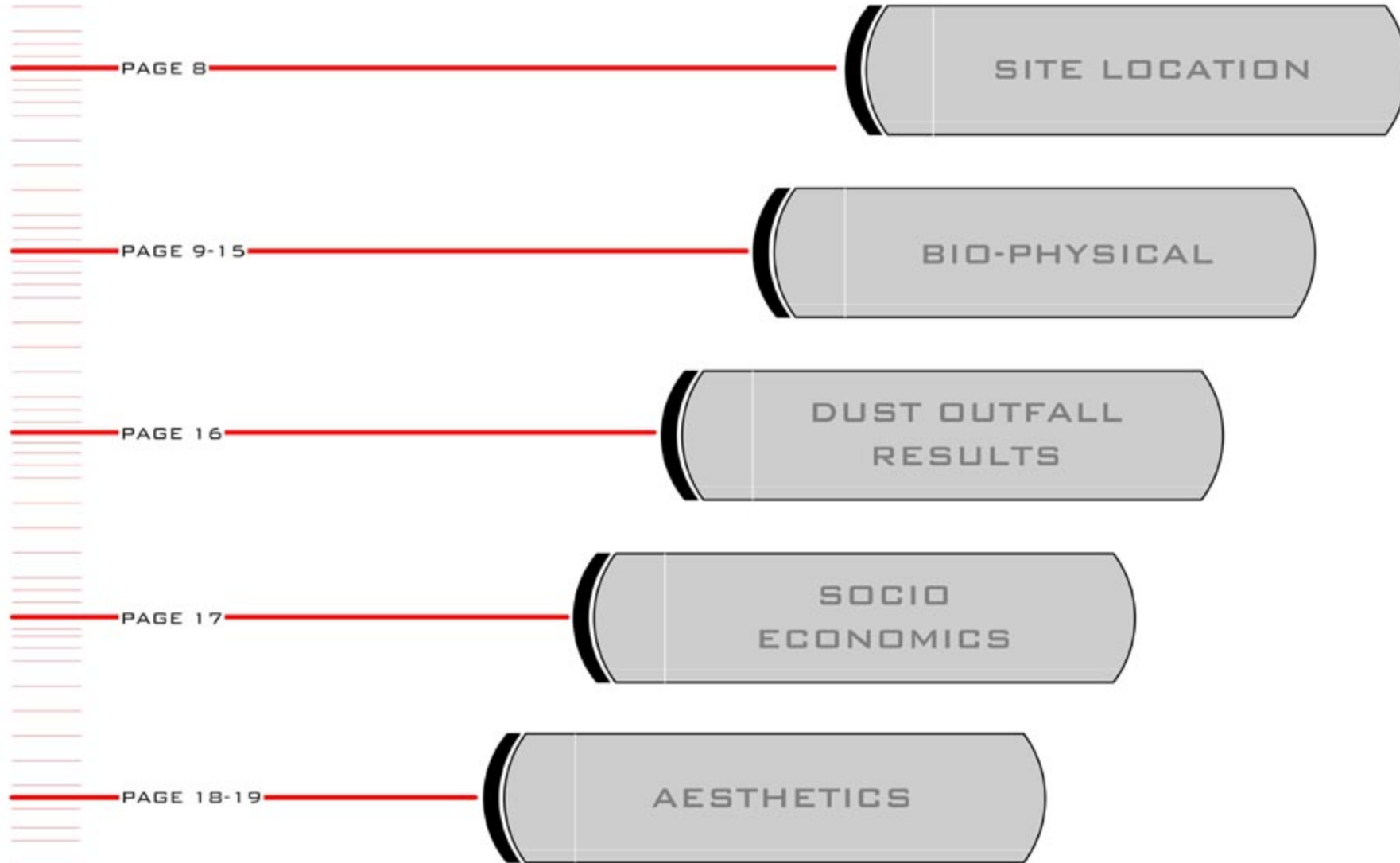


CONTEXT



SITE LOCATION

BIO-PHYSICAL ENVIRONMENT

DUST OUTFALL RESULTS

SOCIO ECONOMICS

AESTHETICS



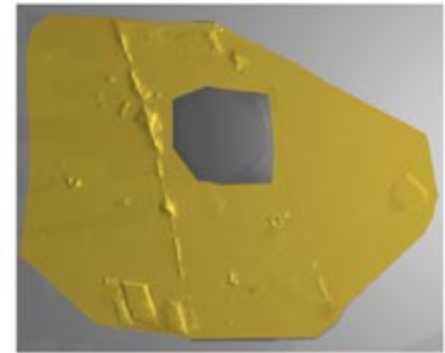
NORTH-WEST PROVINCE



RUSTENBURG DISTRICT

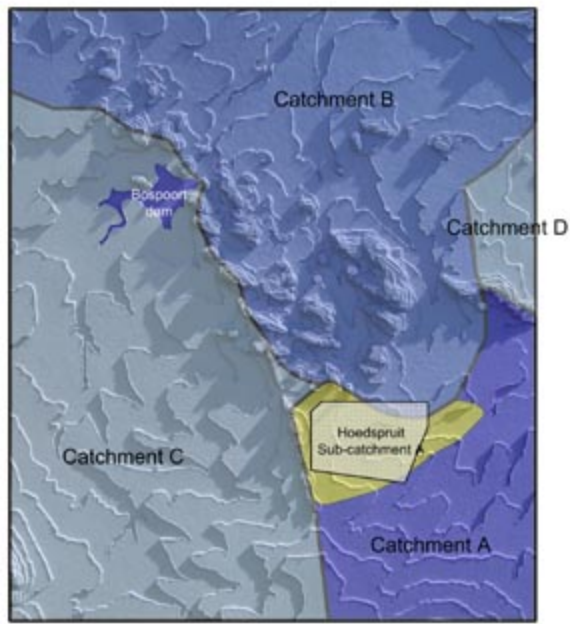


SITE LOCATION

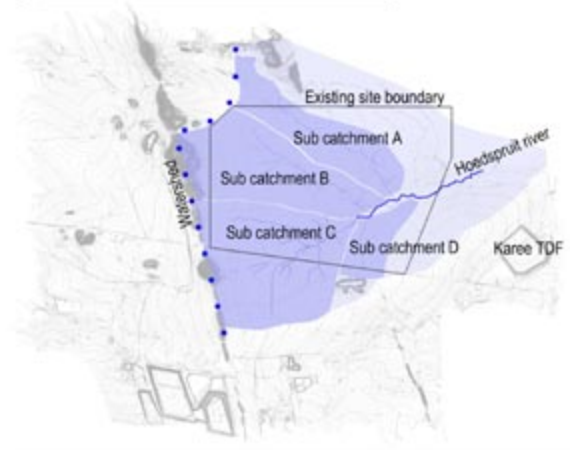


- SITE LOCATION
- BIO-PHYSICAL ENVIRONMENT
- DUST OUTFALL RESULTS
- SOCIO ECONOMICS
- AESTHETICS

WATERSHED ANALYSIS - REGIONAL



WATERSHED ANALYSIS - SITE



Surface Water

Surface water use

- The following informal water users, downstream from the study area were identified:
- Domestic use by residents of the informal communities in the vicinity,
 - Livestock watering of animals owned by residents of the informal communities,
 - Aquatic users
 - Recreational users of the Bospoort and Vaalkop dams (Botha *et al* 2002)

Water Authority

The North West Regional office of the Department of Water Affairs and Forestry (DWAf) in Hartebeespoort is the responsible water authority (*ibid*).

Wetlands

According to the studies conducted by Envirolink for Anglo Platinum, no wetlands occur in the study area. The definition for wetlands compiled by Rogers (1995), was adopted in that report (*ibid*).

Groundwater

Depth of water table

The water table level average at a depth of 10.5m below ground level for the study area. (*ibid*)

Ground water quality

The ground water quality was compared to and classified in accordance with the Quality of Domestic Supplies, Volume 1, Assessment Guide published by DWAf (1999).

All the tests have shown that the ground water quality is poor and unacceptable for domestic use. (*ibid*)

Ground water use

Surveys have showed that ground water is not used as a resource within a 1km radius of the study area. The surrounding communities utilise municipal water only. (*ibid*)

Catchment size

Hoedspruit sub-catchment A = 18.3km²
 Site area = 15km² (*ibid*)

Mean annual runoff

| | | |
|-------------------------|---|--|
| Hoedspruit catchment | 0.26 mill m ³ /ha | |
| Flood peaks and volumes | 1:20 year flood - 39.2 m ³ /s | 0.54 mill m ³ |
| | 1:50 year flood - 59.6 m ³ /s | 0.8 mill m ³ |
| | 1:100 year flood - 79.2 m ³ /s | 1.03 mill m ³ (<i>ibid</i>) |

