

# SPECIALIST STUDY:

## Agricultural Potential of Bosch Hoek, Newcastle

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## *Executive summary*

*The site is approximately 217 hectares. The farm is primarily used as grazing. Previously cultivated land has reverted to veld. Approximately 7 hectares are cultivated. There are two farm houses on the site and many labour houses.*

*Newcastle normally receives about 687 mm of rain per year, with most rainfall occurring during midsummer. The monthly average daily maximum temperatures range from 19,5°C in June to 27,6°C in January. The prevailing winds experienced are south easterly winds during the winter months and westerly during summer. Highest wind speeds are experienced in easterly and westerly directions with an average speed of 3.8 m/s. Hail only occurs during thunderstorms and is not confined to specific months. Approximately 6% of storms can be expected to produce hail.*

*iMbodwane River, a perennial stream runs through the property and finally drains into the iNcandu River. There is a dam in the southern portion of the property.*

*The site falls on three vegetation types: KwaZulu-Natal Highland Thornveld, Northern KwaZulu-Natal Moist Grassland and Northern Kwazulu-Natal Moist Grassland. The condition of the veld is good with a capacity estimated at 2,5 ha per LSU for 157 days of the year. The 217 hectares is, therefore, able to carry approximately 86 large livestock.*

*There are four soil types:*

- 1) Moderately deep, well-drained soil with topsoil of sandy clay loam texture and clay content of around 24% to 35%. The soil was classified as Hutton with surface rock.*
- 2) Dark coloured vertic soils containing black expansive clay. It is normally shallower than 500 mm with a greyish brown colour and clayey texture with a clay content of more than 55% and scattered loose rock fragments. Soil types identified were Rensburg and Sepane.*
- 3) Structured soils: The soil is a-pedal topsoil that overlies structured subsoil. Sepane and Rensburg are the dominant soil forms.*
- 4) Shallow rocky soil that derived from predominantly weathered dolomite, quartzite and shale.*

### **Potential**

*The site is not under permanent irrigation nor has it any particular unique value that needs protection. None of the soils forms identified qualify as high potential if the soil depth is taken into consideration. The Hutton soil that normally has a higher potential is rocky, and is 6,6 hectares in extent. It is located in the south western part of the farm. Although it fails to qualify as high potential it can, nevertheless, gainfully be used in producing fodder for the harsh winter months when the temperature can fall below freezing.*

*For the purposes of this study the potential income is calculated from the following land uses:*

- 1) 6,6 hectares of crops;*
- 2) 210 hectares of livestock grazing.*

*The projected net farm income is a loss of R54 423.*

### **Conclusions & findings**

*The land is too small for commercially viable farming. The total farming income is R146 300 hectares, which is too little to cover overheads and part time management. Changing the land use will not pose a significant loss to agriculture.*

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# 1 INTRODUCTION & BACKGROUND

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Index was requested by LEAP to do an agricultural assessment of land just south of Richview, a residential area in Newcastle in KwaZulu-Natal.

The site is approximately 217 hectares and consists mostly of grazing.

This study will provide the Department of Agriculture with an evaluation of the agricultural potential; it will indicate the present land use, classification of soils, potential land uses as determined by soil conditions, climate, availability of water and the impact that loss of the site will have on agriculture.

