A DESKTOP AGRICULTURAL IMPACT ASSESSMENT, REMEDIAL MEASURES AND IMPLEMENTATION MEASURES FOR THE UPGRADE, WIDENING AND STRAIGHTENING OF MAIN ROAD R101 FROM BELA BELA TO MOLEMOLE, LOCATED IN MOLEMOLE LOCAL MUNICIPALITY, CAPRICORN DISTRICT MUNICIPALITY, LIMPOPO PROVINCE. IN EXTENT APPROXIMATELY 27 KM. DRAFT

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1. INTRODUCTION AND BACKGROUND

1. Introduction

The purpose of this Deskto Agricultural Impact Assessment has been fourfold:

1) To describe the soil and agricultural status quo of the target site.
2) To estimate the impact of the civil works required for the upgrade of the target site and the immediately adjoining landscape
3) To make recommendations for the amelioration of any envisaged negative agricultural and agribusiness impacts that might be associated with the upgrade of the road
4) To make recommendations for the implementation of any rehabilitation programme that might be required during and after the proposed upgrade

It must be emphasized that due to budgetary constrains this assessment is limited to available desktop data which has been abstracted from databases on a scale of 1:250 000 or coarser and therefore cannot exclude the possibility that there might be errors along the roots that have an Agricultural Potential that has not been shown within the broad database

It is accepted that most of the proposed upgrade will be within the existing road reserve. However, there are two sites along the route where road straightening will intrude on to privately owned land. It is outside of the scope of the available desktop data to determine the impact on these two land parcels without an onsite exposure and evaluation of the soil profiles and current land use. If the client or the land owners could produce photographs of the land parcels, this would be useful. Any photographs that show soil profiles at culverts, dongas etc would be very instructive

Should this localised information not be available prior to the submission of this study, it can be added as an addendum at a later stage

In assessing the agricultural impacts that would arise from the proposed upgrade there are a number of fundamental considerations taken into account, both when making the assessment and when recommending preventative or ameliorative steps that might need to be taken.

2. Background

The background considerations given attention to in this assessment are:

- ✓ The Status Quo
- ✓ The Opportunity Costs
- ✓ The Upgrade Phase
- ✓ Any Long Term Impacts

The Mitigation Hierarchy is as follows

- ➢ Avoidance or Prevention
- ➢ Minimise Impact
- ➢ Rehabilitate
- ➢ Offset

Avoidance or Prevention is not an option in this study.

The short outcome of this study is that:

The road passes through two distinct ecosystems, viz:

The southern half

This portion of the route passes through the Central Sandy Bushveld ecosystem that comprises of gently and undulating terrain with open savannah dominated by species such as *Terminalia sericea* (Silver cluster- leaf) *and Burkea africana* (Wild seringa) and other typical broad leaf bushveld species. The herbaceous layer is dominated by grasses. The climate is hostile to agricultural activity unless irrigation water is available. Soils are generally deep, sandy and weak.

The northern half

This portion of the route passes through the Waterberg Mountain Bushveld ecosystem that comprises of the rugged Waterberg Mountains including foothills, escarpment and table lands. The vegetation is mainly *Faurea Saligna* (Transvaal Beech) and *Protea caffra* (common Protea) bushveld on the highest slopes. *Terminalia sericea* and *Burkea africana* dominate the mid slopes and lower slopes. The climate is hostile to Agricultural Activity unless irrigation water is available. Soils are generally steep and shallow. Grass cover is moderate too good

The sensitivities of these two areas are illustrated and commented on in Appendix 4.5 hereto

Giving due weight to the above considerations, this assessment has no objection to the proposed upgrade of the road, provided the recommendations contained herein are implemented during the construction phase and adhered to thereafter.

The further following comments are made by way of confirmation of the foregoing:

1.1 Soil Forms and Series

The Soil Forms and Series found within the target area are always good initial indicators of soil potential, of the level of management required to mitigate damage during the development phase and then the steps that need to be taken to implement the best form of rehabilitation necessitated by the change of land use or disturbance of the soils along the route.

Soils in the southern half are likely to have a depth of 1 m or more, to have a poor water holding capacity and a moderate to high erosion hazard. Red soils will have a good yield potential but due to seasonal factors will require irrigation water

In contrast to this soils in the northern portion of the route will be mainly shallow and steep with a very poor yield potential.

This initial assessment cannot be further refined during the process of establishing the Land Capability Classes (LCCs) and Agricultural Theme Sensitivity (ATS) of the Soil Forms found along the route.

LCC and ATS determination includes establishing the soil texture (clay content), slope %, topsoil depth, ability to absorb and hold water, drainage qualities, rockiness and crusting potential of the soils under review.

The Authorities may require an onsite impact assessment on privately owned land parcels where road straightening is required as the major portion of these two land parcels lie outside of the road reserve. The distribution of Soil Parent Materials is illustrated in Appendix 4.1 hereto.