SITE LOCATION

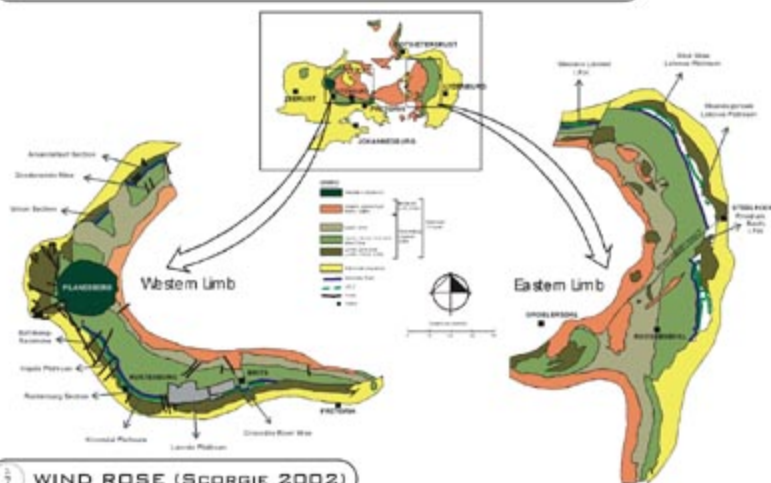
BIO-PHYSICAL ENVIRONMENT

DUST OUTFALL RESULTS

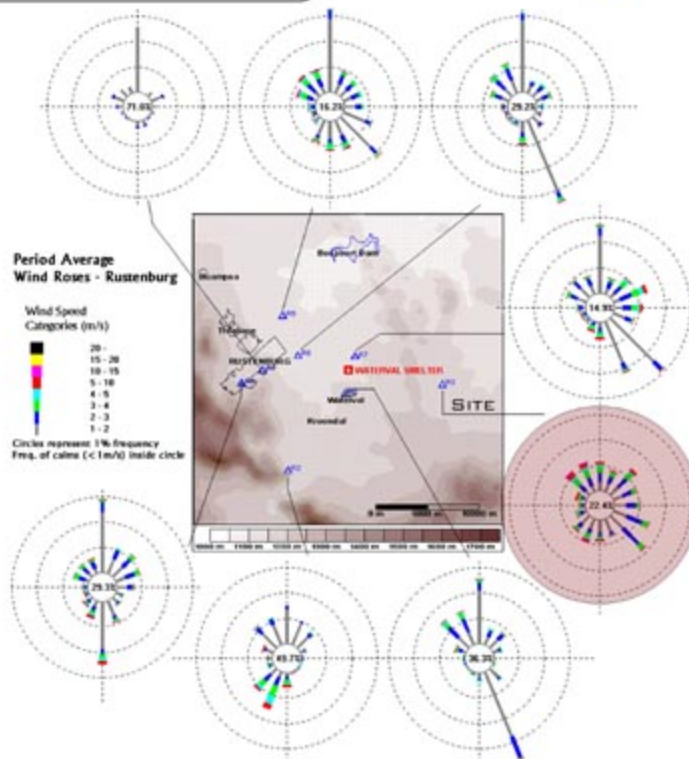
SOCIO ECONOMICS

AESTHETICS

6 GEOLOGY - BUSHVELD COMPLEX (RADEMEYER 2004)



7 WIND ROSE (SCORGIE 2002)



Geology (fig 2-6)

The Bushveld Complex is rich in a variety of minerals due to its specific geological formation. Potentially, the entire Bushveld Complex is a source for future mineral extraction. Currently, mining is restricted to the mining-belt that is located on the fringes of the Bushveld Complex. Platinum is nearest to the surface in these areas and thus making extraction less expensive. South Africa has the richest platinum bearing geology in the world, with the greatest concentration in the Bushveld Complex.

Climate on meso-scale

Ambient temperature

Summer: 16°C-31°C

Winter: 3°C-24°C

Average daily max and min (Rustenburg)

| | | |
|---------|--------|--------|
| January | 30.6°C | 16.9°C |
| April | 26.2°C | 10.6°C |
| July | 20.6°C | 1.8°C |
| October | 30.0°C | 13.4°C |

(Carruthers 2000)

Precipitation and evaporation

The study area occurs in a summer rainfall area. Approximately 70% of annual rainfall occurs during October to February.

Average rainfall: 630mm-740mm

Average seasonal distribution of rain:

| | | |
|--------------------|-----|-------|
| January - March | 44% | 300mm |
| April - June | 11% | 75mm |
| July - September | 5% | 34mm |
| October - December | 40% | 272mm |

(Ibid)

Average number of rainy days per annum: 80

Average nr of thunderstorms per annum: 75

Average incidence of hail per annum: 4

Surface winds (fig 2-7)

Prevailing wind direction:

| | |
|-------------------|--------------------------|
| Summer mornings | East to north-east |
| Summer afternoons | North to north-east |
| Winter mornings | South-east to north-east |
| Winter afternoons | North-west |

(Ibid)

- SITE LOCATION
- BIO-PHYSICAL ENVIRONMENT
- DUST OUTFALL RESULTS
- SOCIO ECONOMICS
- AESTHETICS

Soil (fig 2-8)

Regional soil is typically shallow soils on rocky ridges and gentle to flat mid slopes where Arcadia and Hutton soils are found. (Botha *et al* 2002)

Soil analysis

pH levels: 6.3-8.5

Electrical conductivity (indicator of salinity): 21-68 mS/m indicating that soils are not saline

Sodium levels: Low, meaning that no risk of erosion due to dispersion of clay particles by sodium ions will occur

Nitrogen and phosphorus: Fairly low

Potassium, calcium & magnesium: Sufficient to sustain normal plant growth

Hutton soils have a low buffer capacity, high porosity and high infiltration capacity. Arcadia soils have a high buffer capacity, low porosity and low infiltration capacity (*ibid*).

Suitability of soils for mining operations

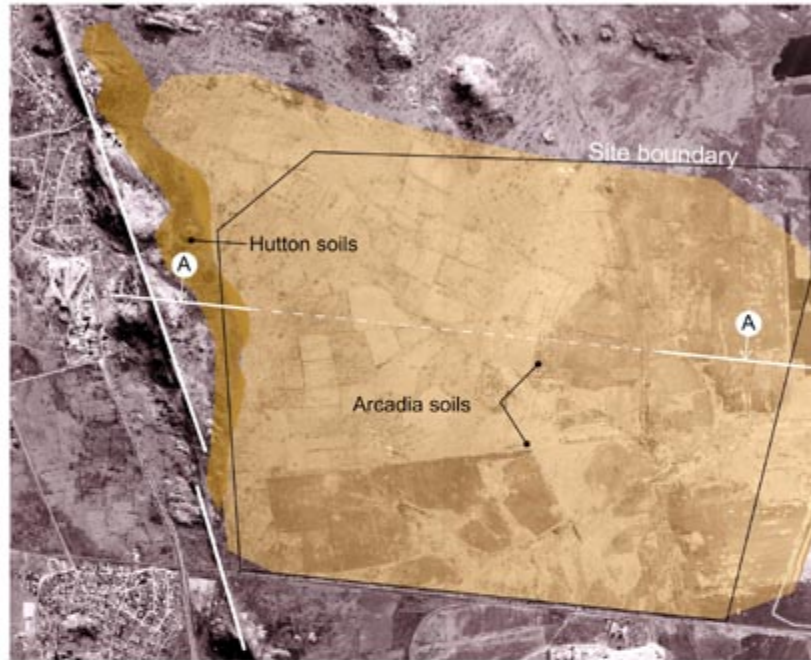
Both Hutton and Arcadia soils are chemically and physically suitable for use in rehabilitation (*ibid*). Hutton soils are particularly suitable for rehabilitation. Arcadia soils provide a valuable natural liner to reduce seepage of contaminated water to the groundwater. Caution should be taken when topsoil is collected from the surface for subsequent capping of the TDF, not to destroy the buffer layer i.e. natural liner.