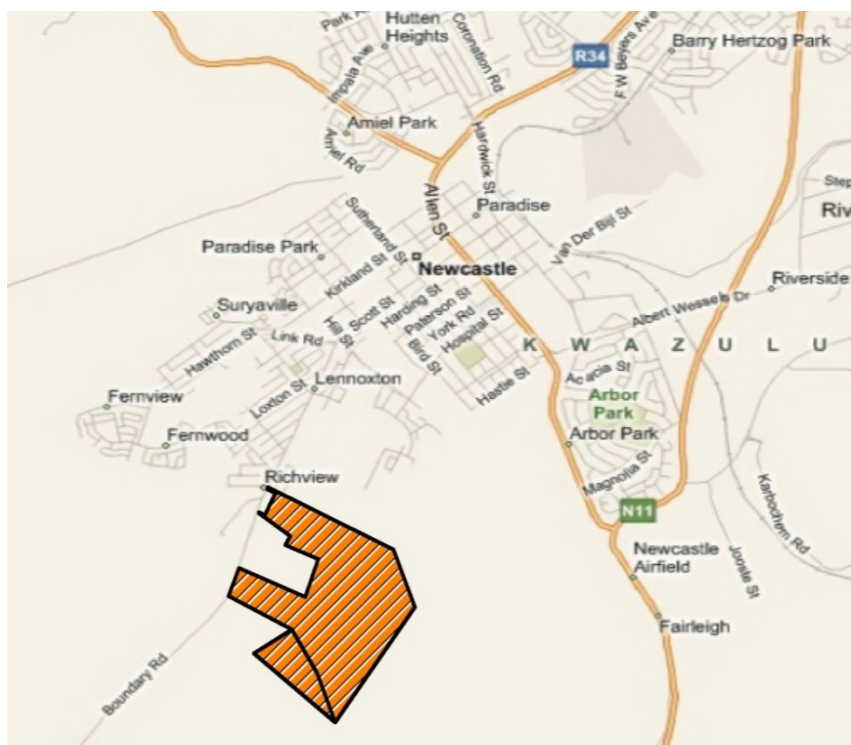


Figure 1. Locality map

## Site information

- ❖ Land portions      Bosch Hoek
- ❖ Size:                 217 hectares
- ❖ Proposed use:     Property development

# 2 PROCESS AND PROCEDURES

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Obvious geomorphologic units were delineated on satellite images on which contours were generated from DTM data. These boundaries were then refined in the field by means of a soil auger and probe. Modal profiles were then classified according to the Binomial Classification System for Southern Africa. Climatic conditions and soil properties such as texture, structure, colour, consistency and depth were then interpreted to provide an indication of agricultural potential. The guidelines of the National Department of Agriculture were used to determine the suitability of the land for arable agriculture.

# 3 PRESENT LAND USE

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The farm is used as grazing. Previously cultivated land has reverted to veld. Approximately 7 hectares are cultivated. There are two farm houses on the site and many labour houses.

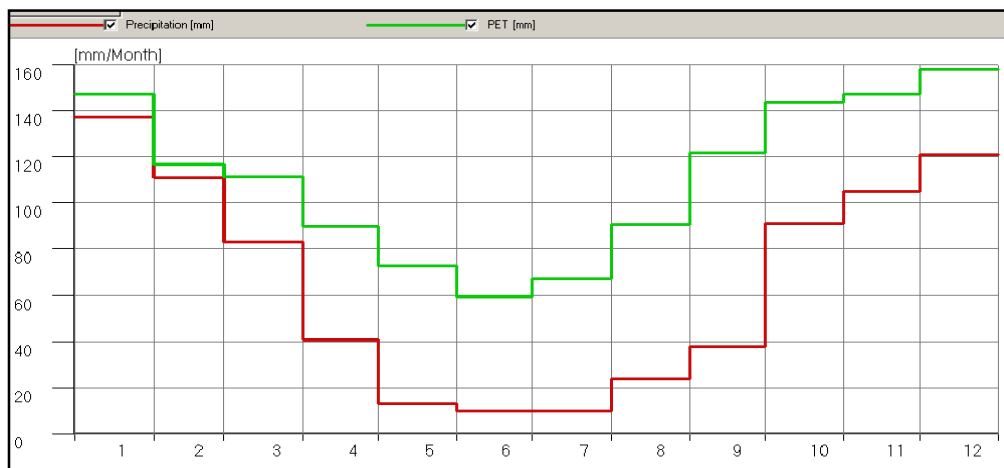
# 4 NATURAL ENVIRONMENT

## 4.1 Climate

### Rainfall

Newcastle normally receives about 687 mm of rain per year with most rainfall occurring during midsummer. The chart below shows the average rainfall for Newcastle. It receives the lowest monthly rainfall in June and the highest of 132 mm in January.