1.2. Topography

Topography is usually taken into account in this type of study, as topography and Soil Family usually play a large part in determining recommendations for ameliorative measures that may need to be taken as a result of the civil work that will be undertaken along the route.

The southern portion is generally level or gently undulating a while the northern portion is steep with mountains and deep valleys. Where there are level areas the soils are likely to be as sandy and deep as in the southern section

1.3 Climate

The climate is a third important determinant. This determines the volume of rainfall precipitation, the type of precipitation, the seasonal occurrence thereof, soil moisture evaporation rate, the effect of sunshine hours, heat and chill units on crop yield and ground cover

The climate and the southern section reflects a cool dry season from May to mid August, a hot dry season from mid August to October and a hot wet season from November to April

The northern portion has summer rainfall with very dry winters

Table 1: Description of Climate Capability Class Criteria (Scotney et al. UKZN 1987)

Climate Capability Class	**Limitation Rating**	**Description**
C1	None to slight	Local climate is favourable for good yields for a wide range of adapted crops throughout the year.
C2	Slight	Local climate is favourable for a wide range of adapted crops and a year round growing season. Moisture stress and lower temperatures increase risk and decrease yields relative to C1.
C3	Slight to Moderate	Slightly restricted growing season due to the occurrence of low temperatures and frost. Good yield potential for a moderate range of adapted crops.
C4	Moderate	Moderately restricted growing season due to low temperatures and severe frost
C5	Moderate to Severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops at risk of some yield loss
C6	Severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Limited suitable crops which frequently experience yield loss
C7	Severe to Very Severe	Severely restricted choice of crops due to heat, cold and/or moisture stress
C8	Very Severe	Very severely restricted choice of crops due to heat, cold and/or moisture stress. Suitable crops at high risk of yield losses.

Table 1: Climatic Data for the Study Area: Central Sandy Bushveld

As no locally specific climatic data is available from the Limpopo Department of Agriculture the local climatic data was extrapolated from climatic data tabled in Mucina and Rutherford.

Climate Item	**Incidence and Impact**
Mean Annual Rainfall, precipitated mainly from May to August. Winter rainfall area	596 mm. This is insufficient to sustain temperate vegetative growth which requires 600 mm to 800 mm rainfall per annum
Annual Precipitation Coefficient of Variation	28%. Rainfall can vary from 430 mm per annum to 760 mm per annum this implies that, except in particularly good years arable crops would be at high risk. It is however sufficient to maintain grazing for livestock and game, provided they are dams or boreholes for livestock drinking water
Mean Annual Temperature	18.0 Deg C. Temperatures range from a monthly mean of 5 Deg C to 30 Deg C monthly mean. Recorded temperatures range from 38 Deg C to 2 Deg C
Mean Frost Days per annum	14
Mean Annual Potential Evaporation	2 234 mm. In temperate areas this figure is typically around 1 800mm
Mean Annual Soil Moisture Stress. Evaporative demand is more than double soil moisture supply	77%

Climate Capability rating for this area is C7.

Table 3: Climatic Data for the Study Area: Waterberg Mountain Bushveld

As no locally specific climatic data is available from the Limpopo Department of Agriculture the local climatic data was extrapolated from climatic data tabled in Mucina and Rutherford.

Climate Item	**Incidence and Impact**
Mean Annual Rainfall, precipitated mainly from May to August. Winter rainfall area	616 mm. This is insufficient to sustain temperate vegetative growth which requires 600 mm to 800 mm rainfall per annum
Annual Precipitation Coefficient of Variation	28%. Rainfall can vary from 444 mm per annum to 788 mm per annum this implies that, except in particularly good years arable crops would be at high risk. It is however sufficient to maintain grazing for livestock and game, provided they are dams or boreholes for livestock drinking water
Mean Annual Temperature	17.6 Deg C. Temperatures range from a monthly mean of 5 Deg C to 30 Deg C monthly mean. Recorded temperatures range from 38 Deg C to 2 Deg C
Mean Frost Days per annum	15
Mean Annual Potential Evaporation	2 289 mm. In temperate areas this figure is typically around 1 800mm
Mean Annual Soil Moisture Stress. Evaporative demand is more than double soil moisture supply	77%

Climate capability class for this area is also C7: suitable for livestock and wild animals only

It should also be noted that due to the hot summers this is effectively a winter production area for most arable crops. Rainfall during the winter season very seldom exceeds 100 mm over the entire 5 winter months

1.4 Traffic

The effect of traffic during the construction phase will also be a considerations, particularly the creation of nuisance dusts and the possible temporary obstruction of water courses and stone water runoff both along and across the road.

1.5 Vegetation and Livestock

As livestock carry in capacity is typically one Large Stock Unit (LSU) per 12 to 18 ha the total amount of grazing lost is also irrelevant. And LSU is equivalent to one ox of 450 kg or 6 large goats

1.6 General Comment

John Phipson has a lifelong interest in land management and nature conservation. He has served on the Natal Provincial Council Nature Conservation Portfolio Committee and was instrumental in the motivation for the establishment of a Chair of Nature Conservation at the University of KwaZulu-Natal.