Refer to Addendum 1 for soil stripping and stockpiling techniques as well as placement during rehabilitation.

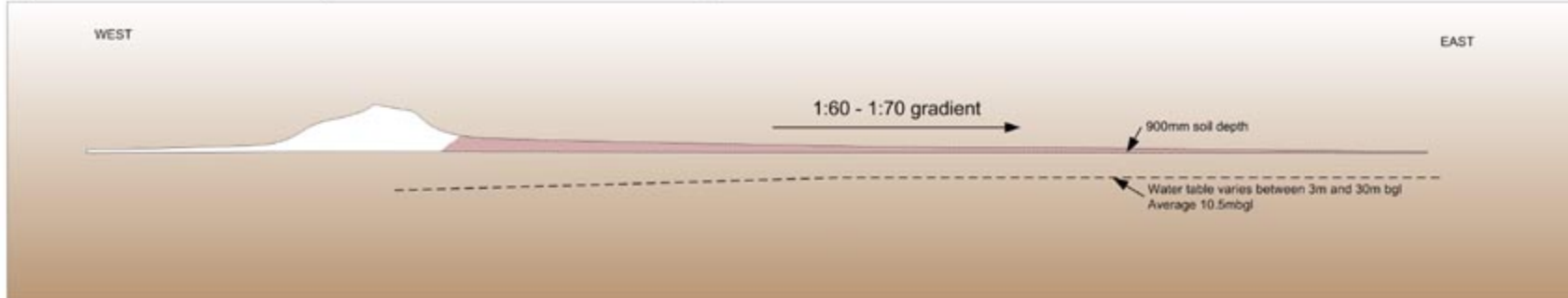
Pre-mining land use

The pre-mining land use was dominated by grazing and cropping although most fields were found fallow (*ibid*).

SOIL DISTRIBUTION



SECTION A-A: SOIL DEPTH



SITE LOCATION

BIO-PHYSICAL ENVIRONMENT

DUST OUTFALL RESULTS

SOCIO ECONOMICS

AESTHETICS

Flora status

Flora of pre-mining environment

The proposed project area is situated in the Savannah Biome. 25 vegetation types occur in the Savannah biome from which the Clay Thorn Bushveld and Mixed Bushveld are relevant. (Botha et al 2002)

Clay Thorn Bushveld

This vegetation type is determined mainly due to the extremely clayey soils. The economic uses are primarily for cultivating crops such as wheat, maize and sunflower.

Dominating plant sp. in the Clay Thorn Bushveld region:

- *Acacia karoo*
- *Acacia nilotica*
- *Ziziphus mucronata*
- *Dichrostachys cinerea*
- *Grewia flava*
- *Ischaemum afrum*
- *Sehima galpinii*
- *Setaria incrassate*
- *Panicum coloratum (ibid)*

Mixed Bushveld

A great variety of plant communities occur in this vegetation type ranging from dense, short bushveld to rather open tree savannah. *Mixed Bushveld* is characterised by coarse, sandy and shallow soil, overlying granite, quartzite sandstone or shale.

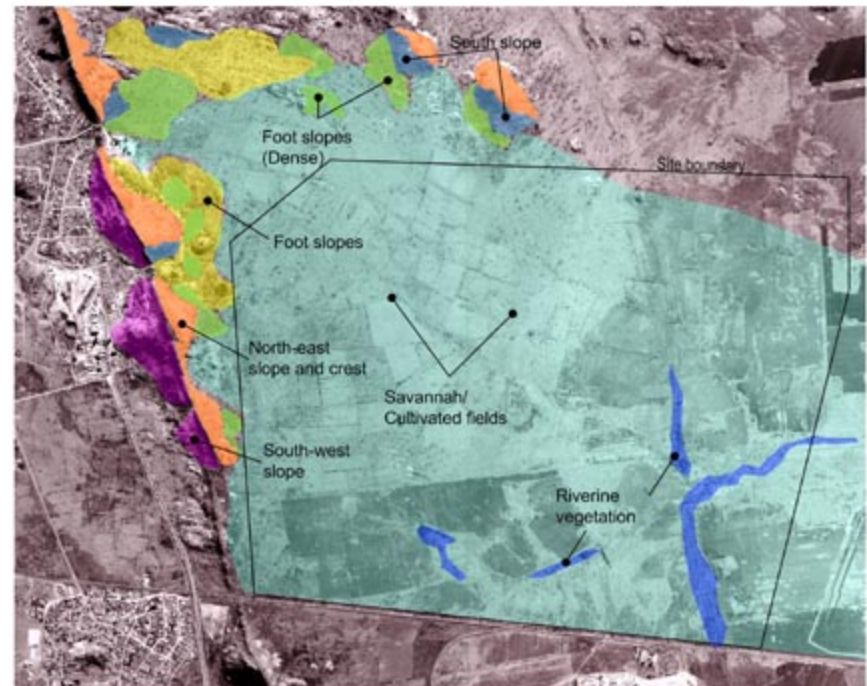
Dominating plant sp. in the Mixed Bushveld region:

- *Combretum apiculatum*
- *Acacia caffra*
- *Lannea discolour*
- *Sclerocarya birrea*
- *Terminalia sericea*
- *Ochna pulcra*
- *Burkea africana*
- *Digitaria eriantha*
- *Schmidtia pappopharoides*
- *Antheophora pubescens*
- *Eragrostis pallens*
- *Perotis patens (ibid)*

10 RIVERINE VEGETATION (SOURCE: SEF DATE UNKNOWN)

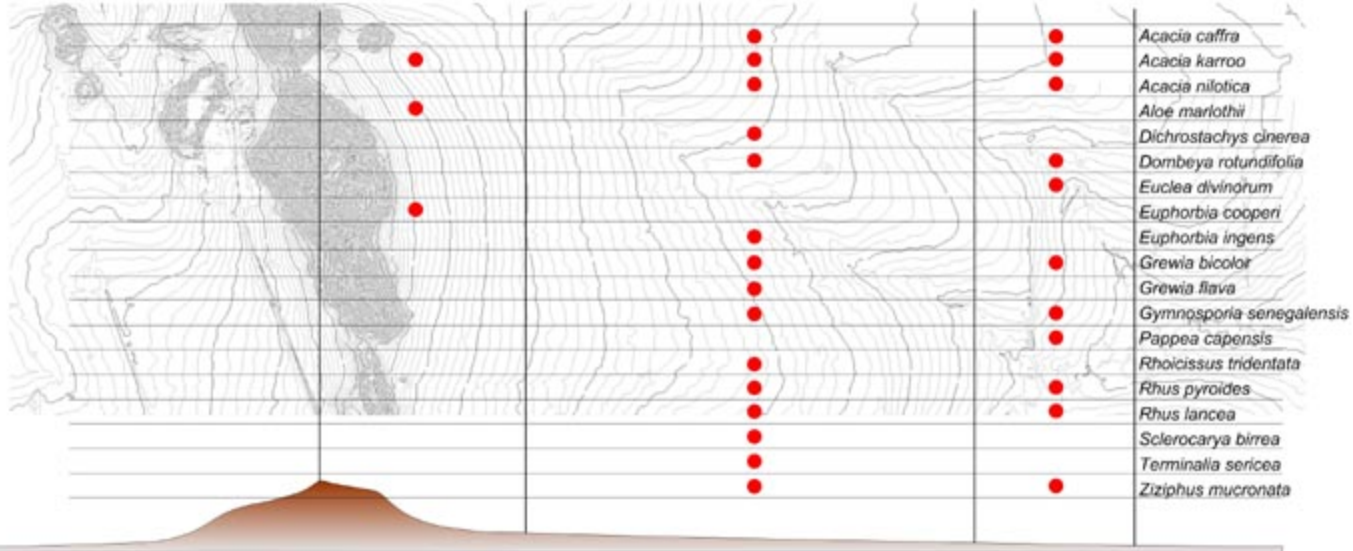
| Vegetation Zone A | Vegetation Zone B | Vegetation Zone C |
|--|--|--|
| Rushes <i>Juncus effusus</i> <i>Juncus kraussii</i> | Grass & Grass like <i>Pennisetum macrourum</i> | Trees <i>Acacia karoo</i> <i>Combretum erythrophyllum</i> <i>Rhus lancea</i> <i>Salix mucronata</i> subs. <i>Woodii</i> |
| Sedges <i>Cyrcium tubulosum</i> <i>Cyperus esculentus</i> <i>Plantago longissima</i> <i>Schoenoplectus corymbosus</i> | Sedges <i>Cyrcium tubulosum</i> <i>Cyperus esculentus</i> <i>Plantago longissima</i> <i>Schoenoplectus corymbosus</i> | Shrubs <i>Calpurnea aurea</i> <i>Halleria lucida</i> "orange" <i>Mellianthus major</i> <i>Rhamnus prinoides</i> <i>Tetradenia riparia</i> |
| Bulrushes <i>Typha capensis</i> Grass & Grass like <i>Phragmites australis</i> | Grass & Grass like <i>Phragmites australis</i> | Grass & Grass like <i>Eragrostis plana</i> <i>Hyparrhenia tamba</i> <i>Imperata cylindrical</i> <i>Setaria sphacelata</i> var. <i>sercea</i> <i>Sporobolus africanus</i> |