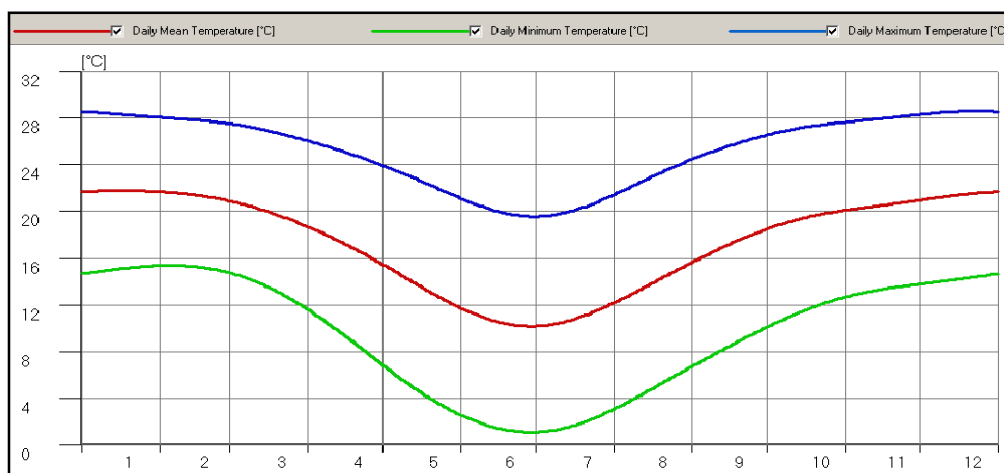
Figure 2: Rainfall for Newcastle



### Temperature

The monthly average daily maximum temperatures range from 19,5°C in June to 27,6°C in January. It is coldest during July when the mercury drops to 2,2°C on average during the night. The maximum temperature recorded was 34,9°C and the minimum temperature, minus 4,1°C

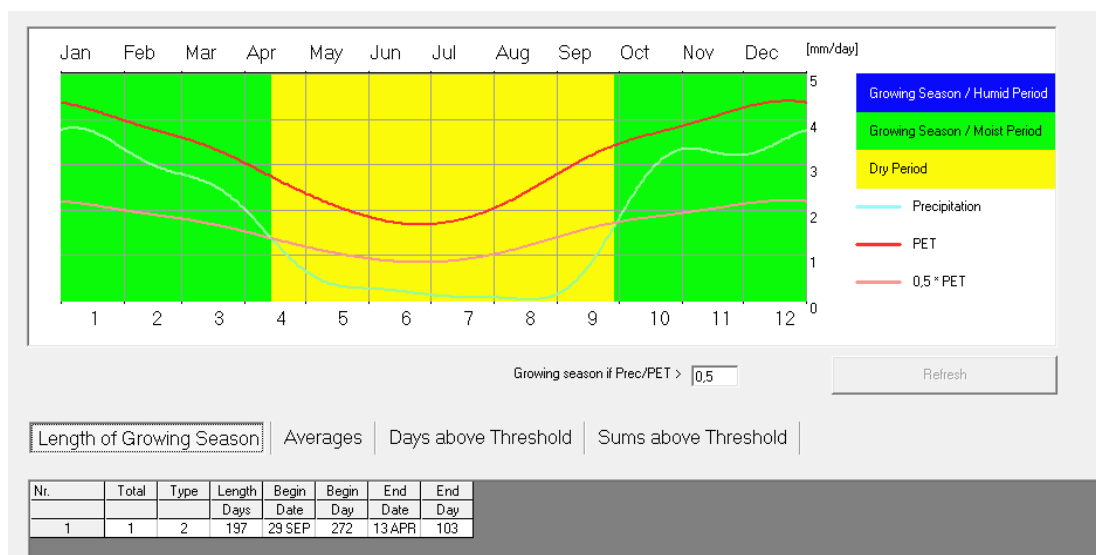
Figure 3: Temperature



### Climatogram

When plotting the rainfall against soil temperature, a climatogram is generated that indicates the growing season. This shows a dry period from mid April to the end of September, during which supplementary fodder may have to be provided; depending on the stocking rate of the land.