He is a member of the Custodians of Rare and Endangered Wildflowers (CREW) and the Zululand Indigenous Tree Society. He is, or has been, a member of a number of soil fertility and crop management interest groups including SA Sugar Technologists Association and the KZN No-Till Club.

Over the last twenty years John Phipson has worked extensively on land usage planning and land usage management at both local and district levels, co operating with municipalities, traditional authorities, provincial and national government as well as private sector participants.

He was a member of the KZN panel for the National Water Resource Strategy (NWRS 2).

He served on Minister of Agriculture Zokwana's Implementation Forum and was a contributor to the Presidential Panel on Land Reform.

He has not only conducted agricultural impact assessments in nearly every district in KZN, but also in all nine Provinces.

1.7 The Study Area

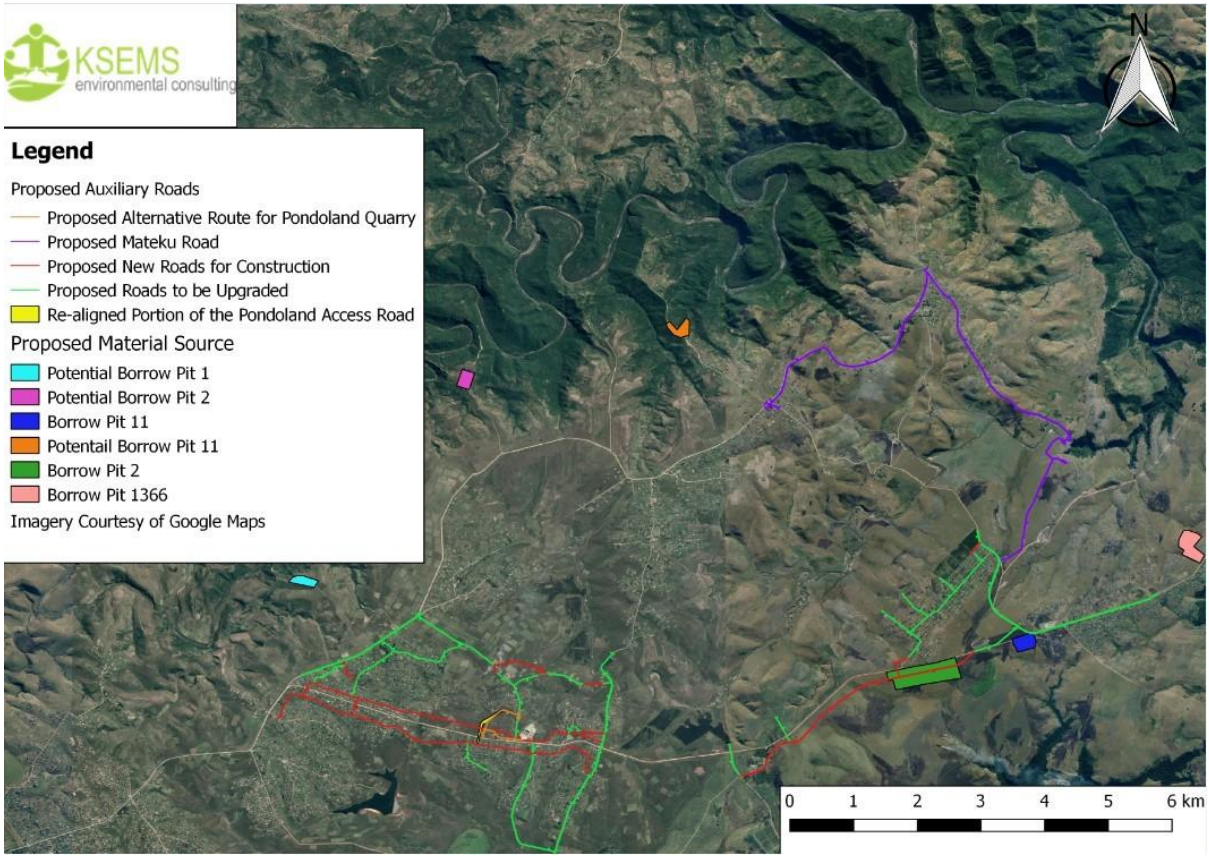
The study area is located along the existing R101 Main Road from BelaBela to Modemolle over a width of 50 m each to the left and right of the road centre, with the exception of two areas that create both a bottleneck and a traffic hazard due to the presence of sharp corners and one spot where a minor straightening would be beneficial. These two sharp corner areas have been addressed separately as they are far broader and also encroach onto privately owned property. The intention at these two sites is to substantially straighten the road in order to facilitate an even and steady traffic flow, basic ingredient in road safety.