11 TOPOGRAPHIC DIVISIONS



DISTRIBUTION ON SITE

12 TYPICAL TREE AND SHRUB DISTRIBUTION ACROSS SITE



13 TYPICAL GRASS DISTRIBUTION ACROSS SITE



SITE LOCATION

BIO-PHYSICAL ENVIRONMENT

DUST OUTFALL RESULTS

SOCIO ECONOMICS

AESTHETICS

SITE LOCATION

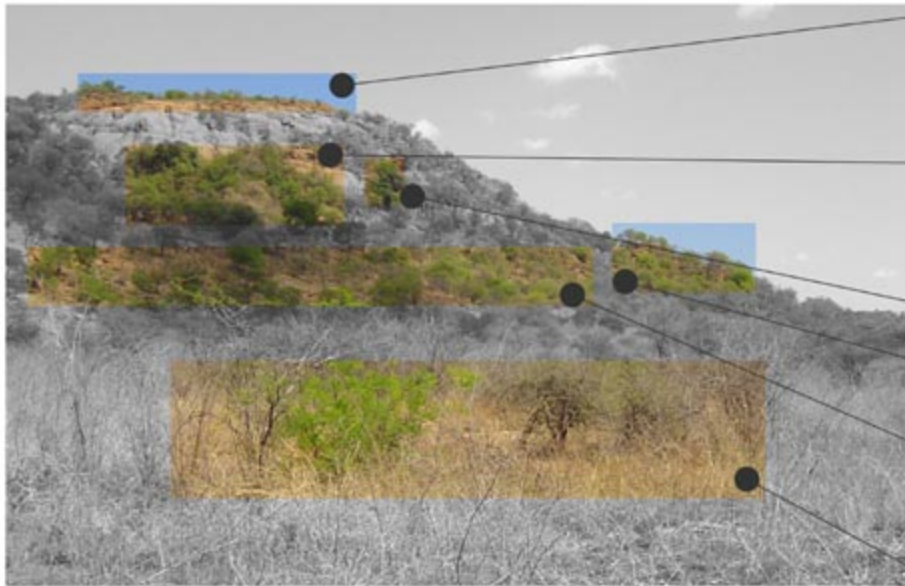
BIO-PHYSICAL ENVIRONMENT

DUST OUTFALL RESULTS

SOCIO ECONOMICS

AESTHETICS

14 EAST SLOPE VEGETATION AND CONDITIONS 1



East slope 1 (fig 2-14)

The crest usually consists of a rocky, granite outcrop. Conditions is dry and very hot. In addition to the aridness is the high solar gain capability of the exposed rock. Roots find their way into cracks in search of moisture. Vegetation is limited to succulent (*Euphorbia cooperi*) and drought resistant trees and shrubs. Grass distribution is sparse.

A characteristic element of adjacent hills, are cliffs. Vegetation is usually dense directly underneath the cliff, probably due to deeper soil, higher moisture availability and protection from wind and fire. Rock debris and a well established leave canopy, protect soil from heavy erosion. Steep slopes are present directly underneath the cliffs, but are stable.

Ficus ingens (Red-leaved rock fig) is characteristic of cliff vegetation in this region.

Another rocky outcrop is often present halfway down the slope. In most cases it is boulders from a previous unstable cliff scenario. Vegetation is similar than directly underneath the cliff.

The slope slowly grades out in a concave manner to the foot of the hill. A combination of trees and grass species dominate the middle slope. Trees are less dense and enough light penetrates to the grassy surface. Periodic fires is a natural process limiting bush encroachment.

The foot of the hills are characterised by the dense thorny shrubbery. Deep, fertile soils and high moisture content stimulates vigorous growth. *Dichrostachys cinerea* is dominant and indicates possible disturbance of the soil.

15 EAST SLOPE VEGETATION AND CONDITIONS 2



East slope 2 (fig 2-15)

This example of a crest, shows a more fragmented condition. Drought tolerant species find it easier to establish. A denser grass cover ensures a more readily occurrence of veldfire.

The middle slope resembles the previous example. A savannah type grass/tree relationship is clearly present.

Clusters of *Aloe marlothii* (Mountain aloe) make its appearance near the foot of the slope. Individual specimens are identifiable in other locations.

The plains are often characterised by dense bushveld vegetation. The availability of fertile, clayey soils with high moisture retention capability, sustain these vegetation communities.

ANALYSIS 2

(i) WEST SLOPE VEGETATION AND CONDITIONS



(ii) SOUTH-SLOPE VEGETATION AND CONDITIONS



- Acacia caffra*
- Diospyros lyciodes*
- Ficus ingens*
- Ziziphus mucronata*
- Papea capensis*
- Rhus pyroides*
- Rhus lancea*

West slope (fig 2-16)

A large colony of *Euphorbia cooperi* is present on the west slope of this hill. Overall, the hill is densely vegetated apart from the odd grassy patches on the bottom left and right. Some vegetation is very specific in terms of its growing conditions. Soil type, water availability and slope aspect is in most cases the determinant factors.

Conclusion

One can conclude the following:

- The distribution of species on the north, east, west and south slope is in most cases very similar.
- The distribution of vegetation is rather determined by micro-condition variations than macro climatic factors.
- Soil type, soil depth and moisture availability dictates vegetation distribution.
- Vegetation on the crest is drought resistant shrubs and small trees interspersed with succulent species.
- It is clear that larger trees require protection from fire and wind. These conditions are available on or adjacent rocky outcrops down the side of the slope.
- Grass dominated areas occur mostly near the foot of a hill.
- The plains can either be savannah vegetation type, or dense low growing shrubbery, resembling a bushveld vegetation type.

SITE LOCATION

BIO-PHYSICAL ENVIRONMENT

DUST OUTFALL RESULTS

SOCIO ECONOMICS

AESTHETICS

SITE LOCATION

BIO-PHYSICAL ENVIRONMENT

DUST OUTFALL RESULTS

SOCIO ECONOMICS

AESTHETICS

Introduction

Following the information concerning wind speed and predominant direction, it is possible to arrive at isopleth plots illustrating highest daily average PM₁₀⁽¹⁾ concentrations and maximum daily dust fall rates, based on results from simulations on a 850 ha and 750 ha tailings dam area scenario.

Air quality guidelines

New air quality target guidelines for PM₁₀ are stipulated by the provincial air pollution control officer. The target guidelines are specified as 50 µg/m³ for a 24 hour averaging period with compliance by 2005. It is also required that modelling be performed for a regular grid covering the impact area with approximate distance of 75 m between receptors.