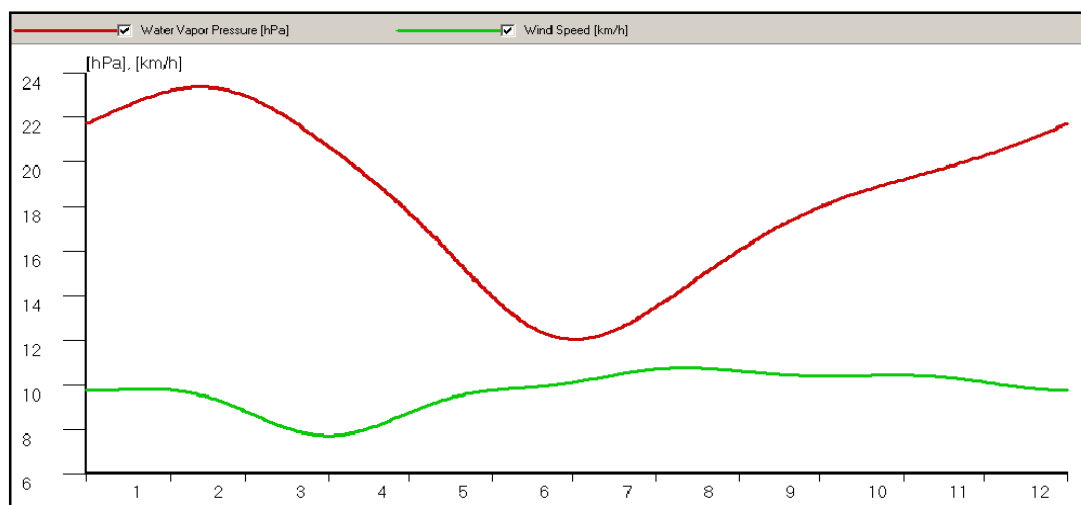
**Figure 4: Climatogram for Newcastle**



### Wind

The prevailing winds experienced are south easterly winds during the winter months and westerly during summer. Highest wind speeds are experienced in easterly and westerly directions with an average speed of 3.8 m/s.

**Figure 5: Wind**



**Figure 6. Wind speed and Water vapour pressure**

### Hail

Hail only occurs during thunderstorms and is not confined to specific months. They are, however, more frequent in spring and summer.

On average, approximately 6% of the thunderstorms can be expected to produce hail.

## 4.2 Geology

The site is underlain by sandstone of the Vryheid formation of the Ecca Group with dolerite intrusions. The sandstone is generally poorly weathered with large areas of shallow rocky soils. The dolerite intrusions form darker coloured clayey soils.

### 4.3 Water

iMbodwane River, a perennial stream runs through the property and finally drains into the iNcandu River. There is a dam in the southern portion of the property. A furrow was used to divert water from the stream to flood irrigate a small portion of land below the house on the southern portion of the property. However this system does not function any longer as the topsoil has eroded away and has exposed the ferricrete. The furrow is also no longer functional.

### 4.4 Vegetation

#### ***Present status***

*The site falls on three vegetation types: KwaZulu-Natal Highland Thornveld, Northern KwaZulu-Natal Moist Grassland and Northern Kwazulu-Natal Moist Grassland<sup>1</sup>. The vegetation consists of tall grassland usually dominated by *Hyparrhenia hirta*, with occasional Savannoid woodlands with scattered *Acacia sieberiana* var. *woodi* and small pockets also of *A. karroo* and *A. nilotica*. The condition of the veld is good.*



#### ***Grazing capacity***

According to the National Department of Agriculture, the grazing capacity is estimated at 2,5 ha per LSU for 157 days of the year. The 217 hectares is, therefore, able to carry approximately 86 large livestock.

### 4.5 Soil

The map notation indicates soil form and average soil depth in millimetres, followed by the abundance or surface rock, ranging from R1 to R3, in a scale few to abundant.

#### ***Moderately deep red soils***

Moderately deep, well-drained soil with topsoil of sandy clay loam texture and clay content of around 24% to 35%. The topsoil has a moderately developed blocky structure and a sticky consistency and a dark reddish brown colour.