These three sites are illustrated and described in Appendix 4.4 hereto.

Like many other Main Roads in RSA that run parallel to toll highways, they themselves caring a heavy traffic flow, especially when there has been an interruption of traffic on the parallel toll road and at peak traffic times

This section of the R101 traverses soils of the Central Sandy Bushveld Ecosystem of the central Bushveld Bioregion of the Savanna Biome. These are generally poor soils whose agricultural potential is also challenged by a relatively low rainfall during hot, subtropical summers

Figure 1: Site Delineation



1.8 Terms of Reference

Terms of reference, proposed future use of land, land parcel details, site relevant KML files and similar data has been provided by the client in a series of site relevant modifications and updates.

1.9 The Regulatory Framework

The most important pieces of legislation effecting land use management are:

- Subdivision of Agricultural Land Act 70 of 1970 (SALA)
- Conservation of Agricultural Resources Act 43 of 1983 (CARA)
- National Environmental Management Act 107 of 1998 (NEMA)

2. APPROACH OF THE STUDY

As there is no provision for empirical site assessment, as much desktop data as possible has been gathered and reported on. This data would suggest that, provided standard civil engineering methodology and safety practices are observed, the impact on any agricultural activity is so insignificant as to be irrelevant to any impact on arable crop production or long term crops such as orchards and pastures

3. REFERENCE PUBLICATIONS

i. The following reference material was utilized during the assessment and verification process:

ii. *Development and Application of a Land Capability Classification System for South Africa:* J L Schoeman et al, ARC-ISCW, 2002

iii. *Geological Journeys:* Norman and Whitfield: Struik

iv. *Natural Resources and/or Agricultural Survey Specifications, Version 3 January 2018:* KZN DARD Natural Resources Directorate, Cedara

v. *Soil Classification: A Taxonomic System for South Africa:* CN MacVicar et Al, ICSW

vi. *Soils of South Africa:* Martin Fey, Cambridge University Press

vii. *The Story of Earth and Life*: McCarthy and Rubridge: Struik

viii. *The Vegetation of South Africa, Lesotho and Swaziland:* Mucina and Rutherford: Sanbi

ix. *Trees of South Africa:* Keith Coates Palgrave: Struik

4. APPENDIX

Appendix 4.1 Soil Parent Materials

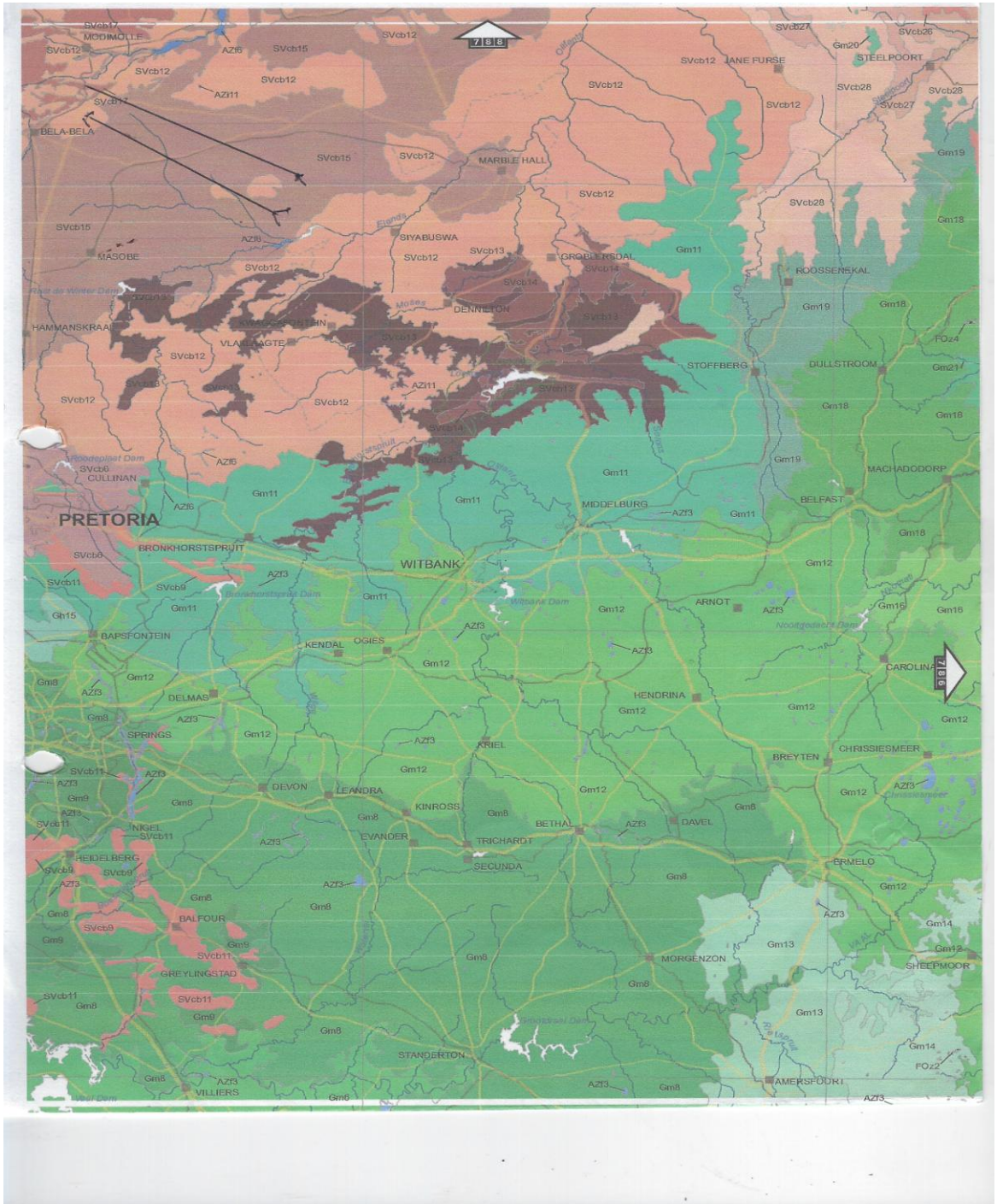
The arrows on the map below indicate the locality of the two soil parent materials along the route. The dark yellow area indicated by the upper arrow which is intrusive dolerite indicated by the symbol ‘d’ approximately 200 million years old. This is probably deep, red, high yield potential soil.