In the air impact assessment report specific reference is made to the predicted level of pollution to occur at the closest exiting residential settlement. When analysing incremental concentrations due to the proposed TDF with 50 µg/m³ and 35 µg/m³ thresholds, the following is noted:

- These thresholds are likely to be exceeded given the 850 ha TDF, regardless of effective controls implemented and the restriction of the TDF to a height of 45m.
- With effective mitigation⁽²⁾ in place, the 45 m high 750 ha TDF is not expected to exceed the 35 µg/m³ threshold. The increase of the TDF to 120 m is likely to result in exceeding this threshold, although maximum concentrations is still lower than the 50 µg/m³ level.

Significance of impact

The significance of the impact is specified as follows:

- Very high - 850 ha, no mitigation
- High - 850 ha, effective mitigation
- Medium-high - 750 ha, effective mitigation

Social concern

The greatest concern lies with the high impact zone on the north-west and south-west areas adjacent to the TDF (fig 2-18 -21). Coincidentally, these are the areas where settlements occur. The establishment of an effective mitigation practice is essential and a subject that will receive attention during the design process.

⁽¹⁾ Inhalable particulate fraction or PM₁₀, particulate matter with an aerodynamic diameter of, 10µm

⁽²⁾ Refers to maintenance of a wet beach over 70% to 80% of the tailings surface, and 80% vegetation density on the side walls up until at least 1 m from the top of the tailings.

18 850 HA TAILINGS IMPOUNDMENT PREDICTED MAXIMUM 'TOTAL DAILY' DUSTFALL (mg/m²/day) DUE TO THE WESTERN LIMB TAILINGS PROJECT (NO MITIGATION)



19 850 HA TAILINGS IMPOUNDMENT PREDICTED MAXIMUM 'TOTAL DAILY' DUSTFALL (mg/m²/day) DUE TO THE WESTERN LIMB TAILINGS PROJECT (WITH MITIGATION)



20 750 HA TAILINGS IMPOUNDMENT PREDICTED MAXIMUM 'TOTAL DAILY' DUSTFALL (mg/m²/day) DUE TO THE WESTERN LIMB TAILINGS PROJECT (NO MITIGATION)



21 750 HA TAILINGS IMPOUNDMENT PREDICTED MAXIMUM 'TOTAL DAILY' DUSTFALL (mg/m²/day) DUE TO THE WESTERN LIMB TAILINGS PROJECT (WITH MITIGATION)





Socio-Economic Environment

Provincial and District Overview

Population size, age and gender distribution
(Source: RSA Population Census, Statistics South Africa, 1996)

North West Province population: 3.3 million

Density: 25 persons per square km

Population in urban centres: 1.17 million

Non-urban population: 2.18 million

Racial composition:

| | |
|--------------|-------|
| Black | 91.2% |
| White | 6.6% |
| Coloured | 0.3% |
| Indian/Asian | 0.3% |

Gender distribution:

| | |
|--------|---------------------|
| Female | 1.7 million (50.8%) |
| Male | 1.6 million (49.2%) |

Unemployment issues

In Southern Africa, each mineworker is responsible for an average of 9-11 dependants, whereas in developed countries, this figure varies between 3 and 6. The problem multiplies when one considers the labour intensive practices currently undertaken by mining companies. The closure of a single mineshaft could result in between 1500-3000 jobless individuals resulting in enormous economic and social impacts. (Knoll 2001)

From the RSA population census, one can conclude that the bulk of the population in the Bojala Platinum District Municipality (BPDM) is of a labour-able age (Addendum 2). This is a reason for concern due to the extensive mining activity in the region. This could be cumbersome if the statistics given in the Nov/Dec Urban Green File (2001) issue are correct. This will only become a problem if the area is depleted of its minerals and mining activity is located elsewhere.

It is a common occurrence in a mineshaft closure event that the employees are left unemployed with little or no education or skills. The conventional approach for dealing with large-scale retrenchment subsequent to mine closure, is the establishment of dedicated funds in order to retrain employees for alternative occupations or to support potential entrepreneurial prospect among retrenched workers. The success has been erratic. (Knoll 2001)

The responsibility of sustainable design rests heavily on mining companies, especially concerning the subject of waste management. In the event of waste deposition and rehabilitation thereof, it is important to realise the requirements of the natural and social components and how it will form an integrative, synergistic system in the future to come.