The subsoil consists of reddish brown clay loam with a moderate blocky structure. The deeper subsoil is free of mottles and has an abundance of nodules and coarse fragments and moderate amounts of rock. The soil was classified as Hutton with surface rock. Other soil forms identified in this group were Glenrosa. The map unit is Hu500/R1.

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<sup>1</sup> *Mucina and Rutherford, 2006.*

### **Dark coloured vertic soils**

The soil consists of deep dark brown and black expansive vertic clay of alluvial origin. It is normally shallower than 500 mm with a greyish brown colour and clayey texture with a clay content of more than 55%.

The structure is strongly developed

prismatic with abundance of coarse fragments, with iron and manganese nodules and scattered loose rock fragments. The structure in both the top and subsoil has well developed slickensides that restrict root development to between the adjoining ped units, which then crush them when the soil expands as the soil receives water.

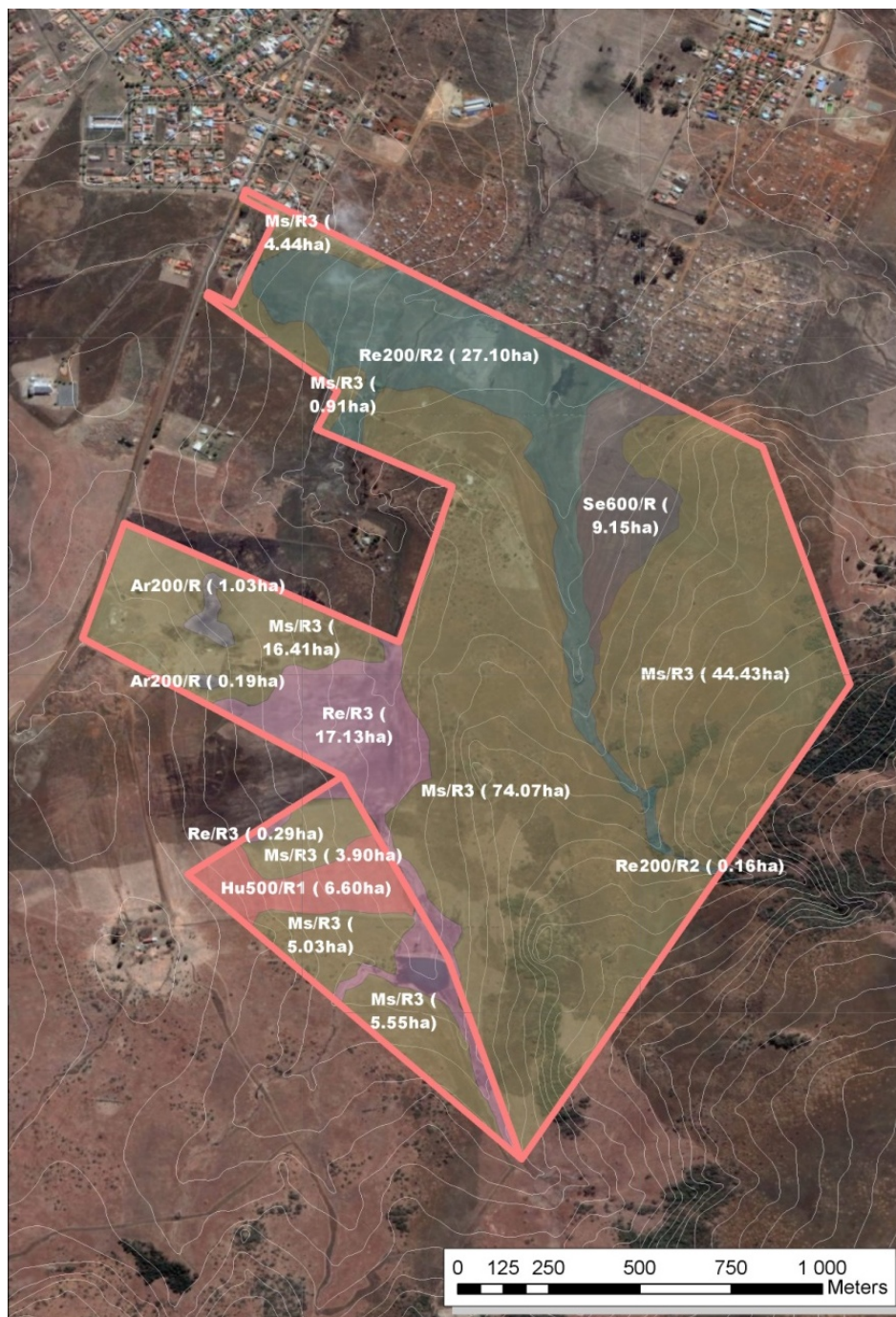
The soil unit occurs along the watercourse.