The pale yellow area indicated by the lower arrow reflects soil parent material of sedimentary origin of the Waterberg and Soutpansberg Groups, approximately 1800 million years old. These are likely to be deep sandy soils with a moderate too poor yield potential


NYLSTROOM
NYLSTROOM SYNCLINE
WARMBAD
Belabela
DOORNKOM
WELGEVONDEN
LOUBAD ANTICLINE
ZWARTKLOOF TIN
ZWARTKLOOF FLUORSPAR
BUISKOP
EERSBEWOOND
TWEEFONTEIN
CYFERFONTEIN
TRIPLE SIX
Phagameng
Kleinood
Oopveld
Elandsfontein
Klein Elandsfontein

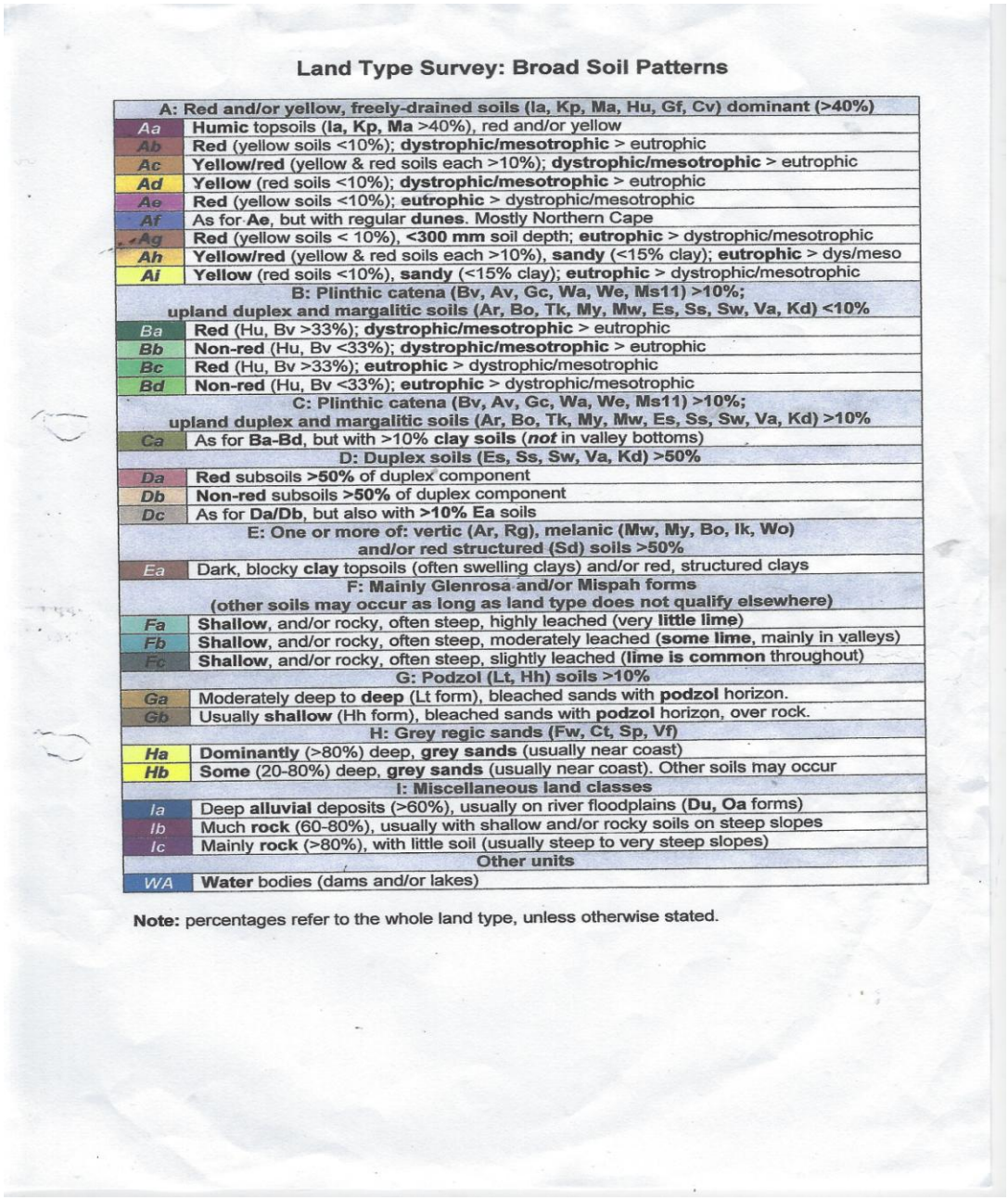
Appendix 4.2 Mucina and Rutherford Vegmap