SITE LOCATION

BIO-PHYSICAL ENVIRONMENT

DUST OUTFALL RESULTS

SOCIO-ECONOMICS

AESTHETICS

SITE LOCATION

29 10 KM TO SITE



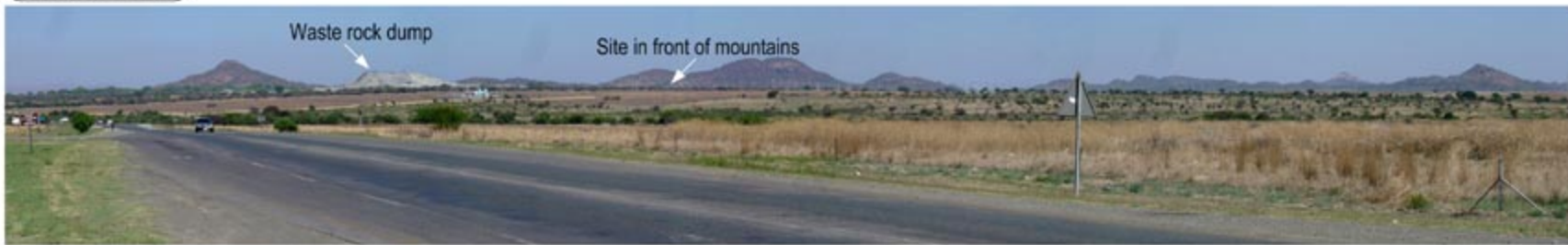
BIO-PHYSICAL ENVIRONMENT

DUST OUTFALL RESULTS

SOCIO ECONOMICS

AESTHETICS

30 5 KM TO SITE



31 TYPICAL LANDFORM ADJACENT TO SITE

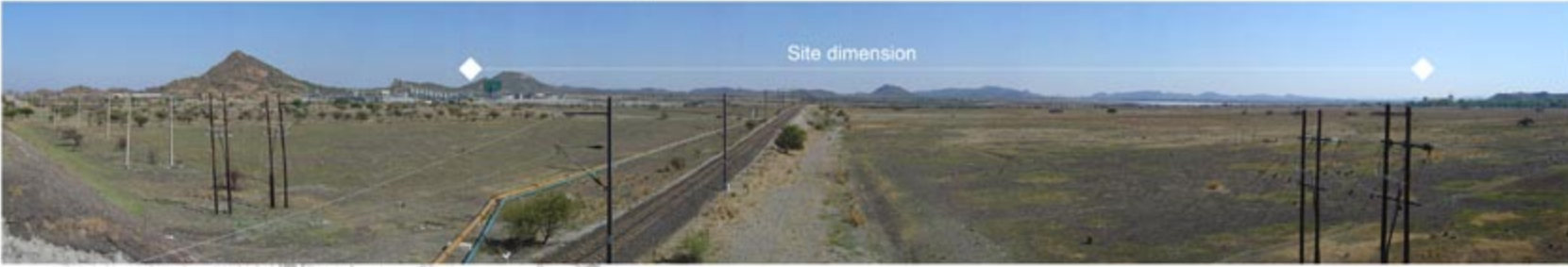


32 TYPICAL LANDFORM ADJACENT TO SITE

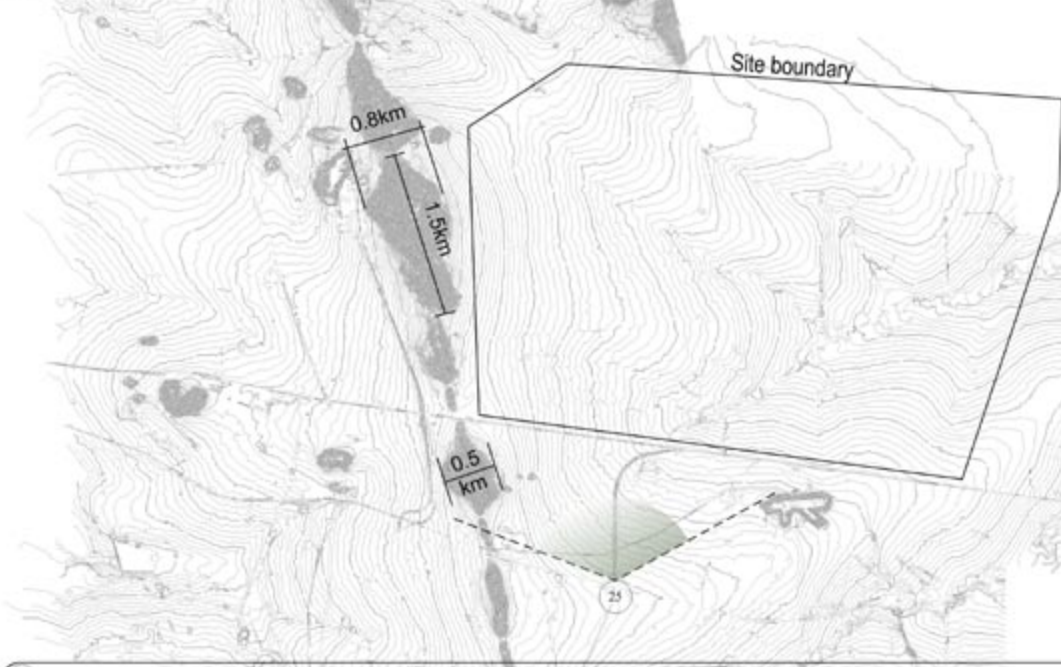


- SITE LOCATION
- BIO-PHYSICAL ENVIRONMENT
- DUST OUTFALL RESULTS
- SOCIO ECONOMICS
- AESTHETICS**

13 PHOTOGRAPH OF SITE FROM MAIN TRANSPORT ROUTE



14 CONTOUR MAP OF SITE INDICATING HORIZONTAL DIMENSIONS OF ADJACENT LANDFORMS



Local landforms and landscape character

This section attempts to determine the visual absorption capability of the site in terms of the scale and proportion of the proposed TDF. The TDF, proposed by SRK, is compared to the adjacent landforms. A clear contrast is noticeable (fig 2-34). From a visual point of view, it is necessary that the existing landforms act as guidelines for the design of a TDF. The scale of the TDF becomes most important, followed by the geometry as well as the surface texture and colour. Each of these elements should be designed/applied with the appropriate complexity, harmony, intensity, etc.

The maximum dimensions for the proposed TDF should be within an acceptable range, considering the adjacent landforms' dimensions. A tolerance of approximately 10% is found to be acceptable.

15 ELEVATION FIGURE-GROUND INDICATING VERTICAL DIMENSIONS AND CONTRASTING PROFILES