The sequence is vertic topsoil on vertic or pedocutanic subsoil. Soil types identified were Rensburg and Sepane. The map units are Ar200/R, Re/R3 and Re200/R2.

### **Structured soils**

A relative small portion of land to the east of the river in the northern portion of the property has well developed structure. The topsoil consists of sandy loam with a poorly developed blocky structure that overlies clay loam subsoil. The subsoil has strongly developed blocky structure to the degree that root penetration is restricted. The soil is a-pedal topsoil that overlies structured subsoil. Sepane and Rensburg are the dominant soil forms. The map units are Se600/R.

**Figure 7: Soil Map**





### ***Shallow rocky soil***

The soil derived from predominantly weathered dolomite, quartzite and shale. The topsoil varies in colour, depending on the base rock and topo-sequence. Normally it is dark brown with a clay loam texture and has a moderately developed sub-angular blocky structure.

The map units are Ms/R3 and makes up the largest portion of the site. It is unsuitable for cultivation and only has a moderate potential for grazing. The soil has a very low potential for agricultural uses.

**Table 1. Soil types**

<b>Soil</b>	<b>Area (Ha)</b>	<b>Suitability</b>	<b>Grazing (Ha)</b>	<b>Fodder (Ha)</b>
Ar200/R	1.2	Grazing	1.2	0
Hu500/R1	6.6	Fodder	0	6.6
Ms/R3	154.7	Grazing	154.7	0
Re/R3	17.4	Grazing	17.4	0
Re200/R2	27.3	Grazing	27.3	0
Se600/R	9.1	Grazing	9.1	0
<b>Total</b>	<b>216.3</b>		<b>209,7</b>	<b>6,6</b>

#### **4.5.1 General observations**

- The farm is mostly suitable for cattle farming. Much of the land consists of rocky shallow soil that is not arable;
- The western portion consists of vertic clay that is naturally fertile;
- Although the Hutten soil is shallow and rocky, it has the potential to produce hay under dryland conditions.

## **5 AGRICULTURAL POTENTIAL RATING**

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### **5.1 Background**

In addition of soil properties, potential is also determined by factors such as slope, watercourses and wetland vegetation which cultivation potential is prescribed by law. However, as important are the socio-economic conditions that will determine if farming is financially viable on the specific portion of land. There are various methods to describe potential, the guidelines used for this assessment is from the National Department of Agriculture.

### **5.2 Criteria for assessing agricultural potential**

Agricultural land is considered to be of high potential if:

- (a) it may be cultivated in terms of Part 1 of the regulations of Conservation of Agricultural Resources Act 43 of 1983;
- (b) is under permanent irrigation;
- (c) is classified as Avalon, Bainsvlei, Bloemdal, Cartref, Kroonstad, Longlands, Pinedene and Westleigh that is deeper than 600 mm and contains more than 9% clay; or Bonheim (families 1100, 2100, 3100), Clovelly, Glencoe, Glenrosa, Griffin, Hutton, Inanda, Magwa, Mayo, Nomanci, Oakleaf, Shortlands and Tukululu that is deeper than 700mm and has a clay content of between 10% and 55%;
- (d) Or has unique properties that warrant protection.

## Discussion

The site is not under permanent irrigation nor has it any particular unique value for which it needs protection.