The upper arrow indicate a narrow belt of Waterberg Mountain Bushveld Ecosystem that crosses the route. The rest of the route runs through the Central Sandy Bushveld Ecosystem of the Central Bushveld Bioregion of the Savannah Biome



Appendix 4.3: ISCW Land Type Survey: Road Broad Soil Patterns

The narrow strip of dolomitic soil that crosses the route probably conforms to Broad Soil Pattern Ba or Bc. The rest of the soils along the route will probably conform to Broad Soil Patterns Ga and Gb



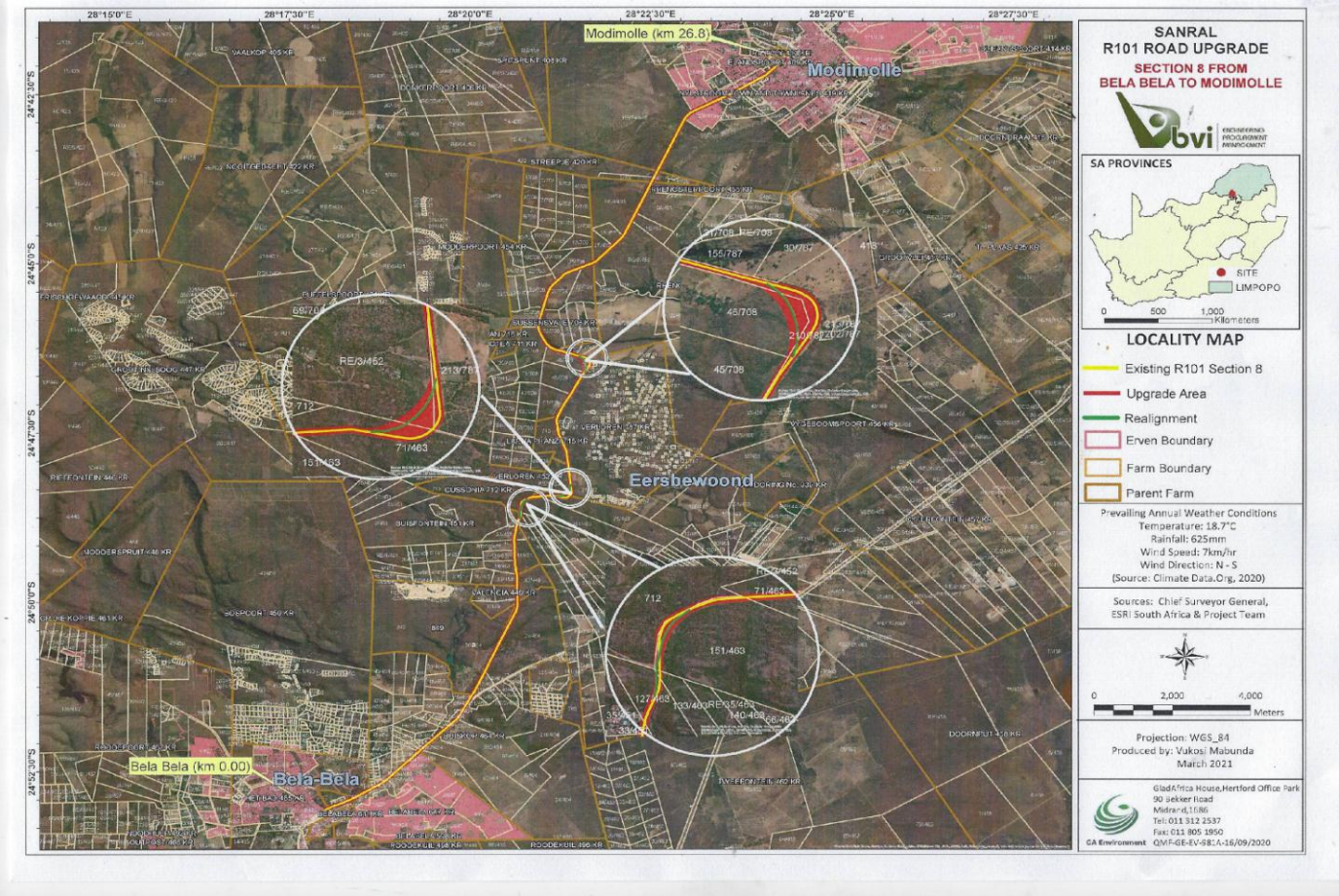
Land Type Survey: Broad Soil Patterns

A: Red and/or yellow, freely-drained soils (Ia, Kp, Ma, Hu, Gf, Cv) dominant (>40%)	
Aa	**Humic** topsoils (**Ia, Kp, Ma** >40%), red and/or yellow
Ab	**Red** (yellow soils <10%); **dystrophic/mesotrophic** > eutrophic
Ac	**Yellow/red** (yellow & red soils each >10%); **dystrophic/mesotrophic** > eutrophic
Ad	**Yellow** (red soils <10%); **dystrophic/mesotrophic** > eutrophic
Ae	**Red** (yellow soils <10%); **eutrophic** > dystrophic/mesotrophic
Af	As for **Ae**, but with regular **dunes**. Mostly Northern Cape
Ag	**Red** (yellow soils < 10%), **<300 mm** soil depth; **eutrophic** > dystrophic/mesotrophic
Ah	**Yellow/red** (yellow & red soils each >10%), **sandy** (<15% clay); **eutrophic** > dys/meso
Ai	**Yellow** (red soils <10%), **sandy** (<15% clay); **eutrophic** > dystrophic/mesotrophic
B: Plinthic catena (Bv, Av, Gc, Wa, We, Ms11) >10%; upland duplex and margalitic soils (Ar, Bo, Tk, My, Mw, Es, Ss, Sw, Va, Kd) <10%	
Ba	**Red** (Hu, Bv >33%); **dystrophic/mesotrophic** > eutrophic
Bb	**Non-red** (Hu, Bv <33%); **dystrophic/mesotrophic** > eutrophic
Bc	**Red** (Hu, Bv >33%); **eutrophic** > dystrophic/mesotrophic
Bd	**Non-red** (Hu, Bv <33%); **eutrophic** > dystrophic/mesotrophic
C: Plinthic catena (Bv, Av, Gc, Wa, We, Ms11) >10%; upland duplex and margalitic soils (Ar, Bo, Tk, My, Mw, Es, Ss, Sw, Va, Kd) >10%	
Ca	As for **Ba-Bd**, but with >10% **clay soils** (***not*** in valley bottoms)
D: Duplex soils (Es, Ss, Sw, Va, Kd) >50%	
Da	**Red** subsoils **>50%** of duplex component
Db	**Non-red** subsoils **>50%** of duplex component
Dc	As for **Da/Db**, but also with **>10% Ea** soils
E: One or more of: vertic (Ar, Rg), melanic (Mw, My, Bo, Ik, Wo) and/or red structured (Sd) soils >50%	
Ea	Dark, blocky **clay** topsoils (often swelling clays) and/or red, structured clays
F: Mainly Glenrosa and/or Mispah forms (other soils may occur as long as land type does not qualify elsewhere)	
Fa	**Shallow**, and/or rocky, often steep, highly leached (very **little lime**)
Fb	**Shallow**, and/or rocky, often steep, moderately leached (**some lime**, mainly in valleys)
Fc	**Shallow**, and/or rocky, often steep, slightly leached (**lime is common** throughout)
G: Podzol (Lt, Hh) soils >10%	
Ga	Moderately deep to **deep** (Lt form), bleached sands with **podzol** horizon.
Gb	Usually **shallow** (Hh form), bleached sands with **podzol** horizon, over rock.
H: Grey regic sands (Fw, Ct, Sp, Vf)	
Ha	**Dominantly** (>80%) deep, **grey sands** (usually near coast)
Hb	**Some** (20-80%) deep, **grey sands** (usually near coast). Other soils may occur
I: Miscellaneous land classes	
Ia	Deep **alluvial** deposits (>60%), usually on river floodplains (**Du, Oa** forms)
Ib	Much **rock** (60-80%), usually with shallow and/or rocky soils on steep slopes
Ic	Mainly **rock** (>80%), with little soil (usually steep to very steep slopes)
Other units	
WA	**Water** bodies (dams and/or lakes)

Note: percentages refer to the whole land type, unless otherwise stated.

Appendix 4.4 Sharp Corners

An expanded Google Earth Pro image indicates that the lowest circle on the diagram below represents a minor straightening that will impact only on land that is currently bush. Similarly, the middle circle reflects bush and open scrub. While the third circle reflects bush and what appear to be two or three seasonal water courses.