None of the soils forms identified qualify as high potential if the soil depth is taken into consideration. In addition, the Hutton soil identified is rocky. It is 6,6 hectares and is located in the south western part of the farm. Although it fails to qualify as high potential it can, nevertheless, be used in producing fodder for the harsh winter months when the temperature fall to below freezing.

The whole eastern portion is shallow and rocky.

According to these guidelines, the site is classified as low potential land for arable farming and is more suitable as a grazing farm.



The rating is as follows:

**Table 2. Potential of farming land for different criteria**

Map notation	Potential for agriculture according to:			Comments
	Soil form	Special classes		
		Irrigation	Special crops	
Ar200/R	Low	Low	Not applicable	Soil is too shallow and rocky to cultivate
Hu500/R1	Moderate/ low	Moderate/ low	Not applicable	Soil is arable and has medium potential
Ms/R3	Low	Low	Not applicable	Soil is too shallow and rocky to cultivate
Re/R3	Low	Low	Not applicable	Soil is too shallow and rocky to cultivate
Re200/R2	Low	Low	Not applicable	Soil is too shallow and rocky to cultivate
Se600/R	Low	Low	Not applicable	Soil structure is restrictive to root development

## 6 POSSIBLE LAND USES

The land is suitable for grazing and small scale food gardens. It is not suitable for commercial scale cropping. The watercourses are susceptible to erosion and functions as wetlands. According legislation, it must be protected.

For the purposes of this study the potential income is calculated from the following land uses:

- 1) 6,6 hectares of crops;
- 2) 210 hectares of livestock grazing.

The projected crop yields are as follows:

TEXTURE CLASSES	
Sandy loam	1
Sandy clay loam	2
Clay loam	3
Clay	4
Sandy clay	5

Rainfall (mm/y)	687
Effective rainfall	584

Soil description	Texture	Soil depth (mm)	Yield t/ha			
	Class		Maize	Grain sorghum	Sunflower	Sugar beans
Ar200/R	4	200	0.9	1.1	0.4	0.3
Hu500/R1	1	500	1.9	2.3	0.9	0.6
Ms/R3	3	0	0.0	0.0	0.0	0.0
Re/R3	4	0	0.0	0.0	0.0	0.0
Re200/R2	4	0	0.0	0.0	0.0	0.0
Se600/R	4	600	2.0	2.5	0.9	0.6

The projected enterprise margins are as follows:

Soil description	Enterprise (R/ha)				
	Maize	Grain sorghum	Sunflower	Sugar beans	beef cattle
Ar200/R	R 0	R 0	R 0	R 0	R 863
Hu500/R1	R 435	R 0	R 0	R 0	R 863
Ms/R3	R 0	R 0	R 0	R 0	R 647
Re/R3	R 0	R 0	R 0	R 0	R 863
Re200/R2	R 0	R 0	R 0	R 0	R 647
Se600/R	R 0	R 0	R 0	R 0	R 647

The projected net farm income is a loss of R54 423.

Net farm income		
	Average	Preferred
Gross income	Rand	Rand
Field crops (average)	R 729	R 0
Cattle	R145 572	R145 572
<b>TOTAL INCOME</b>	<b>R146 300</b>	<b>R145 572</b>
<b>Less:</b>		
Overheads		
Labour (365 days @ R60)	R21 900	R21 900
Management (part time) - R10000/m	R130 000	R130 000
Repayment of loans		
Mechanisation & equipment (R300 000)	R48 824	R48 824
<b>TOTAL EXPENSES</b>	<b>R200 724</b>	<b>R200 724</b>
<b>Net farm income</b>	<b>-R54 423</b>	<b>-55 152</b>

The preferred land use is cattle.

## 7 CONCLUSIONS & FINDINGS

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The land is too small for commercially viable farming. The total farming income is R146 300, which is too little to cover overheads and part time management.

Changing the land use will not pose a significant loss to agriculture.