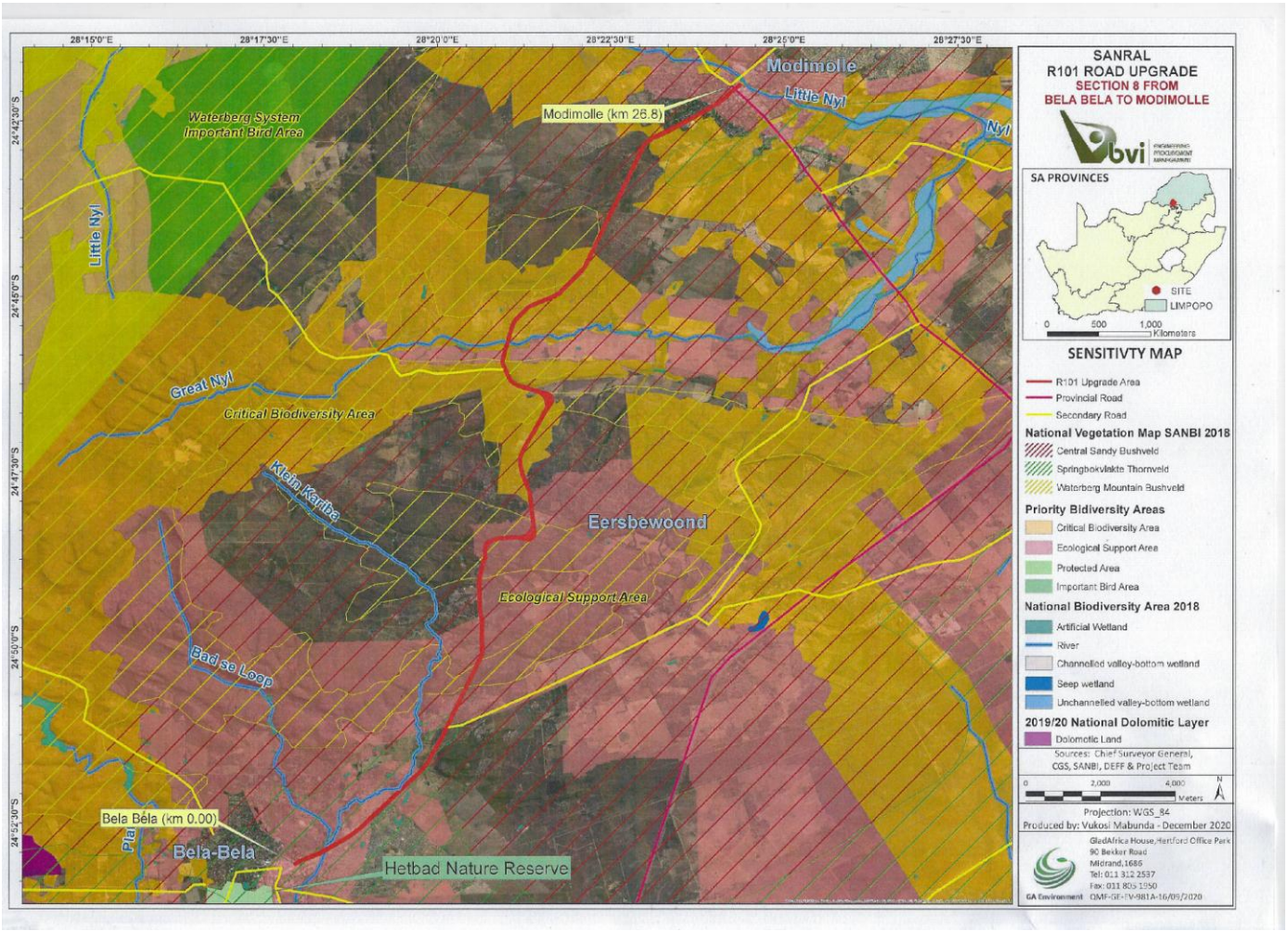


Appendix 4.5 Agricultural Sensitivities

The pink shading represents the Central Sandy Bushveld Ecosystem. The Agricultural Potential is likely to be Land Capability Class IV (LCCIV), a marginal crop potential or LCC VII, suitable or livestock and wild game only, on a scale of LCCI to LCCVIII.

The olive shading representing Waterberg Mountain Bushveld is most probably LCCVII only.

The corresponding Agricultural Theme Sensitivities (ATS) are ATS 5-7 and ATS 2-3 on a Scale of ATS 1 to ATS 15



The above agree with and confirm this study's findings on Soil Parent Materials, Climate and Vegetation and thus support the approval for the road widening to be implemented. It is recommended that should any objections based on soils, climate, vegetation or possible crops come to light during the Public Participation phase, the specialist be engaged for an in situ assessment

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