# 8 ADDENDA

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## 8.1 Sources of information

The following data sources were consulted in the evaluation of the agricultural potential:

- i) Weather Bureau, Department of Transport.
- ii) Grazing capacity estimations. Department of Agriculture.
- iii) Internal report: Guidelines for the evaluation of land use potential. Index, 1998.
- iv) Survey of the soil and veld conditions. Index, 2005.
- v) Field survey for soil and land conditions. Index, 2005.

## 8.2 Criteria used by the National Department of Agriculture

REPORT TO NATIONAL DEPARTMENT OF AGRICULTURE

Report Number GW/A/2002/21: CRITERIA FOR HIGH POTENTIAL AGRICULTURAL LAND IN SOUTH AFRICA

For use within revised spatial framework

### 8.2.1 Methodology

#### **Background**

The Directorate: Agricultural Land Resource Management of the National Department of Agriculture commissioned a study on criteria for prime agricultural land in 1998 (Schoeman *et al.*, 1998). That study was based on Magisterial Districts. It subsequently became clear that smaller, more permanent spatial units are needed. A revision of criteria, and particularly the spatial framework, led to a revised document. In 2004, a suggestion was implemented to institute the term *high potential agricultural land* to encompass prime and unique agricultural land as previously defined.

#### **Land parameters**

The criteria are based on three land parameters: present irrigation, moisture availability and soil type.

#### **Irrigation**

All land currently under permanent or seasonal irrigation is deemed to qualify as prime agricultural land.

#### **Moisture availability**

As a measure of moisture availability, the median seasonal rainfall, R, (the total for October to March for the summer rainfall area and April to September for the winter rainfall area) was divided by an appropriate fraction of the potential evaporation (PET) during the season (0.25 for the summer rainfall season and 0.4 for the winter rainfall season). With respect to areas receiving rainfall throughout the year, the highest class obtained for any of the two seasons was used.

#### **Soil type**

Land type data provided information on the soil forms as well as their depth and clay content ranges (the latter as a substitute for soil texture). Soil family criteria (Soil Classification Working Group, 1991),

where used, were based on best available knowledge, as information on soil families is not provided by land type data.

### ***Identification of qualifying soil forms, minimum soil depth & clay content***

Soil forms generally have limited ranges of physical and hydrological properties. Together with effective depth and clay content, these properties affect the way the soils take up rainwater, store it and make it available to crops.

In areas with low effective rainfall, only those soil forms with favourable water regimes were considered (e.g. deep loamy soils of the Hutton, Clovelly, Avalon and Oakleaf soil forms, Soil Classification Working Group, 1991). In areas with high effective rainfall, soils with less favourable water regimes were included (e.g. shallower members of the above soil forms or unfavourably structured soils).

A “scarcity” factor was furthermore taken into consideration. In the Western Cape, for example, shallow or clay pan soils with relatively unfavourable effective depth and water regime were included because locally they meet the criterion of “the best available” (see section on definitions in text). In a limited number of instances (e.g. the Olifants River in the Western Cape), land adjacent to irrigated areas, though with low natural moisture availability, was considered deserving to be retained in agriculture due to the fact that future irrigation methods may stretch water further so that more land may be needed.

Decisions to include or exclude particular soil-climate situations were strongly influenced by answers to the questions: what is presently produced in the particular situation, how successful are these enterprises and how damaging would it be to lose them? Best available answers to these questions were sought.

### ***Spatial framework***

In search of an appropriate spatial framework for application of criteria, the smallest “cells” with any permanence and with unambiguous boundaries were found to be the national coverage of 1:50 000 sheets. For the sake of simplicity, only one set of criteria applies to every 1:50 000 sheet and applies to the sheet in total. Where climate and soil conditions vary strongly over a particular sheet, the emphasis was put on those lands deserving to be retained in agriculture, even though they may cover a rather small part of the sheet.

Each 1:50 000 sheet is provided with a symbol to aid visual recognition. Because a number of 1:50 000 sheets straddle provincial boundaries, the symbol contains a digit denoting the province covering the dominant part of the sheet, followed by a digit denoting the moisture availability zone. (The latter denotes a geographic area and is not to be confused with the moisture availability class).